

**Introduction.** We present an acoustic study showing that Polish lacks rhythmic secondary stress, contrary to widely accepted formal descriptions. This finding removes Polish as a crucial example of the rare bidirectional stress system with internal lapses, thus seriously undermining the existence of this stress type. This paper carries implications for the typology of stress systems, in that it should only include the attested bidirectional system with internal clashes. Thus, the constraint set needs to be modified to only generate this restricted typology.

**Polish stress.** Polish is much discussed in metrical stress theory, as it represents a classic case of the bidirectional system with internal lapses (McCarthy & Prince 1993, Kager 2001, McCarthy 2003). In this system, primary stress is assigned from one word edge, and secondary stresses are assigned from the other edge. Crucially, a single lapse arises adjacent to main stress in odd-parity words. Hence, six- and seven-syllable words are parsed as in (1a) (Polish, Piro, Lenakel), or (1b) (Garawa, Indonesian, Spanish). The non-initial, rhythmic stresses are often treated as tertiary.

- (1) (a) [(σ̇σ)(σ̇σ)(σ̇σ)]; [(σ̇σ)(σ̇σ)σ̇(σ̇σ)]                      (b) [(σ̇σ)(σ̇σ)(σ̇σ)]; [(σ̇σ)σ̇(σ̇σ)(σ̇σ)]

This system is typologically rare (Gordon 2002), and the few cases that do exist have often been challenged (Hyde 2008). Polish is the only uncontested case, with (1a) reported to apply with few lexical or morphological restrictions (Rubach & Booij 1985, Kraska-Szlenk 2003). Yet, (1a) was posited for Polish based on impressionistic evidence and without support from stress-sensitive processes (Dłuska 1957, Dłuska 1974). Further, (1a) has not been acoustically verified. Previous studies of Polish either ignored secondary stress (e.g. Jassem 1962, Łukaszewicz & Rozborski 2008), or failed to find evidence for it, possibly due to limited data (Dogil & Williams 1999).

**Acoustic study.** This study investigates the prominence of different syllable positions to verify the presence of the pattern in (1a). Ten native speakers of Polish, male and female, were recorded in Poland reading a word list in slow, careful speech. The list contained 100 simple words and 38 compounds, embedded in a carrier phrase. All words were at least four syllables in length. On traditional accounts, they were all expected to exhibit main stress on the penult and secondary stress on the initial syllable (e.g. *banan<sup>2</sup>vi* ‘banana.adj.’). Words at least six syllables long were additionally predicted to show tertiary stress (e.g. *banaliz<sup>3</sup>ov<sup>2</sup>anie* ‘trivialization’).

Syllables were labeled according to their position within the word, which corresponded to an expected level of stress: penultimate (primary), initial (secondary), odd-numbered (tertiary), even-numbered (unstressed), and ultima (unstressed). Ultimas were separated from other unstressed syllables because they show boundary-related lengthening (Oller 1973). Compounds were analyzed separately from simple words, as their syllables were additionally coded for stem.

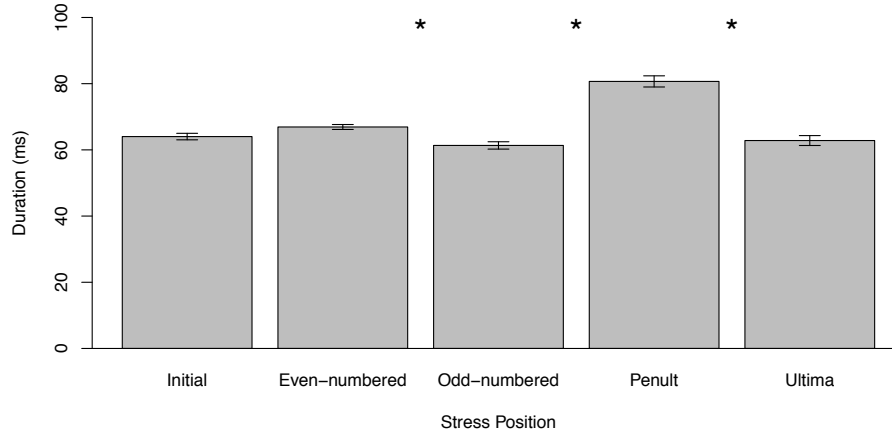
In total, 12,289 and 6,317 vowels were analyzed from simple words and compounds, respectively. They were measured in Praat across four parameters previously shown to correlate with stress cross-linguistically and in Polish: maximum intensity, maximum pitch, pitch change and duration (Jassem 1962, Dogil & Williams 1999, Łukaszewicz & Rozborski 2008). Pitch values, converted to semitones (Nolan 2003), were analyzed separately for men and women. A series of repeated-measures ANOVAs and subsequent Tukey tests was conducted to test whether purportedly stressed syllables were more prominent than purportedly unstressed ones.

**Results: simple words.** Polish simple words do not manifest the pattern in (1a). Regardless of length, they exhibit one penultimate stress and lack lower levels of stress. Thus, we get *banan<sup>2</sup>vi* and *banaliz<sup>3</sup>ov<sup>2</sup>anie*. Main stress employs multiple cues: statistical tests yield significant effects for the penult on all four acoustic variables (all  $p < .001$ ), including vowel duration, which is a novel finding for Polish (see 2). By contrast, syllables traditionally described as bearing secondary or tertiary stress do not show prominence on any variable. Initials do correlate with increased maximum pitch and maximum intensity, but this is expected due to F0 and intensity declination over utterances (Bolinger 1964, Cohen & ‘t Hart 1967, Trouvain et al. 1998). This correlation can explain why secondary stress was misperceived on the initial syllable in impressionistic studies.

**Results: compounds.** Using the correlates of stress identified for simple words, we established that some compounds do exhibit more than one stress. Specifically, both stems receive

penultimate stresses as long as the resulting trochees are non-adjacent. Thus, four-syllable compounds have only one penultimate stress, which falls on the (rightmost) head stem (e.g. [bɔɡɔ-bɔjna]<sub>PWd</sub> ‘god-fearing’). They pattern with three- and two-syllable compounds, argued to constitute single prosodic words (PWds) in Polish (Rubach & Booij 1985). Compounds with more than four syllables show two penultimate stresses, suggesting that each stem is parsed as a separate PWd (e.g. [zɛlɔnɔ]<sub>PWd</sub>[bɛʒɔvi]<sub>PWd</sub> ‘green-beige’). Both stresses correlate with higher values on all parameters, except for pitch change, which only affects the head stem penult. We argue that this parameter represents phrasal pitch accent in Polish, rather than word-level stress (Jassem 1962). It further suggests a recursive structure for compounds.

(2) Mean duration values in simple words.



**Phonological analysis.** We re-analyze Polish as having non-iterative right-aligned syllabic trochees. Main stress arises through the ranking of ENDRULE-L and ALIGN (PWD, R, FT, R) above PARSE-σ. In compounds, the number of (stressed) PWds is determined by clash avoidance (undominated \*FtFt). Both stems are parsed as (stressed) PWds if at least one unfooted syllable intervenes between the resulting feet. Only the head stem receives stress if stressing both would give rise to adjacent feet, irrespective of whether a PWd boundary separates them (see 3).

(3) Tableau 1. Compounds have one or two stresses.

/zɛlɔnɔ-bɛʒɔvi/ ‘green-beige’	*FtFt	ENDRULE-L	ALIGN (STEM, L, PWD, L)	PARSE-σ
1. [zɛ(lɔnɔ)] <sub>PWd</sub> [bɛ(ʒɔvi)] <sub>PWd</sub>				**
2. [zɛlɔnɔ-bɛ(ʒɔvi)] <sub>PWd</sub>			*!	****
3. [zɛ(lɔnɔ)-bɛ(ʒɔvi)] <sub>PWd</sub>		*!	*	**
/bɔɡɔ-bɔjna/ ‘god-fearing’				
1. [bɔɡɔ-(bɔjna)] <sub>PWd</sub>			*	**
2. [(bɔɡɔ)(bɔjna)] <sub>PWd</sub>	*!	*	*	
3. [(bɔɡɔ)] <sub>PWd</sub> [(bɔjna)] <sub>PWd</sub>	*!			

**Conclusions.** The stress parameters considered in this paper provide no evidence of (1a) in Polish. In discussion, we highlight the contested nature of the data on the remaining few languages supposedly exhibiting the system in (1), and challenge its existence. We argue that the constraint set need to be restricted to only generate bidirectional systems with internal clashes.

**Selected references:**

Jassem, Wiktor. 1962. *Akcent Języka Polskiego*. Wrocław: Ossolineum.  
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 Rubach, Jerzy, and Geert Booij. 1985. A grid theory of stress in Polish. In: *Lingua* 66:281-319.