Sonority-driven stress: codas in Brazilian Portuguese

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Abstract This study provides empirical evidence for sonority-driven stress in Brazilian Portuguese. Using auditory forced-choice and orthographic tasks with nonce words, we demonstrate that speakers systematically prefer final stress when final syllables contain sonorant codas {N, l, r} compared to the obstruent coda {s}. Our data reveal that coda sonority influences stress preferences beyond traditional weight distinctions. Lexical analysis of monomorphemic words corroborates experimental findings, showing that s-final words receive final stress less frequently than sonorant-final words.

Keywords: sonority-driven stress; weight-sensitivity; coda sonority; Portuguese

1 Sonority-sensitive stress

Syllable weight factors into several core domains of phonology, including stress, tone, prosodic minimality, syllable structure, compensatory lengthening, meter/textsetting, end-weight, morphophonology, and others. For binary weight distinctions, the two most common criteria treat a syllable as heavy iff it contains (1) a long vowel or, alternatively, (2) a long vowel or a coda. That is, schematically, VV > {VC, V} or {VV, VC} > V, respectively (ignoring the onset). Additionally, in some systems, sonority affects weight, such that a more sonorous rime (e.g. one with a lower vowel, or a sonorant coda) counts as heavier.[1] That said, the prevalence of sonority sensitivity varies across weight-based phenomena. Sonority (at least sonorant vs. obstruent) can clearly condition weight for tone licensing (Gordon 2006: 32f), end-weight (Ryan 2019: 169–77), meter (*ibid.*:147–52), and syllable structure (Zec 1995: 101, Sayeed 2017). Less frequently, it conditions weight for compensatory lengthening (e.g. Kung 2007: 139f, Kiparsky 2011), reduplication (e.g. Ryan & Heath 2022), allomorphy (e.g. Anttila 1997: 5f), and perhaps minimality (cf. Ryan 2019: 122f, 245f).

Stress, for its part, is among the weight-based phenomena for which sonority-sensitivity is less frequent. Though sonority-driven stress was once fairly uncontroversial (e.g. Hayes 1995; Kenstowicz 1997; de Lacy 2004; Gordon 2006) — Munshi & Crowhurst (2012: 429) could still refer to it in an "impressive array of languages" — more recently, several claimed cases have been reanalyzed (e.g. Rasin 2018: 44–7 on Kobon) or refuted empirically (e.g. Shih 2018 and Bowers 2019 on Gujarati), leading several scholars to call its existence in general into question. For example, Rasin (2018: 13) hypothesizes: "The distribution of stress is never conditioned by segmental features," including [±sonorant]. Likewise, Shih & de Lacy (2019: 11) (also Shih 2016) conclude: "there is no reliable

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[1] In the onset, the correlation between sonority and weight is reversed, such that lower sonority counts as (if anything) heavier (for reasons discussed by Goedemans 1998: 143–8, Gordon 2005: 603–7, Ryan 2014: 329, 2019: 213f, 238f).

evidence that metrical feet are attracted to or repelled by segments of particular sonority levels" (but see the next paragraph for qualifications). Faust & Ulfsbjorninn (2025: 19–21) too propose a reanalysis of a case in which sonorants outweigh obstruents for stress (namely, Kwak'wala; see below) and conclude that the existence of sonority-driven stress in the general case is tenuous. But not all scholars agree: Paramore (2025), for instance, allows stress to be sensitive to the sonorant vs. obstruent distinction even when both are moraic (e.g. $V_{\mu}N_{\mu} > V_{\mu}T_{\mu}$; similarly Ryan 2019: 19).

To be sure, accounts denying the existence of sonority-driven stress posit several caveats. First, none of them counts the distinction between reduced and full vowels as being sonority. Second, some allow that sonority can influence stress indirectly via syllabification or other structure (e.g. Latin [woˈlup.t̪aːs] "pleasure" vs. [ˈwo.lu.kr̪is] "bird"; Rasin 2018: 21, 83).[2] Third, Faust & Ulfsbjorninn (2025: 21) make explicit that they are concerned only with categorical rules, and the same is at least implicit in the other accounts. Perhaps for that reason, experimental evidence for sonority sensitivity such as Carpenter (2010) is overlooked. Fourth, Rasin (2018) and Shih & de Lacy (2019) explicitly confine their claims to stress, setting aside other weight-sensitive phenomena. Fifth, Rasin (2018) and Shih & de Lacy (2019) focus almost exclusively on *vowel* sonority. As for consonantal sonority, the former devotes a page to it ("A remaining challenge: consonantal features"), and the latter do not bring it up.[3] Thus, some cases of stress being determined by consonantal sonority (next paragraph) go unaddressed. Indeed, even for vowel-sonority driven stress, perhaps not every case has been refuted (e.g. Kiriwina and Mordwin; de Lacy 2004). Note that while some classic examples of sonority-driven stress treat sonority in a gradient fashion (e.g. low > mid > high; Kenstowicz 1997), in general, the literature has also treated bifurcations in sonority (e.g. low vs. non-low in Gujarati) as being sonority-driven stress. Thus, a [±sonorant]-based criterion is not irrelevant simply because it is binary.

Since interactions between stress and coda sonority are the focus of this article, this paragraph addresses their typology. Several potential cases appear in grammars (e.g. 3 of 107 languages surveyed by Gordon 2006), though most are dubious or underdocumented. For example, per Levinsohn (1976: 29), Inga Quechua stress falls on the ultima only if it has a sonorant (not obstruent) coda. Nevertheless, the evidence is lacking: few examples are provided; closed ultimas are in general uncommon; and we are not aware of any corroborating phenomena or sources. Some other reported cases are similarly questionable, including Lamang (Wolff 1983: 19), Orya (Fields 1991: 32f), Paipai (Joel 1966: 10), and Yahi (Hinton & Luthin 2002). A stronger case is furnished by the Wakashan languages. In Kwak'wala, for one, stress falls on the leftmost heavy (else rightmost), where a heavy is any syllable containing a full vowel or sonorant coda, unless the coda is glottalized (e.g. Zec 1995; Bach et al. 2005). Nevertheless, the Kwak'wala case might reflect phrasal prominence rather than canonical word-based stress (Elfner 2023: 74). Moreover, Faust & Ulfsbjorninn (2025: 20) argue that Kwak'wala is not sonority-driven, but rather a reduced vs. full system. They suggest that non-glottalized sonorants are nuclei rather than codas (as also proposed by Scheer & Szitgetvári 2005: 67), and as

[2] As another example of how structure might potentially be used to obviate direct reference to sonority, consider the famous case of Pirahã, in which voiceless/obstruent onsets are more stress-attracting than voiced/sonorant onsets (Everett & Everett 1984; Hayes 1995: 285–8; Gordon 2005: 608–18). Everett (1988: 216) analyzes Pirahã voiceless onsets as geminates. Hermans & Torres-Tamarit (2016: 5) analyze voiceless onsets as having a different adjunction site from voiced ones (syllable vs. mora).

[3] Although Shih & de Lacy (2019) do not discuss consonant sonority, consonants are in principle relevant, as they exhibit sonority levels like vowels do. That said, any VN > VT criterion that can be attributed to moras (i.e. $V_{\mu}N_{\mu} > V_{\mu}T$) need not be regarded as directly sonority-sensitive on their approach.

such pattern with full vowels, as heavy.[4] At any rate, related languages such as Makah and Nuu-chah-nulth have the same criterion for weight, but without reduced vowels (Wilson 1986: 288f). Stress being conditioned by coda sonority is also documented in Totonacan languages such as Huehuetla Tepehua (Kung 2007) and Pisaflores Tepehua (MacKay & Trechsel 2013). In these languages, primary stress is penultimate unless the ultima has a sonorant or laryngeal (but not obstruent) coda. Kraehenmann (2003: 170ff) likewise maintains that syllables ending with sonorant (but not obstruent) consonants attract stress in Thurgovian Swiss German.

In summary, while different scholars operationalize "sonority-driven stress" in different ways, its existence in general is controversial. Moreover, most of the literature on the subject has focused on vowel sonority. Recent articles such as Faust & Ulfsbjorninn (2025) and Paramore (2025), however, have brought the question of whether stress can be conditioned by coda sonority back to the theoretical forefront. Reported cases in grammars are either underdocumented (e.g. Inga Quechua) or have been challenged on various fronts (e.g. Kwak'wala). Against this backdrop, we turn to Brazilian Portuguese, adding new evidence about the productive application of stress to nonce words with various weight patterns and demonstrating that at least in the ultima, coda sonority determines stress placement. This is the first study to address coda sonority-driven stress experimentally, complementing the (relatively sparse) typological evidence by demonstrating its productivity in Portuguese.

1.1 Stress in Portuguese

Our empirical data on coda-sonority come from Brazilian Portuguese, whose stress system is virtually identical to that of European Portuguese. In this language, stress is final when a final syllable is heavy (*papél* 'paper') and penultimate otherwise (*cabíde* 'hanger') — this is the so-called regular pattern, which accounts for approximately 70% of non-verbs in the language. Antepenultimate stress is also attested (e.g. *patético* 'pathetic'), and is traditionally considered to be idiosyncratic in non-verbs (but see Garcia 2017). As in English, stress behaves differently in verbs, where it is heavily influenced by morphology (see Garcia 2024 for a comprehensive review). In non-verbs, phonological factors such as syllable weight have been shown to have a strong effect on the location of stress, hence the regular pattern described above.

A heavy syllable in Portuguese can contain either a diphthong or a coda consonant. The inventory of possible codas in the language is {s, N, l, r} (both word-internal and word-final), where N represents one of the following allophonic nasal consonants: [m, n, ŋ]. Coda /l/ is typically semi-vocalized, so a word like *papél* /papɛl/ is pronounced as [pa.ˈpɛw] by the vast majority of BP speakers. We show that coda /s/ behaves differently (at least in the ultima), i.e., it is less stress-attracting than the sonorant codas attested in the language.

One confounding factor involving coda /s/ in the ultima is involves morphology, as plural in Portuguese is represented by the morpheme /-s/. Since plural /-s/ does not affect the location of stress, the task of comparing obstruent and sonorant codas becomes less straightforward. Fortunately, there are monomorphemic words ending in /s/ in the lexicon, which can help us map potential sonority effects in the language as a whole. We return to this question after presenting and discussing the results in §3.

[4] The proposed reanalysis requires plain vs. glottalized sonorants to be syllabified differently, as nuclei and codas, respectively. Spectrograms in Noguchi (2011: 78f), which they cite as evidence, do not support such a distinction; Noguchi (2011) and other sources on the language take both to be codas. Moreover, the reanalysis fails to capture that a full vowel before a glottal stop patterns as light (see Elfner 2023: 18).

2 Methods

To examine the potential effects of coda sonority on stress, speakers of Brazilian Portuguese completed two separate tasks. Information about our participants and methods is provided below.

2.1 Participants

Participants ($n = 28$) were native speakers of BP living in Canada at the time of the experiment (18 females, 10 males). They shared relatively similar characteristics with regards to education, region of origin, and linguistic background. Most participants had a bachelor's degree or a graduate degree ($n = 23$), and most came from the same two regions in Brazil, namely south and southeast ($n = 22$). The average age was 35 ($s = 9$). Almost all participants reported at least an intermediate proficiency level in English (20 reported advanced/fluent English). Some also reported some degree of fluency in Spanish and French, ranging from intermediate to advanced levels. These extralinguistic variables had no substantial impact on the patterns we discuss in this paper.

2.2 Design and materials

To examine the effects of coda sonority on stress in BP, we designed two tasks using the Gorilla platform (Anwyl-Irvine et al. 2020) where we varied the quality of the possible coda consonants in the language: {s, N, l, r}. Task 1 was an auditory forced-choice task with different weight profiles (HLL, LHL, LLH, LLL). In this task, participants saw the orthographic form of nonce words ($n = 86$) and heard two versions of each word, i.e., minimal pairs where the only difference was the location of stress in the trisyllabic stress window. All items were recorded by a native speaker of Brazilian Portuguese with phonetic training. For LLH words, the contrast was always between final and penultimate stress, whereas for other weight profiles, the contrast was always between penultimate and antepenultimate stress. This allowed us to use penultimate stress as the reference level (versus alternative stress given weight profile) when modelling the data. Participants were asked to choose which auditory version of each nonce word they preferred, e.g. *nulquibe* (HLL) → [ˈnuw.ki.be] or [nuw.ˈki.be].

Task 2 was an orthographic task, where participants were also presented with nonce words displaying different weight profiles (HLL, LHL, LLL). A carrier sentence was presented for every item: *The XXX will be released at the end of the month*. Participants were always given a binary choice to fill in the blank. For example, "DIpante" versus "diPANte" (LHL). Like task 1, task 2 also focused on minimal pairs where the location of stress was the only difference. Participants were told that capital letters indicated "the strongest syllable in the word."

2.3 Procedure

To ensure the reliability of online results, some participants participated in person ($n = 11$) in a sound-attenuated room at Université Laval. The remaining participants participated remotely and resided in different cities in Canada. No meaningful differences were found between these two groups, so our discussion below will not distinguish the two methods of participation.

In both tasks 1 and 2, participants were told that the words being evaluated had no correct pronunciation, given that they do not exist in the language. In addition, they were

told that all words were in singular form and represented an object. This is important to minimize readings where participants assume they are evaluating a verb of a plural noun in the case of items ending in /s/. The list of stimuli used can be found in the OSF repository listed at the end of this paper. Finally, the experiment including both tasks took approximately 20 minutes to complete, not including a short questionnaire with demographic information completed before tasks 1 and 2.

3 Results and analysis

We begin by examining the main results from task 1, shown in Figure 1. The only weight profile that deviates from an overall preference for penultimate stress is LLH, which is consistent with what is known about stress in the language (PU is the most frequent pattern). It is worth mentioning that LĹH words are not uncommon in the language: *fácil* 'easy', *fêmur* 'femur', *lápis* 'pencil'. As a result, the relatively high preference for penultimate stress (50%) in LLH words is not surprising, and our results are in line with previous studies on weight and stress in the language (e.g. Garcia & Goad 2024).

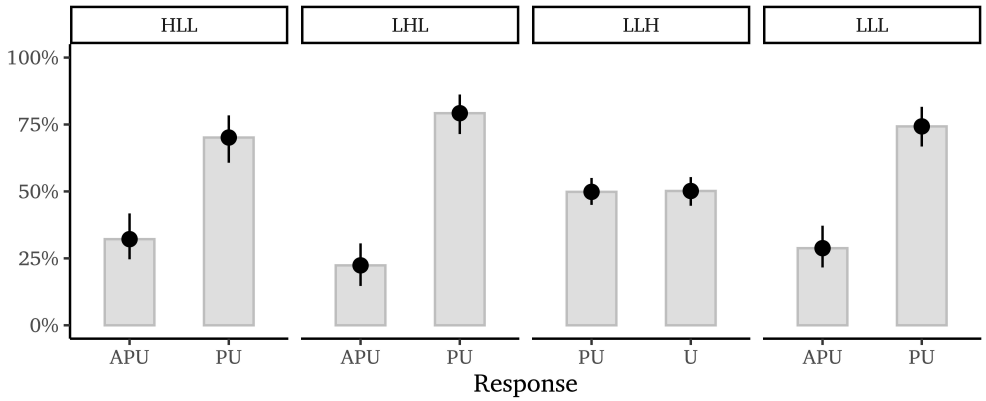

Figure 1: Main results for task 1. Mean preference (y-axis) by stress (x-axis) and weight.

To examine the patterns in question, we ran a Bayesian hierarchical logistic regression using the `brms` package (Bürkner 2021) in R (R Core Team 2025). Our model predicted the log-odds of penultimate stress as a function of the weight profile of a given word. The model in question included by-speaker random intercepts and random slopes for weight, as well as by-word random intercepts. As recommended, $\hat{R}$ values were inspected (< 1.01; Brooks et al. 2011), as were the effective sample sizes (ESS ≥ 682) for the posterior distributions of the main coefficients in the model.

The descriptive patterns shown in Fig. 1 were corroborated by the model. Penultimate stress was statistically preferred in LLL words compared to LLH words ($\hat{\beta} = -1.82$, 95 CrI $= [-2.77, -0.87]$), supporting the view that weight effects are most likely to emerge at the right edge of the stress domain. Within words, the trends aligned with previous observations: penultimate stress was favored more in LHL than in LLL words, and slightly more in LLL than in HLL words (where antepenultimate stress is the alternative). However, these word-internal tendencies were too weak to yield statistically reliable effects.

Unlike task 1, task 2 did not produce statistically credible weight effects, i.e., penultimate stress was favored across all weight profiles being tested. We will therefore not explore those results here. Instead, we now turn to sonority effects, which are the focus of the present study.

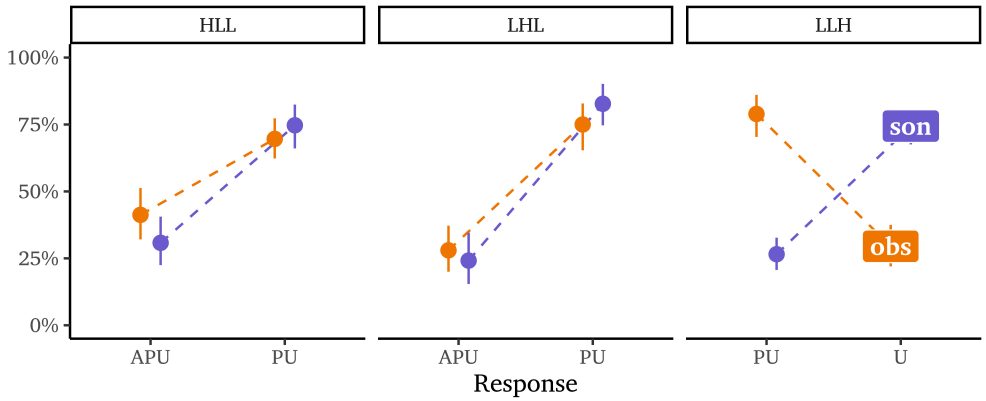

Figure 2: Mean preference for penultimate stress by weight profile and coda sonority (sonorant or obstruent).

We start by examining Fig. 2. We can see that the final syllable displays a clear effect of coda sonority, whereby the sonorant codas in the final syllables are correlated with the preference for final stress. This is confirmed by our model, which predicts the log-odds of selecting penultimate stress as a function of weight, sonority, and their interaction. The model includes this interaction as random slopes by participant, along with random intercepts by item. As with the first model discussed above, we inspected both $\hat{R}$ and ESS values (ESS $\geq$ 915) for this model to ensure that our estimates are reliable and that the four chains used in the model converged. Fig. 3 shows relevant multiple comparisons extracted from the model using the `emmeans` package (Lenth 2024).

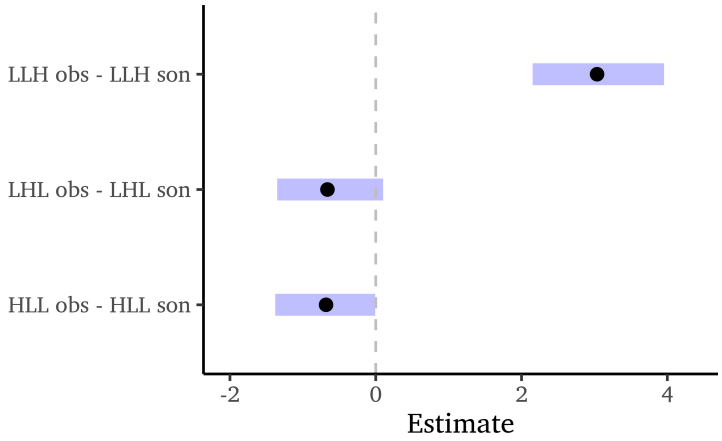

Figure 3: Model estimates (x-axis, in log-odds) showing multiple comparisons for the effect of sonority in task 1 (penultimate stress) given all relevant contrasts (y-axis). Lines represent 95% credible intervals of posterior distributions. A positive effect indicates preference for penultimate stress.

In Fig. 3, we see a robust effect of coda sonority in final syllables: LLH words ending in /s/ are more likely to yield a preference for penultimate stress compared to LLH words ending in a sonorant. We also notice potential effects word-internally. For penultimate syllables, the negative posterior distribution of LHL obs - LHL son indicates that penultimate stress is favored more often when a sonorant coda is present in the penultimate syllable. Conversely, HLL obs - HLL son indicates that antepenultimate stress is

favored in the presence of an obstruent coda in antepenultimate syllables. While both penultimate and antepenultimate effects are predominantly negative (suggesting possible word-internal sonority effects), their posterior distributions are too close to zero for us to draw any categorical conclusions, especially relative to the effect found for LLH obs - LLH son. We instead focus on final syllables, where the effect is clear and robust.

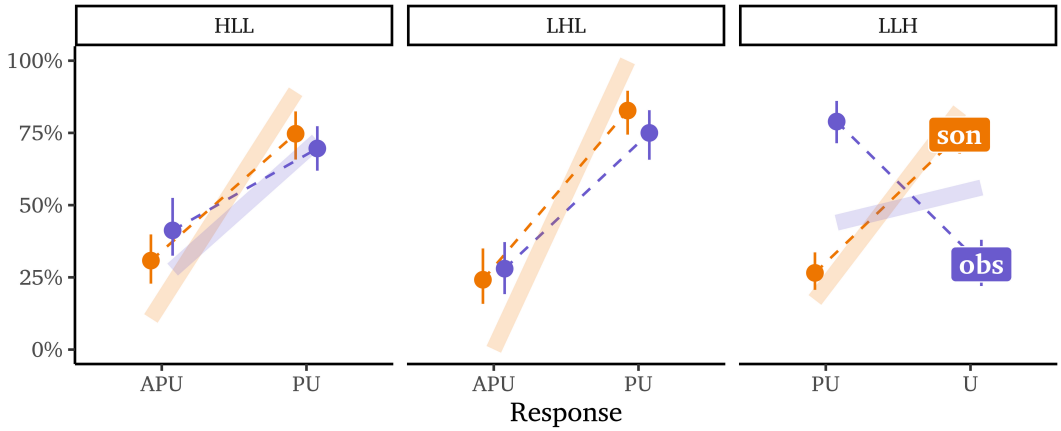

Figure 4: Lexical patterns (semitransparent thick lines) and experimental results (dashed lines). No LHL word with APU stress and a sonorant coda is found in the lexicon, hence the absence of a blue line for LHL words.

The main question that arises is how one can be sure that the effects in question are sonority-driven and not morphology-driven. Because Portuguese plural involves the addition of /-s/, and because plural is not considered in the computation of stress, this creates a natural confound to investigate sonority effects in the language. Although our experimental design attempted to minimize this problem by including explicit instructions regarding number for all nonce words, we recognize that such a confound could indeed pose problems to our findings. We address this point with two types of data, discussed below.

First, it is important to note that monomorphemic /s/-ending words do exist in the Portuguese lexicon. Using the Portuguese Stress Lexicon as our baseline (Garcia 2014), we can easily map the stress patterns in the lexicon as a function of (final) coda quality. We can then overlay these patterns (monomorphemic words) with the patterns in the experiment — this is shown in Fig. 4. Notice how the inversion observed in the experimental data is also observed in the lexicon. Simply put, monomorphemic words ending in /s/ are less likely to have final stress than words ending in sonorants in the lexicon. This is exactly what we observe in the experimental data discussed above.

Second, we can inspect the behavior of individual participants, shown in Fig. 5. If some participants assume that coda /s/ is plural /-s/, their preferences should be virtually categorical. While there are indeed some participants ($n = 8$, IDs 5 to 28 in the figure) who never choose final stress in /s/-ending words, the vast majority of participants display a noncategorical pattern of behavior. Crucially, none of the participants show the opposite effect to what we find for the data as a whole.

4 Final remarks

We have reported empirical evidence that coda sonority influences stress placement preferences in Brazilian Portuguese. Our experimental findings reveal that speakers systemat-

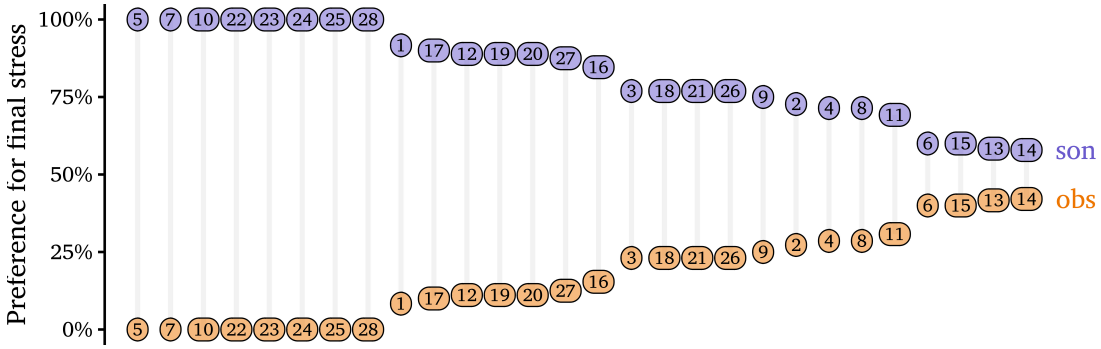

Figure 5: Individual preference for final stress as a function of coda sonority: obstruent coda in orange, sonorants in violet.

ically prefer final stress when the ultima contains sonorant codas {N, l, r} compared to the obstruent coda {s}, with this preference mirrored in lexical distributions of monomorphemic words. This suggests that the observed effects reflect phonological principles beyond potential morphological interference from plural marking.

The robust sonority effects we observe are largely confined to the ultima, which is not surprising given that weight effects are strongest in this position in Portuguese. Nevertheless, sonority has been shown to affect stress word-internally (antepenultimate syllables) in this language (Garcia & Goad 2024). Yet, such sonority effects in antepenultimate syllables do not emerge from our data. Whether this reflects the gradient nature of word-internal sonority effects (especially their subtletly), methodological differences, or genuine positional asymmetries in how sonority conditions stress assignment remains an open question.

Data availability/Supplementary files

The stimuli, data and script for this paper are available at https://osf.io/fuy7d/?view_only=496e8fc482024d858e43be685b70b196.

Ethics and consent

This study was approved by *Le Comité plurifacultaire d'éthique de la recherche* at Université Laval (approval no. 2024-122 R-1).

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Competing interests

The authors have no competing interests to declare.

References

Anttila, Arto. 1997. Deriving variation from grammar. In Hinskens, Frans & van Hout, Roeland & Wetzels, Leo (eds.), *Variation, change and phonological theory*, 35–68. Amsterdam: John Benjamins. https://doi.org/10.1075/cilt.146.04ant

Anwyl-Irvine, Alexander L. & Massonnié, Jessica & Flitton, Adam & Kirkham, Natasha Z. & Evershed, Jonathan K. 2020. Gorilla in our midst: An online behavioral experiment builder. *Behavior Research Methods* 52(1). 388–407. https://doi.org/10.3758/s13428-019-01237-x

Bach, Emmon & Howe, Darin & Shaw, Patricia. 2005. On epenthesis and moraicity in Northern Wakashan. Paper presented at the Society for the Study of the Indigenous Languages of the Americas.

Bowers, Dustin. 2019. Positional vs. sonority-driven stress in Gujarati: new experimental evidence. *Phonological Data and Analysis* 1(1). 1–28.

Brooks, Steve & Gelman, Andrew & Jones, Galin L & Meng, Xiao-Li. 2011. *Handbook of Markov Chain Monte Carlo*. Boca Raton: Chapman and Hall/CRC.

Bürkner, Paul-Christian. 2021. Bayesian item response modeling in R with `brms` and Stan . *Journal of Statistical Software* 100(5). 1–54. https://doi.org/10.18637/jss.v100.i05

Carpenter, Angela C. 2010. A naturalness bias in learning stress. *Phonology* 27. 345–392. https://doi.org/10.1017/s0952675710000199

de Lacy, Paul. 2004. Markedness conflation in Optimality Theory. *Phonology* 21(2). 145–199.

Elfner, Emily. 2023. Prosody and prosodic phrasing in Kwak'wala. Slides from the University of Calgary Linguistics Colloquium, November 10.

Everett, Daniel. 1988. On metrical constituent structure in Pirahã. *Natural Language and Linguistic Theory* 6. 207–246.

Everett, Daniel & Everett, Keren. 1984. On the relevance of syllable onsets to stress placement. *Linguistic Inquiry* 15. 705–711.

Faust, Noam & Ulfsbjorninn, Shanti. 2025. The typology of weight in strict CV metrics: A challenge to moraic theory. *Linguistic Inquiry* 56. 1–60. https://doi.org/10.1162/ling.a.58

Fields, Philip C. 1991. A phonology of the Orya language. In Dutton, Tom (ed.), *Papers in Papuan linguistics*, vol. 1, 29–56. Canberra: The Australian National University.

Garcia, Guilherme D. 2014. *Portuguese stress lexicon*. Comprehensive list of non-verbs in Portuguese. Available at http://gdgarcia.ca/psl.html.

Garcia, Guilherme D. 2017. *Weight effects on stress: lexicon and grammar*: McGill University dissertation. https://doi.org/10.31219/osf.io/bt8hk. https://guilhermegarcia.github.io/thesis

Garcia, Guilherme D. 2024. Current issues in Portuguese main and secondary stress. In Zampaulo, André (ed.), *The Routledge Handbook of Portuguese Phonology*, London: Routledge. https://doi.org/10.4324/9781003266648-9. Pre-print available at https://doi.org/10.31219/osf.io/6dpa5

Garcia, Guilherme D & Goad, Heather. 2024. Weight effects and the parametrization of the foot: English versus Portuguese. *Laboratory Phonology* 15(1). 1–37. https://doi.org/10.16995/labphon.6420

Goedemans, Rob. 1998. *Weightless segments*. The Hague: Holland Academic Graphics.

Gordon, Matthew. 2005. A perceptually-driven account of onset-sensitive stress. *Natural Language and Linguistic Theory* 23. 595–653.

Gordon, Matthew. 2006. *Syllable weight: phonetics, phonology, typology*. New York, NY: Routledge Press. https://doi.org/10.4324/9780203944028

Hayes, Bruce. 1995. *Metrical stress theory: Principles and case studies*. Chicago, IL: University of Chicago Press.

Hermans, Ben & Torres-Tamarit, Francesc. 2016. Onset weight with branchingness constraints: The case of Pirahã. *Proceeding of the Annual Meeting on Phonology 2015* 1–9.

Hinton, Leanne & Luthin, Herb. 2002. Stress & syllable weight in Yahi. Paper presented at the Society for the Study of the Indigenous Languages of the Americas.

Joel, Dina Judith. 1966. *Paipai phonology and morphology*: University of California, Los Angeles dissertation.

Kenstowicz, Michael. 1997. Quality-sensitive stress. *Rivista di Linguistica* 9. 157–187.

Kiparsky, Paul. 2011. Compensatory lengthening. In Cairns, Charles & Raimy, Eric (eds.), *Handbook of the syllable*, 33–70. Leiden: Brill. https://doi.org/10.1163/ej.9789004187405.i-464.10

Kraehenmann, Astrid. 2003. *Quantity and prosodic asymmetries in Alemannic: Synchronic and diachronic perspectives*. Berlin: Mouton de Gruyter. https://doi.org/10.1515/9783110197228

Kung, Susan Smythe. 2007. *A descriptive grammar of Huehuetla Tepehua*: University of Texas, Austin dissertation.

Lenth, Russell V. 2024. *emmeans: Estimated marginal means, aka least-squares means*. https://CRAN.R-project.org/package=emmeans. R package version 1.10.1.

Levinsohn, Stephen H. 1976. *The Inga language*. The Hague: Mouton.

MacKay, Carolyn J. & Trechsel, Frank R. 2013. A sketch of Pisaflores Tepehua phonology. *International Journal of American Linguistics* 79(2). 189–218. https://doi.org/10.1086/669628

Munshi, Sadaf & Crowhurst, Megan J. 2012. Weight sensitivity and syllable codas in Srinagar Koshur. *Journal of Linguistics* 48. 427–472. https://doi.org/10.1017/s0022226712000096

Noguchi, Masaki. 2011. A preliminary study of intonation in Kwak'wala. *University of British Columbia Working Papers in Linguistics* 30. 321–350.
Paramore, Jonathan Charles. 2025. Codas are universally moraic. *Phonology* 42(e1). 1–36. https://doi.org/10.1017/s0952675724000204
R Core Team. 2025. *R: a language and environment for statistical computing*. R Foundation for Statistical Computing Vienna, Austria. http://www.R-project.org/.
Rasin, Ezer. 2018. *Modular interactions in phonology*: Massachusetts Institute of Technology dissertation.
Ryan, Kevin M. 2014. Onsets contribute to syllable weight: Statistical evidence from stress and meter. *Language* 90(2). 309–341.
Ryan, Kevin M. 2019. *Prosodic weight: Categories and continua*. Oxford: Oxford University Press.
Ryan, Kevin M. & Heath, Jeffrey. 2022. Onset prominence in Wubuy reduplication. In Jurgec, Peter & al. (eds.), *Proceedings of the 2021 Annual Meeting on Phonology (AMP)*, Washington, D.C.: Linguistic Society of America. https://doi.org/10.3765/amp.v9i0.5148
Sayeed, Ollie. 2017. Osthoff's law in Latin. *Indo-European Linguistics* 5. 147–177. https://doi.org/10.1163/22125892-00501005
Scheer, Tobias & Szitgetvári, Péter. 2005. Unified representations for stress and the syllable. *Phonology* 22. 37–75. https://doi.org/10.1017/S0952675705000436
Shih, Shu-Hao. 2016. Sonority-driven stress does not exist. In Hansson, Gunnar Ólafur & Farris-Trimble, Ashley W. & McM ullin, Kevin & Pulleyblank, Douglas (eds.), *Supplemental proceedings of the 2015 Annual Meeting on P honology*. Washington, D.C.: Linguistic Society of America. https://doi.org/10.3765/amp.v3i0.3666
Shih, Shu-Hao. 2018. On the existence of sonority-driven stress in Gujarati. *Phonology* 35. 327–364.
Shih, Shu-Hao & de Lacy, Paul. 2019. Evidence for sonority-driven stress. *Catalan Journal of Linguistics* 18. 9–40.
Wilson, Stephen A. 1986. Metrical structure in Wakashan phonology. *Proceedings of the Twelfth Annual Meeting of the Berkeley Linguistics Society* 283–291. https://doi.org/10.3765/bls.v12i0.1857
Wolff, Ekkehard. 1983. *A grammar of the Lamang language*. Glückstadt: Verlag J. J. Augustin.
Zec, Draga. 1995. Sonority constraints on syllable structure. *Phonology* 12(1). 85–129.