Center of gravity as indicator of right edge boundary tone in Akan

Susanne Genzel (University of Potsdam)

This paper investigates the acoustic differences in the quality of the final vowel between statements (S) and Yes/No questions (YNQ) in Akan (Kwa, Niger-Congo). YNQ in Akan have been claimed to show final "laxness" (Rialland 2007, 2009). The results neither show a difference between the conditions for H1-H2, H1-A1, H1-A2, H1-A3 nor for the harmonic-to-noise ratio (HNR) and the cepstral peak prominence (CPP). A significant difference is present for the center of gravity (CoG). It is higher in YNQ than in S. This result is taken to indicate that the YNQ in Akan are marked by more speech effort which is due to an additional tonal target at the right edge of the IP (L%). Furthermore, the results show that Akan is not a "lax prosody" language.

Background: Akan is an African tone (Kwa) language with two tones, L and H, spoken in Ghana (Dolphyne 1988). Sentence mode is marked prosodically. YNQ exhibit a higher register, longer final duration, higher final intensity and lower final F0 than statements (e.g. Genzel 2013, Genzel & Kügler 2016). Akan has been classified as "lax prosody" language by Rialland (2007, 2009). "Lax prosody" is regarded to be similar to breathiness, laryngeal relaxation and reduced speech effort (Ní Chasaide and Gobl, 1997). Breathiness has been shown to come along with increased spectral noise at higher frequencies due to little longitudinal tension resulting in turbulent airflow through the glottis (Gordon & Lagefoged 2001). Hence it is expected that the final vowel of YNQ in Akan terminates in a breathy/lax voice.

Method: Controlled experimental data was collected on a fieldtrip. 4 string identical YNQ/S pairs were recorded 3 times with 6 (1 female, 5 male) native speakers of Akan (Asante dialect). All items end in an /a/, which carries an H tone and was labeled according to Blankenship (2002) in Praat (Boersma & Weenink 2015). It was divided in 4 equally spaced intervals. To access the spectral noise at the higher frequencies H2, A1, A2 and A3 were subtracted from H1 with the help of a Praat script (Remijsen 2004). If the final vowels of YNQ are more breathy/lax, the spectral measures are expected to be higher than for final vowels of S. Further measures of breathiness/laxness include HNR and CPP, both of which are expected to be lower in breathy phonation due to added noise (e.g. Khan 2012). Finally CoG was measured. It is related to the spectral slope and expected to be lower for breathy/lax vowels due to the reduced tension (van Son & Pols 1995). All measures were taken at the temporal mid of each interval. The results of the phonetic analysis were evaluated against the fixed factors SENTENCE MODE with the 2 levels and POSITION with 4 levels in R (R Core Team 2015) using linear mixed models from the 'lme4' package (Bates, Maechler, Bolker and Walker 2015).

Results: Contrary to the expectations SENTENCE MODE did neither significantly affect the four spectral measures nor CPP and HNR. Importantly, no interaction between SENTENCE MODE and POSITION was present. A significant main effect of SENTENCE MODE could be observed for CoG. Unexpectedly, CoG is higher in YNQ than in S. Again, no interaction between SENTENCE MODE and POSITION was present.

Discussion: A higher CoG in Dutch and English has been shown to correlate with perceived sentence accent (Sluijter 1995a, b) and is thus been connected to a higher speech effort. Taken together with the non-significance of any of the breathiness parameters, the results suggest that YNQ of Akan do not show a lower terminal F0 because of lax voice contrary to Rialland (2007, 2009), but because of an additional tonal target at the right edge of the IP which is absent in S (Genzel 2013, Genzel & Kügler 2016).

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