

The too-many-solutions problem in OT in a representational perspective

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I Span Theory

Goal of this meeting

We will discuss McCarthy's (2004) *Span Theory*. This is an attempt to solve instances of the too-many-solutions problem with representations.

Steps in the presentation

- Span theory;
- How Span Theory solves instances of the too-many-solutions problem.

Span-theory

In Span Theory, the segments of a word are exhaustively parsed into spans for each distinctive feature. Each span of the feature [F] has a head segment, and it is the head segment's value for [F] that determines the pronunciation of the other segments in the span.

Two kinds of constraints favor parsing segments as the head of spans. On the faithfulness side, IDENT and MAX-feature constraints are replaced by FTHHDSP, defined in the following way:

FTHHDSP(α F) McCarthy (2004: 5)

If an input segment ζ_I is [α F] and it has an output correspondent ζ_O , then ζ_O is the head of an [α F] span.

On the markedness side, span headship is also demanded by certain feature cooccurrence restrictions. A general schema for such constraints is the following:

HEAD($[\beta$ G, γ H, ...], [α F])

Every [β G, γ H, ...] segment heads a [α F] span.

Then there is a constraint reducing proliferation of spans. It forbids adjacent spans.

*A-SPAN(F)

Assign one violation mark for every pair of adjacent spans of the feature [F]

Directionality is expressed in terms of constraints on the location of a span's head:

SPHDL(+nasal)

The head segment of a [+nasal] span is initial in that span. Assign one violation-mark for each non-conforming span.

SPHDR(+nasal)

The head segment of a [+nasal] span is final in that span. Assign one violation-mark for each non-conforming span.

SPHDL(-nasal)

The head segment of a [-nasal] span is initial in that span. Assign one violation-mark for each non-conforming span.

SPHDR(-nasal)

The head segment of a [-nasal] span is final in that span. Assign one violation-mark for each non-conforming span.

Some candidates from /mawasa/ and their pronunciations (p. 4).

(<u>m</u> awa)(s <u>a</u>)	[mãwãsa]
(<u>m</u> a)(w <u>a</u> sa)	[mãwasa]
(<u>m</u> a)(<u>w</u> a)(s <u>a</u>)	” ”
(<u>m</u>)(aw <u>a</u> sa)	[mawasa]
(<u>m</u>)(awasa <u>a</u>)	” ”
(<u>m</u>)(<u>a</u>)(<u>w</u>)(<u>a</u>)(<u>s</u>)(<u>a</u>)	” ”
(<u>m</u>)(<u>a</u> wasa)	” ”

etc.

Some spans not allowed by GEN

(<u>m</u> awa)sa	non-exhaustive parsing into [nasal] spans
(<u>m</u> a)wa(s <u>a</u>)	same
(<u>m</u> a)(<u>w</u> asa)	two-headed span
(<u>m</u> awa)(s <u>a</u>)	headless span

Nasal incompatibility (after Walker 1998)

- *NASOBSTSTOP
 - *[+nas, -cont, -son]
 - »
- *NASFRICATIVE
 - *[+nas, +cont, -son]
 - »
- *NASLIQUID
 - *[+nas, +approx, +cons]
 - »
- *NASGLIDE
 - *[+nas, +approx, -cons, -syll]
 - »
- *NASVOWEL
 - *[+nas, +approx, -cons, +syll]

McCarthy replaces Walker's constraints with constraints requiring oral spans.

- HEAD([-cont, -son], [-nas])
Every obstruent stop heads an oral span (= OBSTHDOR)
- »
- HEAD([+cont, -son], [-nas])
Every fricative heads an oral span (= FRICHDOR)
- »
- HEAD([+app, +cons], [-nas])
Every liquid heads an oral span (= LIQHDOR)
- »
- HEAD([+app, -cons, -syll], [-nas])
Every glide heads an oral span (= GLIHDOR)
- »
- HEAD([+app, -cons, +syll], [-nas])
Every vowel heads an oral span (= VOWHDOR)

Exemplification of this typology (based on Walker 1998; examples from McCarthy, p. 6)

(1) **Sundanese**; glides and all less sonorant segment are blockers

māwur 'to spread'

(2) **Johore Malay**; glides are undergoers of harmony, but liquids and all less sonorant segments are blockers

pəŋãwãsan '??'

mãratappi 'to cause to cry'

(3) **Kolokoma Ijo**; liquids and glides can nasalize, but less sonorous segments cannot

ʃãĩ 'shake'

izõŋgo 'jug'

(4) **Applecross Gaelic**; even fricatives nasalize, though obstruent stops never do

ʃŋãŋ'dʲan 'thread'

How are blocking effects implemented?

Formally, blocking effects in nasal harmony are the result of ranking *A-SPAN(nasal) below one of the HEAD-constraints

Johore Malay-type systems (vowels and glides as undergoers) (p. 7).

/mawasa/	OBSTHD OR	FRICHD OR	LIQHD OR	*A-SPAN (nasal)	GLIHD OR	VOWHD OR
☞ (mawa)(sa)				*	*	***
(mawasa)		*!			*	***
(ma)(wa)(sa)				**!		***
(m)(a)(w)(a)(s)(a)				***!***		

By interpolating *A-SPAN(nasal) at other spots in the fixed (!) hierarchy, we obtain the typology of blockers described by Walker.

How is harmony implemented?

In any language where underlying oral segments become nasalized through harmony, FTHHDSP(-nasal) must be ranked below *A-SPAN(nasal). ‘In general, the FTHHDSP constraints encourage the proliferation of spans, whereas *A-SPAN encourages economy of spans. Thus, the presence of harmony is an indication that FTHHDSP is dominated by *A-SPAN’ (p. 8).

The relation with segment inventory

By choosing different locations for FTHHDSP(+nasal) relative to the constraints of the HEAD-family, a range of possible systems of nasal contrast can be obtained: contrast only in nasal stops; contrast in nasal stops and vowels; contrast in nasal stops, glides and vowels; and so on.

‘This consequence of ranking permutation matches the typological finding of Cohn (1993), Pulleyblank (1989), and Walker (1998) that the implicational hierarchy for nasality in inventories approximates the implicational hierarchy for nasalizeability in harmony. Just as vowels are most easily nasalized in harmony, so too vowels will contrast in nasality more readily than glides’ (p. 9).

Effect of the ranking GLIHDOR » FTHHDSP(+nasal) » VOWHDOR on inventory (p. 9)

/a/	GLIHDOR	FTHHDSP(+nasal)	VOWHDOR
☞ (a)			
(ã)			*!
/ã/			
☞ (ã)			*
(a)		*!	
/w̃/			
☞ (w)		*	
(w̃)	*!		

No blocking of epenthesis with *A-SPAN » NO-CODA (p. 18)

/mawas/	FRICHdOR	*A-SPAN(nasal)	NO-CODA	GLIHdOR	DEP	VOWHdOR
☞ (mawa)(sə)		*		*	*	***
(mawa)(s)		*	*!	*		**
(mawasə)	*!					***

The winner and its primary competitor (the second candidate) have identical numbers of adjacent spans, so they tie on *A-SPAN. Consequently, NO-CODA is able to rule out *mãwãã*.

Harmony by selection of short allomorphs

Effect of ALIGN-R(nasal) » SWP (p. 19)

/mawasa- { ta, pta }	ALIGN-R(nasal)	SWP
☞ ¹ mã.wã. sa.ta	****	**
¹ mã.wã. sap.ta	*****!	*

This is a language where allomorphs are selected by prosodic criteria, *except in words with blocked harmony*. ‘No known language works like this’ (p. 19). In Span Theory no such problem arises.

*A-SPAN(nasal) and allomorph selection (p. 19)

/mawasa- { ta, pta }	*A-SPAN(nasal)
(¹ mawa)(<u>s</u> a)(p)(<u>t</u> a)	***
(¹ mawa)(<u>s</u> a)(<u>t</u> a)	**
(¹ ga)(<u>b</u> a)(<u>s</u> a)(p)(<u>t</u> a)	****
(¹ ga)(<u>b</u> a)(<u>s</u> a)(<u>t</u> a)	***

The reason is that the choice of allomorphs has the same effect on span structure regardless of whether a nasal precedes or not.

Harmony by alteration of blockers

Another way to improve alignment is to change the features of a potential blocker. For instance /mawasa/ could be changed to *mãwããã*. This does not seem to happen (cf. also first session of first class).

Span Theory does not suffer from this problem. This is because lenition has the same effects on *A-SPAN in nasal and oral environments.

*A-SPAN(nasal) and lenition (p. 20)

	*A-SPAN(nasal)
/mawasa/	
(<u>m</u> awa)(<u>s</u> a)	*
(<u>m</u> awara)	
/gabasa/	
(<u>g</u> a)(<u>b</u> a)(<u>s</u> a)	**
(<u>g</u> a)(<u>b</u> ara)	*
/nadasa/	
(<u>n</u> a)(<u>d</u> a)(<u>s</u> a)	**
(<u>n</u> a)(<u>d</u> ara)	*

Harmony by deletion

Gradient alignment can compel deletion of segments. Deletion of segments to promote harmony does not exist.

Effect of ALIGN-R(nasal) » MAX (p. 21)

/mawasa/	*[+nas,-son]	ALIGN-R(nasal)	MAX
↵ māwã			**
mãwãsa		*!*	
mãwãsã	*!		

Span Theory does not suffer from this problem. Performance on *A-SPAN(nasal) can be improved by deletion, but the effect is the same whether or not the word contains a nasal trigger and blocker.

*A-SPAN(nasal) and deletion (p. 22)

	*A-SPAN(nasal)
/mawasa/	
(<u>m</u> awa)	
(<u>m</u> awa)(<u>s</u> a)	*
(<u>m</u> awa.a)	
/gawasa/	
(<u>g</u> awa)	
(<u>g</u> awa)(<u>s</u> a)	*
(<u>g</u> awa.a)	

Harmony by reduplicative emergence of the unmarked

ALIGN(nasal) can determine how much is copied, favoring less copying if spreading cannot reach the copied segments.

Effect of ALIGN-R(nasal) » MAX-BR (p. 22)

	ALIGN-R(nasal)	MAX-BR
/mapata+RED/		
☞ māpata-ta	*****	****
māpata-pata	*****!*	**
/gadaba+RED/		
gadaba-ba		***!*
☞ gadaba-daba		**

Span Theory does not have this problem; copying has the same effect on the span structure of /mapata/ and /gadaba/.

*A-SPAN(nasal) and copying (p. 23)

	A-SPAN(nasal)
/mapata+RED/	
(<u>ma</u>)(<u>pa</u>)(<u>ta</u>)(<u>ta</u>)	***
(<u>ma</u>)(<u>pa</u>)(<u>ta</u>)(<u>pa</u>)(<u>ta</u>)	****!
/gadaba+RED/	
(<u>ga</u>)(<u>da</u>)(<u>ba</u>)(<u>ba</u>)	***
(<u>ga</u>)(<u>da</u>)(<u>ba</u>)(<u>da</u>)(<u>ba</u>)	****!

Harmony by affix repositioning

Gradient ALIGN(nasal) can affect affix placement. *A-SPAN(nasal), on the other hand, cannot produce this alternation. The reason is that the competing candidates have the same numbers of [nasal] spans.

Effect of ALIGN-R(nasal) » ALIGN-R(suffix) (p. 23)

	ALIGN-R(nasal)	ALIGN-R(suffix)
/mapata+ka/		
☞ ka-māpata	****	*****
māpata-ka	*****!*	
/gadaba+ka/		
ka-gadaba		*!*****
☞ gadaba-ka		

*A-SPAN(nasal) and affix position (p. 24)

	A-SPAN(nasal)
(<u>ka</u>)-(ma)(pa)(ta)	***
(ma)(pa)(ta)-(ka)	***
(ka)-(ga)(da)(ba)	***
(ga)(da)(ba)-(ka)	***

Harmony by stress shift

It is possible to satisfy ALIGN-R(nasal) by moving stress. In Span Theory, on the other hand, this is not possible.

Effect of IDENT_σ(nasal) » ALIGN-R(nasal) » NONFINALITY (p. 24)

	IDENT _σ (nasal)	ALIGN-R(nasal)	NONFINALITY
/mawata/			
☞ māwātá		**	*
māwáta		***!*	
māwāta	*!	**	
/gawata/			
gawatá			*!
☞ gawáta			

FTHHDS_σ(-nasal) » *A-SPAN(nasal), NONFINALITY (p. 25)

	FTHHDS _σ (-nasal)	*A-SPAN(nasal)	NONFINALITY
/mawata/			
(<u>m</u> awa)(<u>t</u> á)		*	*
(<u>m</u> a)(<u>w</u> á)(<u>t</u> a)		**	
(<u>m</u> awá)(<u>t</u> a)	*!		
/gawata/			
(gaw <u>a</u>)(<u>t</u> á)		*	*
(g <u>a</u>)(<u>w</u> á)(<u>t</u> a)		**	
(gaw <u>a</u>)(<u>t</u> a)	*!	*	

*A-SPAN(nasal) and NONFINALITY determine whether stress falls on the penult or the ultima, but their effect is the same regardless of whether there is a preceding nasal or oral span.

Conclusion

Span Theory is an interesting (and ingenious) attempt to solve the too-many-solutions problem in autosegmental spreading. The challenge now is to get the effects of Span Theory *without [-nasal]*.