

A formal approach to Romance conjugation

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Introduction

- ▶ My goals today :
 1. Defend a particular view of the structure of Romance conjugation
 - ▶ Bonami and Boyé (2003, 2006); Boyé and Cabredo Hofherr (2006); Montermini and Bonami (2013)
 2. Illustrate the usefulness of formal modelling in morphology, using Paradigm Function Morphology
 - ▶ Stump (2001); Bonami and Stump (2016)
- ▶ I will use mainly French for illustration, but analogous proposals have been made for other Romance languages.
- ▶ This corresponds to a small fraction of questions on Romance morphology that I have looked at :
 1. Quantitative exploration of predictability in paradigms (Bonami and Boyé, 2014; Bonami and Luís, 2014; Bonami and Beniamine, 2016)
 2. Periphrastic conjugation (Bonami and Webelhuth, 2013; Bonami, 2015)
 3. Pronominal clitic order (Bonami and Boyé, 2007; Crysmann and Bonami, 2016)
 4. The organization of word formation systems (Bonami and Crysmann, 2016; Bonami and Strnadová, 2016; Bonami and Thuilier, in preparation)

The central observation

- ▶ In Romance conjugation, diversity of inflectional behavior is mostly located word-internally rather than at the word periphery.

	LAVER 'wash'	ENVOYER 'send'	FINIR 'finish'	BOIRE 'drink'	TENIR 'hold'	CONCLURE 'conclude'
SG	lav	āvwa	fini	bwa	tjě	kōkly
1PL	lavō	āvwaĵō	finisō	byvō	tənō	kōklyō
2PL	lave	āvwaje	finise	byve	təne	kōklye
3PL	lav	āvwa	finis	bwav	tjɛn	kōkly

Present indicative of 6 French verbs

- ▶ It doesn't have to be that way :

	BRÁT 'take'	SPÁT 'sleep'	DĚLAT 'do'
1SG	beru	spím	dělám
2SG	bereš	spíš	děláš
3SG	bere	spí	dělá
1PL	bereme	spíme	děláme
2PL	berete	spíte	děláte
3PL	berou	spí	dělají

The central claim

- ▶ This leads to the following proposal (Boyé, 2000) :
 - ▶ (Almost) all variation of inflectional behavior is reducible to stem allomorphy.
 - ▶ Hence, the system of affixes is remarkably agglutinative (for an Indo-European system).
- ▶ I will substantiate the proposal in three steps
 1. Provide a full description of French regular conjugation.
 2. Describe the rich stem allomorphy.
 3. Show how these two can be addressed together in Paradigm Function Morphology.

French regular conjugation

Regular conjugation

- ▶ We first focus on the first conjugation.
 - ▶ Note that I use standard labels from the Leipzig Glossing Rules to name the tenses

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS	lav	lav	lav	lavĩ	lav ^e	lav
IND.PST.IPFV	lav ^ε	lav ^ε	lav ^ε	lavjĩ	lavje	lav ^ε
IND.PST.PFV	lav ^ε	lava	lava	lavam	lavat	lav ^ε v
IND.FUT	lav ^ə vε	lav ^ə va	lav ^ə va	lav ^ə vĩ	lav ^ə ve	lav ^ə vĩ
COND	lav ^ə vε	lav ^ə vε	lav ^ə vε	lav ^ə vjĩ	lav ^ə je	lav ^ə vε
SBJV.PRS	lav	lav	lav	lavjĩ	lavje	lav
SBJV.PST	lav ^a s	lav ^a s	lava	lav ^a sĩ	lav ^a sje	lav ^a s

- ▶ Constant stem + endings
- ▶ Endings should be segmented into smaller exponents where that leads to generalizations.
- ▶ First issue : what is particular to the first conjugation ?
- ▶ To address this issue, we compare 1st conjugation verbs to the most regular 3rd conjugation verbs.

Regular conjugation

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS	lav	lav	lav	lav-õ	lav-e	lav
IND.PST.IPFV	lav-ε	lav-ε	lav-ε	lav-jõ	lav-je	lav-ε
IND.PST.PFV	lav-ε	lav-a	lav-a	lav-a-m	lav-a-t	lav-ε-ϕ
IND.FUT	lav-ə-ϕε	lav-ə-ϕa	lav-ə-ϕa	lav-ə-ϕõ	lav-ə-ϕe	lav-ə-ϕõ
COND	lav-ə-ϕε	lav-ə-ϕε	lav-ə-ϕε	lav-ə-ϕjõ	lav-ə-ϕje	lav-ə-ϕε
SBJV.PRS	lav	lav	lav	lav-jõ	lav-je	lav
SBJV.PST	lav-a-s	lav-a-s	lav-a	lav-a-sjõ	lav-a-sje	lav-a-s

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS	ẽkly	ẽkly	ẽkly	ẽkly-õ	ẽkly-e	ẽkly
IND.PST.IPFV	ẽkly-ε	ẽkly-ε	ẽkly-ε	ẽkly-jõ	ẽkly-je	ẽkly-ε
IND.PST.PFV	ẽkly	ẽkly	ẽkly	ẽkly-m	ẽkly-t	ẽkly-ϕ
IND.FUT	ẽkly-ϕε	ẽkly-ϕa	ẽkly-ϕa	ẽkly-ϕõ	ẽkly-ϕe	ẽkly-ϕõ
COND	ẽkly-ϕε		ẽkly-ϕε	ẽkly-ϕjõ	ẽkly-ϕje	ẽkly-ϕε
SBJV.PRS	ẽkly	ẽkly	ẽkly	ẽkly-jõ	ẽkly-je	ẽkly
SBJV.PST	ẽkly-s	ẽkly-s	ẽkly	ẽkly-sjõ	ẽkly-sje	ẽkly-s

► red and blue morphs should be separated.

Identifying exponents

- ▶ Comparisons within the table leads to more segmentation wherever some sequence appears in multiple paradigm cells which share some feature.

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS	lav	lav	lav	lav- õ	lav- e	lav
IND.PST.IPFV	lav- ε	lav- ε	lav- ε	lav- j-õ	lav- j-e	lav- ε
IND.PST.PFV	lav- ε	lav- a	lav- a	lav- a-m	lav- a-t	lav- ε-ϕ
IND.FUT	lav- ə-ϕ-ε	lav- ə-ϕ-a	lav- ə-ϕ-a	lav- ə-ϕ-õ	lav- ə-ϕ-e	lav- ə-ϕ-õ
COND	lav- ə-ϕ-ε	lav- ə-ϕ-ε	lav- ə-ϕ-ε	lav- ə-ϕ-j-õ	lav- ə-ϕ-j-e	lav- ə-ϕ-ε
SBJV.PRS	lav	lav	lav	lav- j-õ	lav- j-e	lav
SBJV.PST	lav- a-s	lav- a-s	lav- a	lav- a-s-j-õ	lav- a-s-j-e	lav- a-s

- ▶ In the most complex cases (COND.1PL, COND.2PL, SBJV.PST.1PL, SBJV.PST.2PL) we identify a combination of 4 suffixes.

Identifying exponents

- ▶ When the same affix appears in multiple paradigm cells, we must still decide whether this should be introduced by a single rule or treated as a case of homophony.
- ▶ Easy cases :
 - ▶ The exponent has a clear, coherent distribution.
Examples : 1PL -**ñ**, 2PL -**e**.
 - ▶ The distribution is clearly incoherent.
Example : 1PL-**ñ** ≠ FUT.3PL -**ñ**.
- ▶ Harder cases :
 - ▶ Is there something in common between the subjunctive and the imperfect, licensing the use of the same -**j** (1/2PL)?
 - ▶ Is there something in common between the conditional and the imperfect, licensing the use of the same -**j** (1/2PL)?
 - ▶ Is there something in common between the conditional and the imperfect, licensing the use of the same -**к**?
- ▶ The answer depends on syntactic and semantic analysis.

Conditional, future and imperfect I

- ▶ The conditional seems to combine exponents otherwise used in the future and imperfect.
- ▶ As it happens, the conditional **does** have a distribution that has something to do with both that of the future and that of the imperfect (Verkuyl et al., 2004).

- (1) a. Paul pense_{PRS} que Marie viendra_{FUT}.
'Paul thinks that Marie will come.'
b. Paul pensait_{PST.IPFV} que Marie viendrait_{COND}.
'Paul thought that Marie would come.'
- (2) a. Si Paul vient_{PRS}, Marie sera_{FUT} contente.
'If Paul comes, Marie will be happy.'
b. Si Paul venait_{PST.IPFV}, Marie serait_{COND} contente.
'If Paul came, Marie would be happy.'

Conditional, future and imperfect II

- ▶ This suggests a two-feature analysis of the tense system (Bonami and Boyé, 2007) :
 - ▶ Type of reference point : deictic (grounded in the speech situation), anaphoric.
 - ▶ Tense proper : temporal position with respect to the reference point.

	{TNS <i>pst</i> }	{TNS <i>prs</i> }	{TNS <i>fut</i> }
{REF <i>deictic</i> }	« passé simple »	« présent »	« futur »
{REF <i>anaphoric</i> }	« plus que parfait »	« imparfait »	« conditionnel »

The form and distribution of stem allomorphy

The paradigm of *laver* ‘wash’

Finite forms

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS.DEIC	lav	lav	lav	lav -õ	lav -e	lav
IND.PRS.ANA	lav -ε	lav -ε	lav -ε	lav -jõ	lav -je	lav -ε
IND.FUT.DEIC	lav -əβε	lav -əβα	lav -əβα	lav -əβõ	lav -əβε	lav -əβõ
IND.FUT.ANA	lav -əβε	lav -əβε	lav -əβε	lav -əβjõ	lav -əβje	lav -əβε
IND.PST.DEIC	lav -ε	lav -a	lav -a	lav -m	lav -t	lav -εβ
SBJV.PRS	lav	lav	lav	lav -jõ	lav -je	lav
SBJV.PST	lav -as	lav -as	lav -a	lav -asjõ	lav -asje	lav -as
IMP	—	lav	—	lav -õ	lav -e	—

Nonfinite forms

INF	PRS.PTCP	PST.PTCP			
		M.SG	F.SG	M.PL	F.PL
lav -e	lav -ã	lav -e	lav -e	lav -e	lav -e

The paradigm of *finir* 'finish' : 2 stems

Finite forms

TEMPS	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS.DEIC	<i>fini</i>	<i>fini</i>	<i>fini</i>	<i>finis</i> -õ	<i>finis</i> -e	<i>finis</i>
IND.PRS.ANA	<i>finis</i> -ε	<i>finis</i> -ε	<i>finis</i> -ε	<i>finis</i> -jõ	<i>finis</i> -je	<i>finis</i> -ε
IND.FUT.DEIC	<i>fini</i> -βε	<i>fini</i> -βα	<i>fini</i> -βα	<i>fini</i> -βõ	<i>fini</i> -βε	<i>fini</i> -βõ
IND.FUT.ANA	<i>fini</i> -βε	<i>fini</i> -βε	<i>fini</i> -βε	<i>fini</i> -βjõ	<i>fini</i> -βje	<i>fini</i> -βε
IND.PST.DEIC	<i>fini</i>	<i>fini</i>	<i>fini</i>	<i>fini</i> -m	<i>fini</i> -t	<i>fini</i> -β
SBJV.PRS	<i>finis</i>	<i>finis</i>	<i>finis</i>	<i>finis</i> -jõ	<i>finis</i> -je	<i>finis</i>
SBJV.PST	<i>fini</i> -s	<i>fini</i> -s	<i>fini</i>	<i>fini</i> -sjõ	<i>fini</i> -sje	<i>fini</i> -s
IMP	—	<i>fini</i>	—	<i>finis</i> -õ	<i>finis</i> -e	—

Nonfinite forms

INF	PRS.PTCP	PST.PTCP			
		M.SG	F.SG	M.PL	F.PL
<i>fini</i> -β	<i>finis</i> -ã	<i>fini</i>	<i>fini</i>	<i>fini</i>	<i>fini</i>

The paradigm of *boire* 'drink' : 4 stems

Finite forms

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS.DEIC	bwa	bwa	bwa	byv -ĩ	byv -e	bwav
IND.PRS.ANA	byv -ε	byv -ε	byv -ε	byv -jĩ	byv -je	byv -ε
IND.FUT.DEIC	bwa -βε	bwa -βα	bwa -βα	bwa -βĩ	bwa -βε	bwa -βĩ
IND.FUT.ANA	bwa -βε	bwa -βε	bwa -βε	bwa -βjĩ	bwa -βje	bwa -βε
IND.PST.DEIC	by	by	by	by -m	by -t	by -β
SBJV.PRS	bwav	bwav	bwav	byv -jĩ	byv -je	bwav
SBJV.PST	by -s	by -s	by	by -sjĩ	by -sje	by -s
IMP	—	bwa	—	byv -ĩ	byv -e	—

Nonfinite forms

INF	PRS.PTCP	PST.PTCP			
		M.SG	F.SG	M.PL	F.PL
bwa -β	byv -ã	by	by	by	by

The paradigm of *mourir* : 5 stems

Finite forms

TEMPS	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS.DEIC	mœʁ	mœʁ	mœʁ	mυʁ-ɔ̃	mυʁ-e	mœʁ
IND.PRS.ANA	mυʁ-ε	mυʁ-ε	mυʁ-ε	mυʁ-jɔ̃	mυʁ-je	mυʁ-ε
IND.FUT.DEIC	mυʁ-βε	mυʁ-βa	mυʁ-βa	mυʁ-βɔ̃	mυʁ-βε	mυʁ-βɔ̃
IND.FUT.ANA	mυʁ-βε	mυʁ-βε	mυʁ-βε	mυʁ-βjɔ̃	mυʁ-βje	mυʁ-βε
IND.PST.DEIC	mυʁy	mυʁy	mυʁy	mυʁy-m	mυʁy-t	mυʁy-ʁ
SBJV.PRS	mœʁ	mœʁ	mœʁ	mυʁ-jɔ̃	mυʁ-je	mœʁ
SBJV.PST	mυʁy-s	mυʁy-s	mυʁy	mυʁy-sjɔ̃	mυʁy-sje	mυʁy-s
IMP	—	mœʁ	—	mυʁ-ɔ̃	mυʁ-e	—

Nonfinite forms

INF	PRS.PTCP	PST.PTCP			
		M.SG	F.SG	M.PL	F.PL
mυʁi-ʁ	mυʁ-ã	mɔʁ	mɔʁ-t	mɔʁ	mɔʁ-t

Stem spaces I

- ▶ Overall, the paradigm can be divided in 12 zones that always rely on the same stem allomorph.

Index	Zone	LAVÉR	FINIR	MOURIR	BOIRE	ALLER
1	IMPERFECT, PRESENT 1/2PL	lav	finis	muy	byv	al
2	PRESENT 3PL	lav	finis	mœv	bwav	võ
3	PRESENT SG	lav	fini	mœv	bwa	va
4	PRESENT PARTICIPLE	lav	finis	muy	byv	al
5	IMPERATIVE 2SG	lav	fini	mœv	bwa	va
6	IMPERATIVE 1/2PL	lav	finis	muy	byv	al
7	PRS. SUBJUNCTIVE SG & 3PL	lav	finis	mœv	bwav	aj
8	PRS. SUBJUNCTIVE 1/2PL	lav	finis	muy	byv	al
9	INFINITIVE	lav	fini	muyi	bwa	al
10	FUTURE/CONDITIONAL	lav	fini	muy	bwa	i
11	INDICATIVE SIMPLE PAST, PAST SUBJUNCTIVE	lav	fini	muyv	by	al
12	PAST PARTICIPLE	lav	fini	mœv	by	al

Stem spaces II

- ▶ Any verb only ever uses a maximum of 6 distinct stems, but these 6 stems can be distributed in different ways in the 12 zones.
- ▶ Knowing how to inflect a French verb amounts to knowing which stem is used in each of the 12 zones.
- ▶ This inventory of 12 stems is called the STEM SPACE of a verb.
- ▶ The structure of the stem space is **morphomic** : stem alternants typically do not express any coherent set of properties.
- ▶ There are constraints on ways of filling the stem space : not all combinations are attested.
- ▶ The same types of generalizations hold for other Romance languages
 - ▶ Boyé and Cabredo Hofherr (2006) on Spanish.
 - ▶ Montermini and Boyé (2012) and Montermini and Bonami (2013) on Italian.
 - ▶ Guerrero (2011, 2014) on Catalan.

Constant inflection

- ▶ We are now very close to a description of French conjugation where all inflectional variability is located in the stem space.

Finite forms						
	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS.DEIC	3	3	3	1- $\tilde{3}$	1-e	2
IND.PRS.ANA	1- ϵ	1- ϵ	1- ϵ	1-j $\tilde{3}$	1-je	1- ϵ
IND.FUT.DEIC	10- $\text{b}\epsilon$	10- $\text{b}\alpha$	10- $\text{b}\alpha$	10- $\text{b}\tilde{3}$	10- $\text{b}\epsilon$	10- $\text{b}\tilde{3}$
IND.FUT.ANA	10- $\text{b}\epsilon$	10- $\text{b}\epsilon$	10- $\text{b}\epsilon$	10- $\text{b}\text{j}\tilde{3}$	10- $\text{b}\text{j}\epsilon$	10- $\text{b}\epsilon$
IND.PST.DEIC	11	11	11	11-m	11-t	11- b
SBJV.PRS	7	7	7	8-j $\tilde{3}$	8-je	7
SBJV.PST	11-s	11-s	11	11-sj $\tilde{3}$	11-sje	11-s
IMPÉRATIF	—	5	—	6- $\tilde{3}$	6-e	—

Nonfinite forms					
INF	PRS.PTCP	PST.PTCP			
		M.SG	F.SG	M.PL	F.PL
9- b	4- $\tilde{\alpha}$	12	12	12	12

Suppletive inflected forms

- ▶ 6 forms of 3 hyper-frequent lexemes have unexpected endings.

FORME	ÊTRE	FAIRE	DIRE
PRS.1PL	som		
PRS.2PL	et	fet	dit
IMP.2PL		fet	dit

- ▶ These are seen as unanalysable **suppletive inflected forms** that speakers need to learn by rote.
- ▶ Also treating the following 3 forms as suppletive avoids positing a 13th slot in the stem space.

FORME	ÊTRE	AVOIR	ALLER
PRS.1SG	sɥi	ɛ	vɛ

The residue

- ▶ The only remaining variability is found in 1st conjugation verbs.

Finite forms

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS.DEIC	lav	lav	lav	lav -õ	lav -e	lav
IND.PRS.ANA	lav -ε	lav -ε	lav -ε	lav -jõ	lav -je	lav -ε
IND.FUT.DEIC	lav -əβε	lav -əβα	lav -əβα	lav -əβõ	lav -əβε	lav -əβõ
IND.FUT.ANA	lav -əβε	lav -əβε	lav -əβε	lav -əβjõ	lav -əβje	lav -əβε
IND.PST.DEIC	lav -ε	lav -a	lav -a	lav -a-m	lav -a-t	lav -εβ
SBJV.PRS	lav	lav	lav	lav -jõ	lav -je	lav
SBJV.PST	lav -a-s	lav -a-s	lav -a	lav -a-sjõ	lav -a-sje	lav -a-s
IMP	—	lav	—	lav -õ	lav -e	—

Nonfinite forms

INF	PRS.PTCP	PST.PTCP			
		M.SG	F.SG	M.PL	F.PL
lav -e	lav -ã	lav -e	lav -e	lav -e	lav -e

Revised analysis : Regular stem allomorphy

- ▶ Apparent suffixes are really part of the stem.
- ▶ First conjugation verbs have 4 distinct stems.

Finite forms

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS.DEIC	lav	lav	lav	lav-õ	lav-e	lav
IND.PRS.ANA	lav-ε	lav-ε	lav-ε	lav-jõ	lav-je	lav-ε
IND.FUT.DEIC	lavə-βε	lavə-βα	lavə-βα	lavə-βõ	lavə-βε	lavə-βõ
IND.FUT.ANA	lavə-βε	lavə-βε	lavə-βε	lavə-βjõ	lavə-βje	lavə-βε
IND.PST.DEIC	lavε	lava	lava	lava-m	lava-t	lavε-β
SBJV.PRS	lav	lav	lav	lav-jõ	lav-je	lav
SBJV.PST	lava-s	lava-s	lava	lava-sjõ	lava-sje	lava-s
IMP	—	lav	—	lav-õ	lav-e	—

Nonfinite forms

INF	PRS.PTCP	PST.PTCP			
		M.SG	F.SG	M.PL	F.PL
lavε-β	lav-õ	lave	lave	lave	lave

Two remaining issues

- ▶ Nonrealisation of final /-ʁ/ in the infinitive in the 1st conjugation is due to regular phonology : word-final /-eʁ/ sequences are illegal in French, leading to consonant deletion.
- ▶ Vowel alternations in the simple past can be attributed to a non-concatenative morphological process akin to German umlaut :
`raise(s)` : if the final vowel of sequence *s* is low, make it mid-level

Since second and third conjugation past stems never end in /a/, the function `raise` has no effect.

- ▶ `raise(lava)` = `lavε`
- ▶ `raise(finι)` = `finι`
- ▶ `raise(kuʁy)` = `kuʁy`

A Paradigm Function Morphology formalisation

Introduction

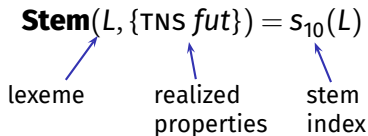
- ▶ We now have a conceptually clear analysis of French conjugation.
- ▶ However :
 - ▶ We would like to be sure that the analysis is complete in every detail.
 - ▶ We would like for computational implementations of the analysis to be simple.
 - ▶ We would like to be able to place the system under examination in a broad typological context.
- ▶ All these goals call for the design of a formalized analysis.

Paradigm Function Morphology

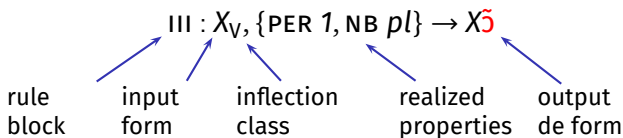
- ▶ Formal theory of morphology designed by Gregory Stump and associates in the past 25 years.
- ▶ See Bonami and Stump (2016) for an up-to-date synopsis.
- ▶ Main design properties :
 1. Word and Paradigm approach : words are not analyzed as combinations of morphemes, but as the result of the application of rules to deduce surface forms from a lexical entry.
 2. Embraces non-concatenative morphology : no formal difference between rules that add an affix and rules that effect some other kind of change.
 3. Accounts for position class morphology : affixes tend to be organized in strictly ordered classes of mutually exclusive markers.
 4. Embraces Paṇīni's Principle : given two alternative ways of expressing some property, choose the more specific one.

Three kinds of inflection rules

1. Rules of stem choice : indicate which of an array of different stems are to be used in a particular morphosyntactic context.



2. Rules of exponence : indicate what function should be applied to a stem to express some set of morphosyntactic properties



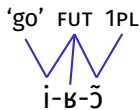
3. Rules of referral : indicate that some set of morphosyntactic properties is realised in the same way one would realize another set of morphosyntactic properties.

Paṇinian competition

- ▶ Both rules of stem choice and rules of exponence are subject to **Paṇinian competition** : given a choice between two rules, one uses the more restricted of the two.
- ▶ Example in stem selection :
 - ▶ **Stem**($L, \{\}$) = $s_1(L)$
 - ▶ **Stem**($L, \{\text{TNS fut}\}$) = $s_{10}(L)$
- ▶ Example in exponence :
 - ▶ III : $X_V, \{\text{PER 1, NB pl}\} \rightarrow X\tilde{\text{c}}$
 - ▶ III : $X_V, \{\text{TNS pst, REF deic, PER 1, NB pl}\} \rightarrow X\text{m}$

Rule blocks

- ▶ Any approach to inflection must account for the fact that :
 1. some affixes stand in paradigmatic opposition (one or the other gets realized), but
 2. some affixes must co-occur in the same word, and
 3. these affixes may even partly express the same things (overlapping exponence)



- ▶ In Paradigm Function Morphology, this is done using **rule blocks** (Anderson, 1992) :
 - ▶ Every rule belongs to some strictly ordered block
 - ▶ Rules within a block compete under Paṇinian competition.
 - ▶ Rules in different blocks do not compete.
 - ▶ Every block contains an **Identity Function Default** rule :

$$X, \{ \} \rightarrow X$$

“If no more specific rule applies, do nothing.”

Back to French conjugation (finite forms)

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS.DEIC	lav	lav	lav	lav-ṽ	lav-e	lav
IND.PRS.ANA	lav-ε	lav-ε	lav-ε	lav-j-ṽ	lav-j-e	lav-ε
IND.FUT.DEIC	lavə-β-ε	lavə-β-a	lavə-β-a	lavə-β-ṽ	lavə-β-e	lavə-β-ṽ
IND.FUT.ANA	lavə-β-ε	lavə-β-ε	lavə-β-ε	lavə-β-j-ṽ	lavə-β-j-e	lavə-β-ε
IND.PST.DEIC	lavε	lava	lava	lava-m	lava-t	lavε-β
SBJV.PRS	lav	lav	lav	lav-j-ṽ	lav-j-e	lav
SBJV.PST	lava-s	lava-s	lava	lava-s-j-ṽ	lava-s-j-e	lava-s
IMP	—	lav	—	lav-ṽ	lav-e	—

- ▶ 3 rule blocks are required (witness IND.FUT.ANA and SBJV.PST 1/2PL).
- ▶ The remaining exponents must be placed in blocks so as to allow appropriate application of Paṇīnian competition.

One optimal block assignment

I	II	III
$\mathfrak{v} : \{\text{fut}\}$	$\varepsilon : \{\text{ana}\}$	$\tilde{\mathfrak{o}} : \{\text{1pl}\}$
$\mathfrak{s} : \{\text{sbjv pst}\}$	$\mathfrak{j} : \{\text{ana 1pl}\}$	$\mathfrak{e} : \{\text{2pl}\}$
$\text{—} : \{\text{sbjv pst 3sg}\}$	$\mathfrak{j} : \{\text{ana 2pl}\}$	$\mathfrak{m} : \{\text{deic pst 1pl}\}$
	$\mathfrak{j} : \{\text{sbjv 1pl}\}$	$\mathfrak{t} : \{\text{deic pst 2pl}\}$
	$\mathfrak{j} : \{\text{sbjv 2pl}\}$	$\mathfrak{v} : \{\text{deic pst 3pl}\}$
	$\text{raise} : \{\text{deic pst 1sg}\}$	$\mathfrak{a} : \{\text{deic fut sg}\}$
	$\text{raise} : \{\text{deic pst 3pl}\}$	$\varepsilon : \{\text{deic fut 1sg}\}$
		$\tilde{\mathfrak{o}} : \{\text{deic fut 3pl}\}$

► Notes :

- A few choices are motivated only by keeping blocks as coherent as possible.
- There is a residue of exponents with a **morphomic distributions** : they are used in a collection of cells that do not form a natural class.
- This is captured by simply having multiple rules with the same phonological effect.

(3) Stem selection

- a. **Stem**($L, \{ \}$) = $s_1(L)$
- b. **Stem**($L, \{\text{TNS } pst\}$) = $s_{11}(L)$
- c. **Stem**($L, \{\text{TNS } fut\}$) = $s_{10}(L)$
- d. **Stem**($L, \{\text{TNS } prs, \text{MOOD } sbjv\}$) = $s_7(L)$
- e. **Stem**($L, \{\text{TNS } prs, \text{MOOD } sbjv, \text{NB } pl, \text{PER } 1\}$) = $s_8(L)$
- f. **Stem**($L, \{\text{TNS } prs, \text{MOOD } sbjv, \text{NB } pl, \text{PER } 2\}$) = $s_8(L)$
- g. **Stem**($L, \{\text{TNS } prs, \text{REF } deic, \text{NB } sg\}$) = $s_3(L)$
- h. **Stem**($L, \{\text{TNS } prs, \text{REF } deic, \text{NB } pl, \text{PER } 3\}$) = $s_2(L)$
- i. **Stem**($L, \{\text{MOOD } imp\}$) = $s_6(L)$
- j. **Stem**($L, \{\text{MOOD } imp, \text{NB } sg\}$) = $s_5(L)$

(4) Bloc I :

- a. $I : X_v, \{\text{TNS } fut\} \rightarrow X\mathbf{b}$
- b. $I : X_v, \{\text{MOOD } sbjv, \text{TNS } pst\} \rightarrow X\mathbf{s}$
- c. $I : X_v, \{\text{MOOD } sbjv, \text{TNS } pst, \text{PER } 3, \text{NB } sg\} \rightarrow X$

(5) **Bloc II :**

- a. II : $X_v, \{\text{REF ana}\} \rightarrow X\epsilon$
- b. II : $X_v, \{\text{REF ana, PER 1, NB pl}\} \rightarrow Xj$
- c. II : $X_v, \{\text{REF ana, PER 2, NB pl}\} \rightarrow Xj$
- d. II : $X_v, \{\text{MOOD sbjv, PER 1, NB pl}\} \rightarrow Xj$
- e. II : $X_v, \{\text{MOOD sbjv, PER 2, NB pl}\} \rightarrow Xj$
- f. III : $X_v, \{\text{TNS pst, REF deic, PER 1, NB sg}\} \rightarrow \text{raise}(X)$
- g. III : $X_v, \{\text{TNS pst, REF deic, PER 3, NB pl}\} \rightarrow \text{raise}(X)$

(6) a. **Bloc III :** III : $X_v, \{\text{PER 1, NB pl}\} \rightarrow X\bar{5}$

- b. III : $X_v, \{\text{PER 2, NB pl}\} \rightarrow Xe$
- c. III : $X_v, \{\text{TNS fut, REF deic, NB sg}\} \rightarrow Xa$
- d. III : $X_v, \{\text{TNS fut, REF deic, PER 1, NB sg}\} \rightarrow X\epsilon$
- e. III : $X_v, \{\text{TNS fut, REF deic, PER 3, NB pl}\} \rightarrow X\bar{5}$
- f. III : $X_v, \{\text{TNS pst, REF deic, PER 1, NB pl}\} \rightarrow Xm$
- g. III : $X_v, \{\text{TNS pst, REF deic, PER 2, NB pl}\} \rightarrow Xt$
- h. III : $X_v, \{\text{TNS pst, REF deic, PER 3, NB pl}\} \rightarrow X\bar{b}$

(7) Suppletive inflected forms

- a. III : X_{aller} , {TNS *prs*, REF *deic*, PER 1, NB *sg*} → **vε**
- b. III : X_{aller} , {TNS *prs*, REF *deic*, PER 3, NB *pl*} → **vĩ**
- c. III : X_{avoir} , {TNS *prs*, REF *deic*, PER 1, NB *sg*} → **ε**
- d. III : X_{avoir} , {TNS *prs*, REF *deic*, PER 3, NB *pl*} → **ĩ**
- e. III : X_{dire} , {TNS *prs*, REF *deic*, PER 2, NB *pl*} → **dit**
- f. III : X_{dire} , {MOOD *imp*, PER 2, NB *pl*} → **dit**
- g. III : $X_{\text{être}}$, {TNS *prs*, REF *deic*, PER 1, NB *sg*} → **suj**
- h. III : $X_{\text{être}}$, {TNS *prs*, REF *deic*, PER 1, NB *pl*} → **som**
- i. III : $X_{\text{être}}$, {TNS *prs*, REF *deic*, PER 2, NB *pl*} → **εt**
- j. III : $X_{\text{être}}$, {TNS *prs*, REF *deic*, PER 3, NB *pl*} → **sĩ**
- k. III : X_{faire} , {TNS *prs*, REF *deic*, PER 2, NB *pl*} → **fεt**
- l. III : X_{faire} , {MOOD *imp*, PER 2, NB *pl*} → **fεt**
- m. III : X_{faire} , {TNS *prs*, REF *deic*, PER 3, NB *pl*} → **fĩ**

Conclusions : PFM analysis of French conjugation

- ▶ We confirmed formally the feasibility of an analysis of French conjugation with no affixal inflection class distinctions.
- ▶ The analysis highlights the presence in French of formal means of expressions rarely discussed in the Romance context :
 1. Position class morphology
 2. Umlaut
- ▶ The simplicity of the inflectional system proper combines with a high complexity of constraints on the stem space.

Conclusion : more results, new questions

- ▶ The analysis presented here corresponds to the state of the art about 10 years ago.
- ▶ More recent developments :
 - ▶ Psycholinguistic confirmation (Bonami et al., 2008) : speakers do not differentiate the first and second conjugation in terms of regularity.
 - ▶ The same types of stem allomorphy also play a crucial role in derivation and compounding (Bonami et al., 2009).
 - ▶ The present analysis can readily be combined with an analysis of periphrastic conjugation (Bonami, 2015).
 - ▶ Cysmann and Bonami (2016) presents IbM, a new theory derived from PFM and which accounts for variable ordering of affixes, as found with Romance pronominal clitics.
 - ▶ Quantitative studies of raw inflectional paradigms (e.g Bonami and Beniamine, 2016) : there is more structure in Romance conjugation systems than can be assessed using formal approaches such as the one presented here.

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Exercise : Spanish I

Assume that Spanish verbs have a basic stem ending in a theme vowel : **ama** for AMAR, **teme** for TEMER, **parti** for PARTIR.

Using the following tables, identify exponents valid for all three conjugation classes, and establish the distribution and identity of stem alternants for each verb. Then write a set of PFM rules that accounts for the data.

Note that the data is simplified in three ways : we work with orthography rather than phonology, stress is ignored, and some tenses are omitted.

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS	amo	amas	ama	amamos	amais	aman
IND.PST.IPFV	amaba	amabas	amaba	amabamos	amabais	amaban
IND.PST.PFV	ame	amaste	amo	amamos	amasteis	amaron
COND	amaria	amarias	amaria	amariamos	amariais	amarian
SBJV.PRS	ame	ames	ame	amemos	ameis	amen
SBJV.PST	amara	amaras	amara	amaramos	amarais	amaran
SBJV.FUT	amare	amares	amare	amáremos	amareis	amaren

Exercise : Spanish II

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS	temo	temes	teme	tememos	temeis	temen
IND.PST.IPFV	temia	temias	temia	temiamos	temiais	temian
IND.PST.PFV	temi	temiste	temio	temimos	temisteis	temieron
IND.FUT	temere	temeras	temera	temeremos	temereis	temeran
SBJV.PRS	tema	temas	tema	temamos	temais	teman
SBJV.PST	temiera	temieras	temiera	temieramos	temierais	temieran
SBJV.FUT	temiere	temieres	temiere	temieremos	temiereis	temieren

	1SG	2SG	3SG	1PL	2PL	3PL
IND.PRS	parto	partes	parte	partimos	partis	parten
IND.PST.IPFV	partia	partias	partia	partiamos	partiais	partian
IND.PST.PFV	parti	partiste	partio	partimos	partisteis	partieron
IND.FUT	partire	partiras	partira	partiremos	partireis	partiran
SBJV.PRS	parta	partas	parta	partamos	partais	partan
SBJV.PST	partiera	partieras	partiera	partieramos	partierais	partieran
SBJV.FUT	partiere	partieres	partiere	partieremos	partiereis	partieren