

Syllable- and rhyme-internal timing: Combined effects of postvocalic voicing and distinctive vowel length in Norwegian

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Earlier work on the glottalization of vowel-initial syllables sought an account in terms of the morphosyntactic hierarchy and isolated intonational facts, without accounting for the possible role of prosodic constituent structure. In a corpus of digitized, prosodically labeled speech (FM radio news style, 371 vowel-onset syllables produced by a single female speaker), (a) a syllable which begins in intonational constituent and is pitch accented is likely to show a glottal onset (91%), (b) constituent-initial position and pitch accent each separately increase the likelihood of glottal onset (66% and 47%, respectively). Noninitial nonaccented syllables are much less likely to be glottalized (16%; some of these syllables may have a pitch accent that is small in comparison with the strongly realized accents often produced in FM news speech). Constituent-initial glottalization occurs even for reduced-vowel syllables, which earlier work suggested was rare: 83% of reduced-vowel syllables in constituent-initial position glottalized, but only 24% in noninitial position. Preliminary results for a second speaker show a similar pattern, illustrating both the value of revisiting earlier analyses with prosodic structure in mind, and the usefulness of a large prosodically labeled database of continuous speech.

4pSP36. Effects of speaking rate and paragraph structure on the production of sentence prosody. Shari R. Speer (Psychol. Dept., Northeastern Univ., 360 Huntington Ave., Boston, MA 02115), Sarah C. Wayland (Univ. Maryland School of Medicine, Baltimore, MD 21201-1595), Margaret M. Kjelgaard (Northeastern Univ., Boston, MA 02115), and Arthur Wingfield (Brandeis Univ., Waltham, MA 02254)

Four speakers read each of eight paragraphs at four different speaking rates: Normal speaking rate and half, twice, and three times the normal rate. Each paragraph contained five sentences, one each of five types of syntactic structure: Early major syntactic break, early minor syntactic break, late major syntactic break, late minor syntactic break, or syntactic break midway through the sentence. Across paragraphs, sentences of the same syntactic type had the same prosodic foot structure, and the order of syntactic structures within paragraphs was counterbalanced. Care was also taken to make the paragraphs semantically coherent. Phonetic analyses of the prosodic structures produced for these paragraphs are presented, including absolute and relative duration measures for words and silences. In addition, listener judgments of perceived prosodic phrasing are presented. Results will be compared to the durational and pausing patterns predicted by current prosodic production algorithms (Ferreira, 1993; Gee and Grosjean, 1983). Prosodic variation due to speaking rate, syntactic structure, and paragraph structure will be discussed. [Order of authorship determined by multiple coin flips.]

4pSP37. Synthesizing multistyle speech using the Klatt synthesizer. Daniel Lambert, Kathleen Cummings (School of Elec. and Comput. Eng., Georgia Inst. of Tech., Atlanta, GA 30332-0250), Janet Rutledge (Northwestern Univ., Evanston, IL 60208), and Mark Clements (Georgia Inst. of Tech., Atlanta, GA 30332-0250)

Synthesizing multistyle speech has been an important topic of research in recent years. In this research, 11 commonly encountered speech styles have been synthesized by varying pitch, duration, intensity, and the glottal excitation on the Klatt Synthesizer 88, KLSYN88. These 11 speech styles include angry, clear, 50% tasking, 70% tasking, fast, Lombard, loud, normal, question, slow, and soft. All of the styles proved to be intelligible and appropriately styled based on subjective listening tests. The parameter variations of the glottal excitation are based on the results of statistical analyses [K. Cummings, Analysis,

Syn., and Rec. of Stressed Speech, Ph.D thesis, Georgia Inst. of Tech., 1992] that demonstrated the importance of glottal excitation changes in styled speech. These statistical analyses demonstrated that the glottal excitation of each of the eleven styles is significantly and identifiably different. One utterance of the word "hot" was synthesized in the normal style. The other ten styles of this word were synthesized by changing only the glottal excitation parameters of the normal utterance. Subjective listening tests with untrained subjects demonstrated that the eleven synthetic styles were perceivably and identifiably different.

4pSP38. Syllable- and rhyme-internal timing: Combined effects of postvocalic voicing and distinctive vowel length in Norwegian. Dawn M. Behne (Inst. for Linguistics and Phon., Univ. of Umeå, S-901 87 Umeå, Sweden and Linguistics Inst., Univ. of Trondheim, N-7055 Dragvoll, Norway) and Bente Moxness (Univ. of Trondheim, N-7055 Dragvoll, Norway)

Syllable-internal timing can be affected by a variety of factors, including distinctive vowel length and postvocalic voicing. Distinctive vowel length, which occurs in Norwegian, and postvocalic voicing have typically been found to inversely affect vowel duration and the closure duration of a postvocalic consonant. When these factors converge on a syllable, syllable-internal timing simultaneously reflects the concurrent influence of distinctive vowel length and postvocalic voicing. Research on English [D. M. Behne and L. C. Nygaard, *J. Acoust. Soc. Am.* **93**, 2296(A) (1993)] has shown that when multiple factors concurrently influence syllable-internal timing, their effects occur independent of each other. The goal of the present study is to examine the effects of distinctive vowel length and postvocalic voicing on syllable- and rhyme-internal timing, and characterize the concurrent effect of these factors. A set of 12 Norwegian CVCs containing /i, o, a, i:, o:, a:/ before a final voiced and a final voiceless consonant were produced in context by 12 native speakers of Norwegian. Results indicate that syllable-internal timing is independently affected by distinctive vowel length and postvocalic voicing, however their effects on syllable-internal timing were found to differ. These findings will be discussed in terms of syllable- and rhyme-internal timing.

4pSP39. Perception of Arabic and English vowels by Arabs. Fares Mitleb (English Dept., Yarmouk Univ., Irbid, Jordan)

This study intends to investigate the effects of experience in L₂ sound patterns and interference on the perception of English vowels. Thus natural vowel stimuli of both Arabic and English vowels were generated for the purpose of this study. Arabic stimuli were presented to native Arabic speakers who showed highly significant identification scores. The English test material was presented to two groups of Arabs learning English: (1) relatively inexperienced in English; and (2) experienced group. The two groups of listeners performed very well in the identification task of Arabic-like English vowels whereas they differed significantly in their perceptual task of the non-Arabic-like ones. Yet, in the final analysis of the results both groups fell short of the native norm in the identification of the non-Arabic-like vowel stimuli. Confusion of non-native-like vowels with other non-native-like ones but not with Arabic-like ones is found in the responses of the two groups. This implies that non-Arabic-like stimuli are not identified with Arabic-like ones as is assumed by contrastive analysts. Thus a new vowel segment is not easy to acquire since vowel phonemes are composed of complex auditory, acoustic, and perceptual features. [Research supported by Yarmouk University.]