

# Control experiments on the frequency scale of speech intonation

**Citation for published version (APA):**

Hermes, D. J., & Rump, H. H. (1994). Control experiments on the frequency scale of speech intonation. *Journal of the Acoustical Society of America*, 96(5), 3349. Article 5pSP10.

**Document status and date:**

Published: 01/01/1994

**Document Version:**

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

**Please check the document version of this publication:**

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

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and (6) ineffective interpersonal responses. For females only, a higher mean  $F_0$  was predictive of both a greater sense of excessive responsibility for partner ( $p < 0.05$ ) and an increased fear of abandonment ( $p < 0.05$ ).

**5pSP6. Neuroticism and openness are predicted by fundamental frequency of speech.** Douglas A. Vakoch, Dean A. Pollina, and Lee H. Wurm (Dept. of Psychol., State Univ. of New York at Stony Brook, Stony Brook, NY 11794-2500)

The fundamental frequency ( $F_0$ ) of speech has been used for examining both transient emotional states [D. A. Vakoch, *J. Acoust. Soc. Am.* **95**, 2974 (1994)] and more stable personality traits. For example, low perceived pitch has been associated with attributions of high emotional stability [K. R. Scherer, *Eur. J. Soc. Psychol.* **8**, 467-487 (1978)]. In the current study, characteristics derived from  $F_0$  were related to five personality traits as measured by the NEO-PI: neuroticism, extroversion, openness, agreeableness, and conscientiousness. A high degree of openness was predicted by a high mean  $F_0$  of an utterance ( $p < 0.025$ ) and by a great variability in  $F_0$  within an utterance ( $p < 0.004$ ). The best predictor of neuroticism was peak  $F_0$  within an utterance, with subjects scoring high on this scale having a higher maximum  $F_0$  ( $p < 0.021$ ). The latter finding, in conjunction with previous research on attributions of emotional stability, suggests a convergence between objective acoustical measures and subjective perceptions of personality.

**5pSP7. Allophonic variation in spoken and sung speech.** Ray Daniloff, Kathy Wolf, George Larsen (Dept. of Speech and Hear. Sci., Univ. of North Texas, P.O. Box 5008, Denton, TX 76203-0008), and Lee Evans (Univ. of North Texas, Denton, TX 76203-0008)

Research suggests that sung and spoken speech differ systematically in terms of laryngeal, intonational, rhythmic, and articulatory performance. In the present study we examined control of pronunciation rules [Ladefoged, *A Course in Phonetics* (HBJ, 1993)] in singers. Three doctoral students of vocal performance sang and then spoke a set of sentences. Simple melodies were composed to fit the rhythmic figure of each sentence. The sentences contained five examples of each of 24 pronunciation rules of English. Recordings were transcribed, rhythm and stress patterns noted, and acoustic analysis was performed (GW Soundscope) to ascertain the degree to which each pronunciation rule was/was not implemented in sung versus spoken production. Results indicate that singing induces both systematic and nonsystematic changes in pronunciation across singers which can be related to the more stereotyped production strategies associated with singing.

**5pSP8. Effects of speaking rate, focal stress, and distinctive vowel length on syllable-internal timing in Norwegian.** Dawn M. Behne and Bente Moxness (Linguist. Inst., Univ. of Trondheim, N-7055 Dragvoll, Norway)

The relative timing of consonants and vowels of a syllable can be affected by factors such as speaking rate, focal stress, and distinctive vowel length. Speaking rate and focal stress tend to have a global affect on syllable-internal timing, whereas the effect of distinctive vowel length in Norwegian is generally believed to be localized to the syllable rhyme. When these factors converge on a syllable, the syllable-internal timing simultaneously reflects their concurrent effects. The goal of the present study is to examine and characterize the concurrent effects of speaking rate, focal stress, and distinctive vowel length on syllable-internal timing of C1VC2 components. Conversations were developed in which 12 Norwegian CVCs containing /i, o, a, i:, o:, a:/ were either focused or nonfocused by the discourse. The set of conversations was produced at three speaking rates by native speakers of Norwegian. Results indicate that speaking rate and focal stress have an overall affect on the timing of components in the syllable. In addition, the effects of distinctive vowel length and focal stress on components of the syllable rhyme were found to be interdependent across speaking rates. These findings are discussed in terms of syllable- and rhyme-internal timing.

**5pSP9. Forward and backward presentation of Chinese and English speech in the verbal transformation effect.** Magdalene H. Chalikia, Rachel Waldstein, and William J. Stech (Dept. of Psychol., Moorhead State Univ., Moorhead, MN 56563)

When hearing a word which is continuously repeated, listeners report that the word seems to change into different forms and then vacillates among these forms. This auditory illusion has been called the verbal transformation effect [R. M. Warren, *Br. J. Psychol.* **17**, 249-258 (1961)] and is considered to be caused by the lack of verbal context, produced by the repetition. This study further investigated the role of context in the interpretation of auditory stimulation. Twenty-six listeners heard the individual, continuous, repetition of six stimuli: an English sentence, an English word, and a Chinese word (each played forward and backward). It was assumed that listeners will report verbal transformations with all stimuli except the English sentence, since only this condition contained sufficient contextual cues. Results showed that both forms of the English sentence were treated in the same manner, and that significantly more verbal transformations were reported with the words.

**5pSP10. Control experiments on the frequency scale of speech intonation.** Dik J. Hermes and H. H. Rump (Inst. for Percept. Res. IPO, P.O. Box 513, 5600 MB Eindhoven, The Netherlands)

According to Hermes and Van Gestel [*J. Acoust. Soc. Am.* **90**, 97-102 (1991)], prominences of accent-lending pitch movements in different registers are equal when their excursion sizes are equal on the ERB-rate scale. A reanalysis of their experiments showed that an octave relationship between the high pitch levels in the different registers may have been crucial. In order to test whether this factor influenced the outcome of their experiments, adjustment experiments were performed with stimuli in different low and high registers. The results, supporting the ERB-rate scale hypothesis of Hermes and Van Gestel, showed that the octave relationship had no systematic influence on the results. In an additional experiment, stimuli were resynthesized from a male and a female voice in order to test the effect of the speaker's natural pitch range. The male and female stimuli gave about the same results. In sum, the effect of pitch excursion on prominence is very robust. An unexpected finding was that, on average, the excursions of the pitch movements in the high register were about 0.15 E (0.5-1 semitone) larger than those of the pitch movements in the low register when lending equal prominence.

**5pSP11. Some control experiments on a model for prominence perception.** H. H. Rump and Dik J. Hermes (Inst. for Percept. Res. IPO, P.O. Box 513, 5600 MB Eindhoven, The Netherlands)

According to the model proposed by Hermes and Rump [*J. Acoust. Soc. Am.* (in press)] the prominence lent by accent-lending pitch movements is proportional to the pitch-level difference between the vowel nucleus of the accented syllable and the vowel nucleus of the preceding syllable. The pitch level on the lower declination line or baseline and the pitch level on the upper declination line or topline are thus regarded as equally important. By varying the height of the pitch levels on the baselines this assumption was tested against the alternative assumption that listeners equated pitch levels on the topline of each of the stimuli when adjusting prominences to be equal. Results showed that pitch levels on the toplines were adjusted to be more or less equal, but that the pitch-level difference between the low and the high pitch level influenced the adjusted height of the high pitch level, too. It is concluded that the proposed model makes claims about the relevance of the position of the low pitch level which is too strong. The role of pitch levels in relation to the perception of prominence will be discussed.

**5pSP12. Prosodic characteristics of register variation in the read speech of adult native speakers of French.** Andrea G. Levitt and Jeannine Geoffrion (Wellesley College, 106 Central St., Wellesley, MA 02181-8289)

Ten female native speakers of French were asked to read two paragraphs in each of three register styles: to a friend (native), to a nonnative speaker (foreigner talk), and to a 1-year-old child (child-directed speech). There were significant differences in the speech rate, number and length of pauses, and mean  $F_0$  and  $F_0$  range among the three speech styles. Speech rate was significantly different for each of the registers, with foreigner talk the slowest, native speech the fastest, and child-directed speech in between the other two. A similar pattern of significant differences emerged for pause length and number of pauses, again with foreigner talk showing the most pauses and the longest average pause length, native speech showing