The expressivity of liquid dissimilation in Yidiny

Tatevik Yolyan & Adam McCollum
Rutgers University

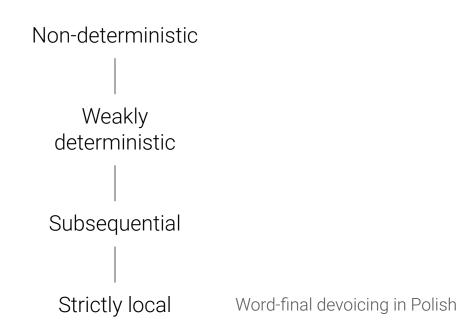28th Manchester Phonology Meeting

Formal language theory

Formal language theory provides a mathematically rigorous way to analyze the expressivity of both stringsets (grammaticality) and string-to-string functions (input-output mappings).

Early work demonstrates that the expressivity of ordered SPE-style rewrite rules is regular, proposing that phonology is also regular.

Johnson 1972; Kaplan & Kay 1994

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Subregular hypothesis

More recently, work in computational phonology has argued that phonological computation does not require the full expressivity of the regular functions.

Researchers have explored the expressivity of simpler classes of functions, developing a typology of subregular functions.

Heinz 2011a,b; Heinz & Lai 2013; Chandlee 2014 among many others

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Subregular hierarchy

Non-deterministic

|

Weakly
deterministic

|

Subsequential

|

Local dependency   **Strictly local**   Word-final devoicing in Polish

Subregular hierarchy

Non-deterministic

|

Weakly
deterministic

|

Long-distance dependency in one direction   Subsequential   Sibilant harmony in Chumash

|

Local dependency   Strictly local   Word-final devoicing in Polish

Subregular hierarchy

Non-deterministic

| |

For all elements, long-distance dependency EITHER to the right OR left

Weakly deterministic

ATR harmony in Diola-Fogny

| |

Long-distance dependency in one direction

Subsequential

Sibilant harmony in Chumash

| |

Local dependency

Strictly local

Word-final devoicing in Polish

3

Subregular hierarchy

For some elements, long-distance dependency to the right AND left ("unbounded circumambient")

Non-deterministic

Tonal plateauing in Luganda

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Long-distance dependency in one direction

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Local dependency

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Local dependency

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3

Weak versus non-determinism

In a weakly deterministic mapping, the output of every element depends on non-local information EITHER to the right OR the left.

In a non-deterministic mapping, the output of some element(s) depends on non-local information on BOTH the right AND the left.

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

- [+ATR] morpheme with alternating morphemes to its left and right

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

- • [+ATR] morpheme with alternating morphemes to its left and right

A finite state transducer (FST) must read the string from left-to-right or right-to-left

Weakly deterministic functions can be decomposed into two contradirectional subsequential functions

Elgot & Mezei 1965; Heinz & Lai 2013

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋊	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋉
Output												⋉

Weakly deterministic functions

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Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Output												⋈

Weakly deterministic functions

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/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋊	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋉
Output											ʊ	⋉

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋊	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋉
Output										n	ʊ	⋉

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋊	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋉
Output									ɛ	n	ʊ	⋉

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Output								m	ɛ	n	ʊ	⋈

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Output							u	m	ɛ	n	ʊ	⋈

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Output						t	u	m	ɛ	n	ʊ	⋈

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋊	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋉
Output					i	t	u	m	ɛ	n	ʊ	⋉

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Output				j	i	t	u	m	ɛ	n	ʊ	⋈

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Output			i	j	i	t	u	m	ɛ	n	ʊ	⋈

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Output		n	i	j	i	t	u	m	ɛ	n	ʊ	⋈

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋊	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋉
Intermediate	⋊	n	i	j	i	t	u	m	ɛ	n	ʊ	⋉
Output	⋊											

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋊	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋉
Intermediate	⋊	n	i	j	i	t	u	m	ɛ	n	ʊ	⋉
Output	⋊	n										

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋊
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋊
Output	⋈	n	i									

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j								

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i							

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i	t						

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Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i	t	u					

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i	t	u	m				

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/ → [ni-jitum-en-u] '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i	t	u	m	e			

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i	t	u	m	e	n		

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/　　→　　[ni-jitum-en-u]　　'1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i	t	u	m	e	n	u	

Weakly deterministic functions

ATR harmony in Diola-Fogny

/nɪ-jitum-ɛn-ʊ/   →   [ni-jitum-en-u]   '1SG-lead.away-CAUS-2PL.OBJ'

Input	⋈	n	ɪ	j	i	t	u	m	ɛ	n	ʊ	⋈
Intermediate	⋈	n	i	j	i	t	u	m	ɛ	n	ʊ	⋈
Output	⋈	n	i	j	i	t	u	m	e	n	u	⋈

Subregular hierarchy

For some elements, long-distance dependency to the right AND left ("unbounded circumambient")

Non-deterministic

Tonal plateauing in Luganda

For all elements, long-distance dependency EITHER to the right OR left

Weakly deterministic

ATR harmony in Diola-Fogny

Long-distance dependency in one direction

Subsequential

Sibilant harmony in Chumash

Local dependency

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Word-final devoicing in Polish

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Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Non-deterministic functions involve a long-distance dependency in two directions – *unbounded circumambience* (Jardine 2016)

Like weakly deterministic functions, these can be decomposed into two contradirectional subsequential functions

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋈
Output								

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋈
Output								⋈

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋊	L	H	L	L	L	H	⋉
Output							H	⋉

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋉
Output						?	H	⋉

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋉
Output					?	?	H	⋉

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋉
Output				?	?	?	H	⋉

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋈
Output			H	?	?	?	H	⋈

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋉
Output		?	H	?	?	?	H	⋉

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋈
Output	⋈	?	H	?	?	?	H	⋈

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋈
Intermediate	⋈	?	H	?	?	?	H	⋈
Output	⋈							

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/   →   [mutémá bísíkí]   "log chopper"

/L H L L L H/   →   [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋉
Intermediate	⋈	?	H	?	?	?	H	⋉
Output	⋈	L						

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋉
Intermediate	⋈	?	H	?	?	?	H	⋉
Output	⋈	L	H					

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/   →   [mutémá bísíkí]   "log chopper"

/L H L L L H/   →   [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋊
Intermediate	⋈	?	H	?	?	?	H	⋊
Output	⋈	L	H	H				

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋊	L	H	L	L	L	H	⋉
Intermediate	⋊	?	H	?	?	?	H	⋉
Output	⋊	L	H	H	H			

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/   →   [mutémá bísíkí]   "log chopper"

/L H L L L H/   →   [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋈
Intermediate	⋈	?	H	?	?	?	H	⋈
Output	⋈	L	H	H	H	H		

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋈
Intermediate	⋈	?	H	?	?	?	H	⋈
Output	⋈	L	H	H	H	H	H	

Non-deterministic functions

Tonal plateauing in Luganda

/mutéma bisikí/ → [mutémá bísíkí] "log chopper"

/L H L L L H/ → [L H H H H H]

Input	⋈	L	H	L	L	L	H	⋈
Intermediate	⋈	?	H	?	?	?	H	⋈
Output	⋈	L	H	H	H	H	H	⋈

Subregular hierarchy

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Long-distance dependency in one direction

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Local dependency

Strictly local

Word-final devoicing in Polish

10

Defining weak determinism

Heinz & Lai's (2013) definition

- ◦ can be decomposed into two contradirectional subsequential functions

- ◦ the first (inner) function does not introduce markup - new symbols (like |?|) or length-increasing coding tricks

Meinhardt et al's (2020) definition

- ◦ can be decomposed into two contradirectional subsequential functions

- ◦ the functions do not interact

  - • necessary function ordering indicates interaction

  - • non-interacting functions can be applied simultaneously

Defining weak determinism

According to Heinz & Lai (2013),

- tonal plateauing is not weakly deterministic because it requires a new symbol |?| to serve as markup

According to Meinhardt et al (2020),

- tonal plateauing is not weakly deterministic because the two functions interact

- If reordered,

	/L H L L L H/
L-to-R function	|L H L L L H|
R-to-L function	*[? H ? ? ? H]

Two questions

1. Which definition of weak determinism is superior?
2. Are dissimilation patterns as complex as tonal plateauing in Luganda (i.e., regular)?

A number of tonal (Jardine 2016) and vowel harmony (McCollum et al 2020) patterns are non-deterministic

However, existing work on consonant harmony (Luo 2017) and dissimilation (Payne 2017) argues that these types of patterns are less expressive

Dissimilation

Payne (2017) argues that all dissimilation is subsequential; the realization of the element in question depends only on information in one direction

Dissimilation in Georgian

/r/ → [l] after /r/; blocked by intervening /l/

/somχ-u**r**i/	→	[somχ-u**r**i]	'Armenia-ADJ'
/i**r**an-u**r**i/	→	[i**r**an-u**l**i] *i**r**an-u**r**i	'Iran-ADJ'
/ka**r**tve**l**-u**r**i/	→	[ka**r**tve**l**-u**r**i] *ka**r**tve**l**u**l**i	'Kartvel-ADJ'

Liquid dissimilation in Yidiny

Payne notes one potential counterexample to her generalization – liquid dissimilation in Yidiny

The challenge is that the realization of suffix /l/ depends on non-local information in *both* directions

> Walsh-Dickey (1997) calls this *peripheral blocking*

Dissimilation and Blocking

The following data are from Dixon (1977).

These examples contain the 'going' aspect /-ŋalin/ which reduces to two forms before /ŋal/ 'COM'

[-ːlin] and [-ːrin].

[-ːrin] is the result of dissimilation, triggered by /l/ in the following affix.

/duŋga-ŋalin-ŋal/ → [duŋga-ːri-ŋal] "go running with"

/magi-ŋalin-ŋal/ → [magi-ːri-ŋal] "go climbing with"

Dissimilation and Blocking

The form [ːlin] surfaces when dissimilation is blocked by /r/ in the preceding verb root.

/burwa-ŋalin-ŋal/ → [burwa-ːli-ŋal] "go jumping with"

/burgi-ŋalin-ŋal/ → [burgi-ːli-ŋal] "go on walkabout with"

Unlike the dissimilation blocking pattern in Georgian, the trigger for dissimilation and the trigger for blocking in Yidiny are on opposite ends of the target.

Double Dissimilation

The standard analysis (Dixon 1977; Suzuki 1998; Bennett 2013) of this blocking pattern is that it is the result of **double dissimilation**.

Dixon proposes that there are two dissimilation processes taking place in Yidiny:

- Leftward Liquid Dissimilation, where /l/ becomes [r] when followed by an /l/

- Rightward Rhotic Dissimilation, where /r/ becomes [l] when preceded by /r/

Double Dissimilation

Liquid dissimilation in Yidiny is then the result of *composing rhotic and lateral dissimilation*, resulting in the following Duke of York derivation.

/du**r**wa-ŋa**l**in-ŋa**l**/	Input
|du**r**wa-:**r**i-ŋa**l**|	Leftward Lateral Dissimilation
[du**r**wa-:**l**i-ŋa**l**]	Rightward Rhotic Dissimilation

Double Dissimilation

/duɾwa-ŋalin-ŋal/ → |duɾwa-ːri-ŋal| → [duɾwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output												⋈

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output												⋈

Double Dissimilation

/durwa-ŋalin-ŋal/   → |durwa-ːri-ŋal| →   [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output											l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output										a	l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output									ŋ	a	l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/   → |durwa-ːri-ŋal| →   [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output								i	ŋ	a	l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output							r	i	ŋ	a	l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output						aː	r	i	ŋ	a	l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output					w	aː	r	i	ŋ	a	l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋊	d	u	r	w	aː	l	i	ŋ	a	l	⋉
Output				r	w	aː	r	i	ŋ	a	l	⋉

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Double Dissimilation

/duɾwa-ŋalin-ŋal/ → |duɾwa-ːɾi-ŋal| → [duɾwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːɾi] or [ːli] before /ŋal/ 'COM'

Input	⋊	d	u	ɾ	w	aː	l	i	ŋ	a	l	⋉
Output			u	ɾ	w	aː	ɾ	i	ŋ	a	l	⋉

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output		d	u	r	w	aː	r	i	ŋ	a	l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/   → |durwa-ːri-ŋal| →   [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Output	⋈	d	u	r	w	aː	r	i	ŋ	a	l	⋈

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Intermediate	⋈	d	u	r	w	aː	r	i	ŋ	a	l	⋈
Output	⋈											

Double Dissimilation

/durwa-ŋalin-ŋal/   → |durwa-:ri-ŋal| →   [durwa-:li-ŋal]

Note: /ŋalin/ 'going' reduces to [:ri] or [:li] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	a:	l	i	ŋ	a	l	⋈
Intermediate	⋈	d	u	r	w	a:	r	i	ŋ	a	l	⋈
Output	⋈	d										

Double Dissimilation

/durwa-ŋalin-ŋal/   → |durwa-ːri-ŋal| →   [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋊	d	u	r	w	aː	l	i	ŋ	a	l	⋉
Intermediate	⋊	d	u	r	w	aː	r	i	ŋ	a	l	⋉
Output	⋊	d	u									

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋊	d	u	r	w	aː	l	i	ŋ	a	l	⋉
Intermediate	⋊	d	u	r	w	aː	r	i	ŋ	a	l	⋉
Output	⋊	d	u	r								

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋊	d	u	r	w	aː	l	i	ŋ	a	l	⋉
Intermediate	⋊	d	u	r	w	aː	r	i	ŋ	a	l	⋉
Output	⋊	d	u	r	w							

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Intermediate	⋈	d	u	r	w	aː	r	i	ŋ	a	l	⋈
Output	⋈	d	u	r	w	aː						

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Intermediate	⋈	d	u	r	w	aː	r	i	ŋ	a	l	⋈
Output	⋈	d	u	r	w	aː	l					

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Intermediate	⋈	d	u	r	w	aː	r	i	ŋ	a	l	⋈
Output	⋈	d	u	r	w	aː	l	i				

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋊	d	u	r	w	aː	l	i	ŋ	a	l	⋉
Intermediate	⋊	d	u	r	w	aː	r	i	ŋ	a	l	⋉
Output	⋊	d	u	r	w	aː	l	i	ŋ			

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋈	d	u	r	w	aː	l	i	ŋ	a	l	⋈
Intermediate	⋈	d	u	r	w	aː	r	i	ŋ	a	l	⋈
Output	⋈	d	u	r	w	aː	l	i	ŋ	a		

Double Dissimilation

/durwa-ŋalin-ŋal/ → |durwa-ːri-ŋal| → [durwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋊	d	u	r	w	aː	l	i	ŋ	a	l	⋉
Intermediate	⋊	d	u	r	w	aː	r	i	ŋ	a	l	⋉
Output	⋊	d	u	r	w	aː	l	i	ŋ	a	l	

Double Dissimilation

/duɾwa-ŋalin-ŋal/   → |duɾwa-ːɾi-ŋal| →   [duɾwa-ːli-ŋal]

Note: /ŋalin/ 'going' reduces to [ːri] or [ːli] before /ŋal/ 'COM'

Input	⋊	d	u	r	w	aː	l	i	ŋ	a	l	⋉
Intermediate	⋊	d	u	r	w	aː	r	i	ŋ	a	l	⋉
Output	⋊	d	u	r	w	aː	l	i	ŋ	a	l	⋉

Expressivity

The two dissimilation processes are both subsequential:

- (Lateral Dissimilation) The output of affixal /l/ depends on whether there is another /l/ some **unbounded distance to the right.**

- (Rhotic Dissimilation) The output of affixal /r/ depends on whether there is another /r/ some **unbounded distance to the left.**

Expressivity

The two dissimilation processes are both subsequential:

- (Lateral Dissimilation) The output of affixal /l/ depends on whether there is another /l/ some **unbounded distance to the right.**

- (Rhotic Dissimilation) The output of affixal /r/ depends on whether there is another /r/ some **unbounded distance to the left.**

Double dissimilation is **Weakly Deterministic** by Heinz & Lai's (2013) definition:

➢ no new symbols, and no length-increasing coding tricks

Expressivity

However, the output of the 'going' affix depends on the presence or absence of a trigger on both sides

- Looks to the right for an /l/
- Looks to the left for a /r/

Dissimilation takes place when there is an /l/ to the right and no /r/ to the left.

Expressivity

However, the output of the 'going' affix depends on the presence or absence of a trigger on both sides.

- Looks to the right for an /l/
- Looks to the left for a /r/

Dissimilation takes place when there is an /l/ to the right and no /r/ to the left.

Thus, liquid dissimilation is **non-deterministic (unbounded circumambient)**

Weak versus non-determinism

WD: depends on non-local information EITHER to the right OR the left.

ND: depends on non-local information on BOTH the right AND the left.

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	Dependency	Heinz & Lai	Meinhardt et al
Tonal plateauing in Luganda	long-distance in both directions	non-deterministic	non-deterministic
Liquid dissimilation in Yidiny	long-distance in both directions	weakly deterministic	non-deterministic

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Liquid dissimilation in Yidiny	long-distance in both directions	weakly deterministic	non-deterministic

Revisiting Weak Determinism

According to Heinz & Lai, liquid dissimilation is weakly deterministic

- no need for new symbols or special coding tricks

/du**r**wa-ŋa**l**in-ŋa**l**/   Input

|du**r**wa-:**r**i-ŋa**l**| Leftward Lateral Dissimilation

[du**r**wa-:**l**i-ŋa**l**]   Rightward Rhotic Dissimilation

Revisiting Weak Determinism

According to Meinhardt et al, liquid dissimilation is non-deterministic

- if you re-order the functions, you get a different output

/durwa-ŋalin-ŋal/   Input

  |durwa-ːri-ŋal| Leftward Lateral Dissimilation

  [durwa-ːli-ŋal]   Rightward Rhotic Dissimilation

/durwa-ŋalin-ŋal/   Input

  |durwa-ːli-ŋal| Rightward Rhotic Dissimilation

  *[durwa-ːri-ŋal]   Leftward Lateral Dissimilation

Revisiting Weak Determinism

Heinz & Lai's (2013) markup-based definition therefore **fails to capture the key computational generalization about functions like double dissimilation.**

Meinhardt et al's interaction-based definition subsumes markup

- all function compositions that require markup also involve interaction

- not all interacting compositions require **abstract** markup

Conclusion

The data on dissimilation in Yidiny makes two major contributions to the formal language theoretic approach to phonology:

➢ From a theoretical perspective, **function interaction** provides a superior way to distinguish weakly deterministic from non-deterministic functions.

   Interaction is more linguistically natural than markup

   Interaction de-tethers expressivity from the size of the alphabet and other irrelevant phonotactic restrictions, which can serve as markup

Lamont et al 2019; O'Hara & Smith 2019; Smith & O'Hara 2019

Conclusion

The data on dissimilation in Yidiny makes two major contributions to the formal language theoretic approach to phonology:

➢ From an empirical perspective, this data expands the range of phonological processes that fall within the class of non-deterministic functions.

   While previous work has shown that tone and vowel harmony can be non-deterministic, dissimilation and consonant harmony have been argued to be less complex.

Thank you!

References

Bennett, William G. 2013. Dissimilation, consonant harmony, and surface correspondence. PhD dissertation, Rutgers University.

Chandlee, Jane. 2014. Strictly local phonological processes. PhD dissertation, University of Delaware.

Dixon, Robert M.W. 1977. *A grammar of Yidin*. Cambridge University Press

Elgot, Calvin C., and Jorge E. Mezei. 1965. On relations defined by generalized finite automata. I*BM Journal of Research and development* 9.1: 47-68.

Heinz, Jeffrey. 2011a. Computational phonology–Part I: Foundations. *Language and Linguistics Compass* 5.4: 140-152.

Heinz, Jeffrey. 2011b. Computational phonology–Part II: Grammars, learning, and the future. *Language and Linguistics Compass* 5.4: 153-168.

Heinz, Jeffrey, and Regine Lai. 2013. Vowel harmony and subsequentiality. In *Proceedings of the 13th Meeting on the Mathematics of Language*, 52-63.

Jardine, Adam. 2016. Computationally, tone is different. *Phonology* 33.2: 247-283.

Johnson, C. Douglas. 1972. *Formal aspects of phonological description*. Mouton.

Kaplan, Ronald M., and Martin Kay. 1994. Regular models of phonological rule systems. *Computational linguistics* 20.3: 331-378.

Lamont, Andrew; Charlie O'Hara; & Caitlin Smith. 2019. Weakly deterministic transformations are subregular. In *Proceedings of the 16th Workshop on Computational Research in Phonetics, Phonology, and Morphology*, pp. 196-205..

Luo, Huan. 2017. Long-distance consonant agreement and subsequentiality. *Glossa: a journal of general linguistics* 2.1

McCollum, Adam G.; Eric Baković; Anna Mai; and Eric Meinhardt. 2020. Unbounded circumambient patterns in segmental phonology. *Phonology* 37.2: 215-255.

Meinhardt, Eric; Anna Mai; Eric Baković; & Adam G. McCollum. 2020. On the proper treatment of weak determinism: Subsequentiality and simultaneous application in phonological maps. https://ling.auf.net/lingbuzz/005565

O'Hara, Charlie, and Caitlin Smith. 2019. Computational complexity and sour-grapes-like patterns. In *Proceedings of the Annual Meeting on Phonology*.

Payne, Amanda. 2017. All dissimilation is computationally subsequential. *Language* 93.4: e353-e371.

Smith, Caitlin, & Charlie O'Hara. 2019. Formal characterizations of true and false sour grapes. In *Proceedings of the Society for Computation in Linguistics* 2.1: 338-341.

Suzuki, Keiichiro. 1998. A typological investigation of dissimilation. PhD dissertation, University of Arizona.

Walsh Dickey, Laura. 1997. The phonology of liquids. PhD dissertation, University of Massachusetts Amherst.

Appendix

Liquid Dissimilation

The examples of dissimilation and blocking presented so far all involve the 'going' aspect [-ŋalin] and the comitative affix [-ŋal].

In general, application of liquid dissimilation is very restricted in Yidiny.

Dissimilation does not take place within a root:

ga**l**ga**l**i	"curlew"
gu**l**bu**l**	"wave"
ŋa**l**a**l**	"big"

Dissimilation also does not take place within verb roots.

nu**l**ga-**l**	"wake up"
da**l**ŋga-**l**	"chop"
landima-**l**	"teach"

Liquid Dissimilation

Dissimilation does not take place in more complex forms of verbs either.

root	gaḷi-n "go"	magi-l "climb up"
comitative	gaḷiŋa-l	magiḷmaŋa-l
past	gaḷi:naḻu	magiḷmaŋa:l
purposive	gaḷiŋaḻna	magiḷmaŋa:lna
dative subord.	gaḷiŋaḻɲu:n	magiḷmaŋaḻɲunda

In fact, this process seems to be restricted to the GOING aspect /-ŋalin/.

magi-:ri-ŋa:l	'climb.up-GOING-COM-PST'
magi:-ri-ŋal	'climb.up-GOING-COM-PRES'
magi:-ri-ŋa:l-na	'climb.up-GOING-COM-PURP'

Rhotic Dissimilation

Rhotic dissimilation does not take place within roots:

birbibirbi	"small flat fish"
buriburi	"old people"
baɽabaɽa	"common fly"

The following two examples show a construction in which a noun is turned into a verb.

Both of these examples have a /r/ in the root noun which does not trigger dissimilation in the following affix.

dirbi	"promise (noun)"
dirbi-dara-l	"promise to do something"
ɲari	"hole in ground"
ɲari-dara-l	"put in hole and cover"

Liquid and Rhotic Dissimilation

Liquid dissimilation takes place in very restricted environments:

- It does not take place within a word
- An /l/ in an affix does not trigger dissimilation in the root

The process seems to only take place when an affix with an /l/ is followed by another affix with an /l/. Due to the nature of the language, the data on dissimilation is therefore limited to the 'going' aspect /-ŋalin/.

Similarly, rhotic dissimilation takes place in very restricted environments. Within the limited data available, it only takes place in exactly the environment produced by liquid dissimilation.

No independent motivation for rhotic dissimilation seems to exist in the data other than to account for dissimilation blocking.