Weak elements make strong predictions

Evidence for gradient input features from Sino-Japanese compound accent

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The problem

Pitch-accent behaviour of two-member Sino-Japanese compounds looks semi-regular at best.

Morphemes show gradient accenting tendencies in a dataset of 1350 compounds.

In these morphologically minimal pairs, neither M_1 not M_2 solely determines accent:

M_1 accent-friendly	M_1 accent-resisting
hon 本 'this; 'main'; 'book' 15/24	*sin* 新 'new' 3/16
hón-poo 本法 'this law'	*sin-poo* 新法 'new law'
Contrary behaviour	
hon-ryuu 本流 'main-stream'	*sín-pei* 新兵 'new recruit'

Figure 1: (accented compounds shaded blue)

Why OT and Harmonic Grammar fail to explain these patterns

Switching morpheme order can change accentuation:

字数 *zi-súu* '# of written characters' ACCENTED (LH)	数字 *suu-zi* 'numeral' UNACCENTED (HL)
波長 *ha-tyoo* 'wavelength' UNACCENTED (LH)	長波 *tyóo-ha* 'long-wave' ACCENTED (HL)

Prosody cannot explain this contrast. (Opposite correlation between prosody and accent between the two pairs.)

In HG or OT, lexically-indexed markedness and faithfulness constraints[1] and binary input values are insensitive to switching the morpheme order, *unless* edge-aligned floating features and coalescence occur, with a floating feature only occurring on one side. This will sacrifice a morpheme's ability to accent variably across compounds. Preventing *zi* from triggering accent in 数字 *suu-zi* incorrectly prevents it from triggering accent in a variably accenting M_1 such as 十 *zyuu* 'ten' which does accent with *zi* in *zyúu-zi* 十字 'cross' but not in unaccented *zyuu-moku* 十目 'all-eyes'. (See handout for details.)

A Gradient Symbolic Computation account of semi-regular patterns

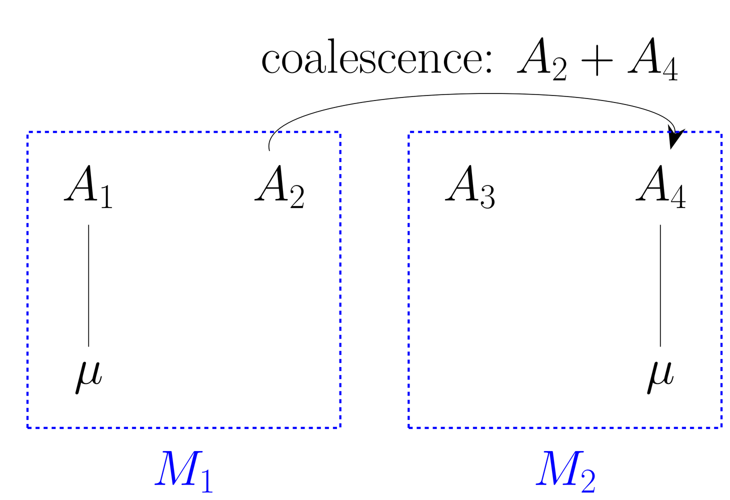
This framework (Smolensky and Goldrick, 2016) allows *partially-activated* input features. When two accent features coalesce in the output, their effective input activation is the sum of the two activations. This allows *accenting propensities* to be expressed by *input activations*. (See also Rosen (2016, 2018) for GSC accounts of gradient behaviour in native Japanese compound accent and Japanese rendaku voicing.)

Gradient features derive gradient behaviour

hon	sin	hei	hoo	ryuu
0_L 0.31_A 0.14_R	0_L 0.19_A 0_R	0.28_L 0_A 0_R	0.14_L 0_A 0_R	0_L 0_A 0_R
L = floating left A = anchored R = floating right				

Figure 2: Some learned input accent activations for Fig. 1 data

Accent is determined by combined accenting tendencies of M_1 and M_2



A floating feature can coalesce with an anchored feature on an adjacent but not the same morpheme. (strict Linearity)

Sample tableau for *hón-poo*

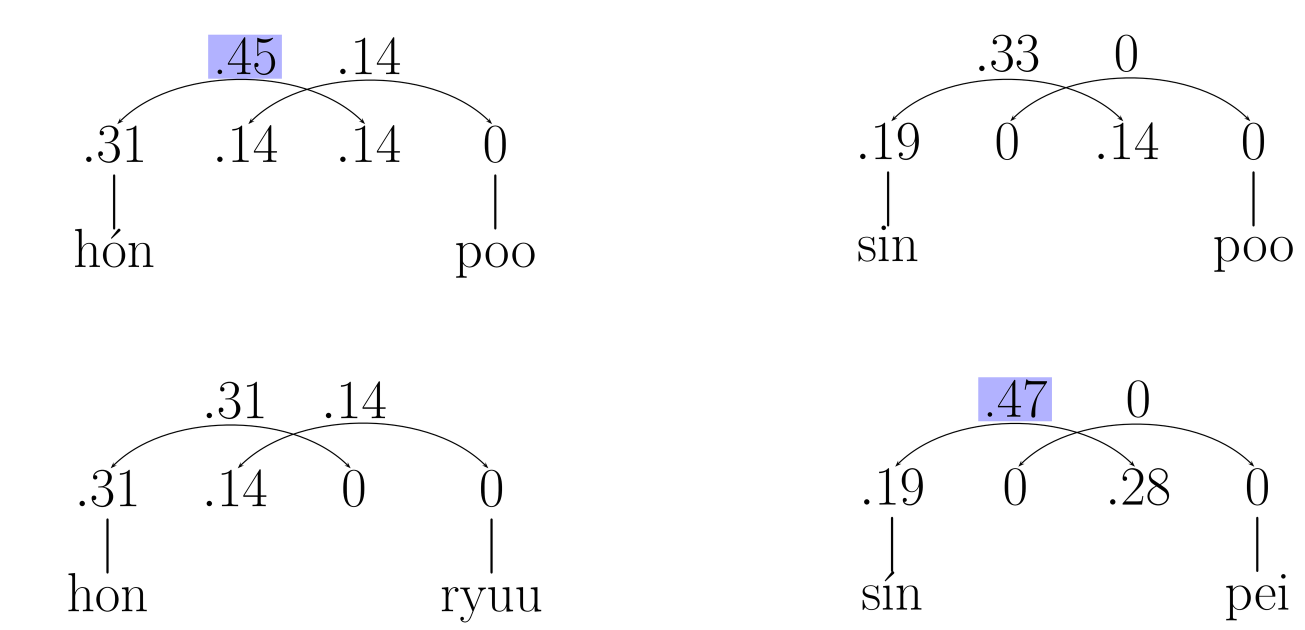
hon+hoo	MAX +1.10	DEP −0.90	RMOST −0.18	PARSE −0.18	PRJNC +0.12	WDACC +0.10	NONFIN −0.09	H
☞ **(hón)-poo** $0.31_A + 0.14_L$ $= 0.45 > 0.37$ threshold	0.49^2	−0.50		−0.18	0.12	0.10		0.029
(hón)-(poo) $0.31_A + 0.14_L$	0.49	−0.50	−0.18		0.12	0.10		0.027
(hon)-(póo) $0.14_R + 0_A$	0.16	−0.77				0.10	−0.09	−0.61
(hon)-(poo)								0

See handout for further tableaux and constraint definitions. (/h/ → [p] predictably)

The result

A learning algorithm derived partially-activated features that account for complex accent patterns among 728 compounds.

Coalescence of gradient features creates summed activations (threshold 0.37)



Learning

- A simple error-driven algorithm learned constraint weights and feature activations for 728 frequently-used compounds with no errors.
- Learned values for a larger group of 1350 compounds yielded 117 exceptions: an accuracy rate of 91.3%.[3]

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[1] See also Round (2017) for an argument that lexical indexation must apply to phonemes, not morphemes.

[2] $0.49 = 1.10 \cdot (0.31_A + 0.14_L)$

[3] This exception rate of 8.7% is well under the 14% limit for a dataset of this size determined by the Tolerance Principle (Yang 2016) that predicts whether a process can be considered productive. An NLP type of approach in which each different prosodic shape was considered a feature yielded a training-set accuracy of 97.1% but these features do not translate directly into principled constraints in linguistic theory.