The Initial Accent in a model of French Prosody

Implications for research in psycho- and neurolinguistics

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Issues

- Marginal status of French accentuation
  - Few studies on French prosody (compared to English)
  - Models of speech processing based on English or prosodically similar languages
  - French is absent from models on speech comprehension (Cutler et al. 1997)
- Important implications for
  - Lexical access and speech segmentation in French
  - Phonological representation
    - Lexical marking?

Traditional view of French Prosody

- Syllabic isochrony
- Non-lexical final accent
  - Lengthening
  - Iambic meter
- Congruency accentuation / prosodic boundaries
  - Language 'without accent' (Rossi, 1980)
  - 'Boundary language' (Vaissiere, 1990; Beckman, 1992)

➢ Rare or no account in cognitive models of role of prosody in French (Cutler et al, 1997)

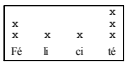
An alternative view on French prosody

Studies on spontaneous speech

- Dual rhythmic and accentual identity of French
  - Coexistence of syllabic rhythm (syllable timing) and accentual rhythm (rhythmic groups regularity) (Wenk & Wioland, 1984; Fant et al., 1991)
  - Coexistence of the traditional final accentuation (lengthening) and an initial accentuation (pitch) (Fonagy, 1980)

A model of French Accentuation (Di Cristo, 1999)

- Principle of Bipolarisation and Edge Promotion (Fraisse, 1967; Hyman, 1975; Fonagy, 1980; Bolinger, 1989)
- Word marked by an Initial and a Final accent {IA/FA}



- IA 'secondary' vs. FA 'primary'
- Discourse and rhythmic constraints
  - IA => Emphatic accent (EMP) ('Hyper' surface realization: Rossi, 1981; Lindblom, 1990)
  - FA => Nuclear accents

Relevance of the model

- Accentuation in the domain of the lexical word
- IA belongs to the metric structure of French
- IA ≠ Emphatic accent
- {IA-FA} = 'accentual arches' (Fonagy, 1980)
  - Bipolar, cohesive marking of lexical or sense units

Validation of the model

(Astésano, 2001)

- Aim
  - Phonological validation of accentual invariants through stylistic variability
  - Quantitative account of phonetic characteristics of stress in French
- Material
  - 3 speaking styles (Reading, News, Interview)
  - ➢ Stylistic 'continuum', 'spontaneity' scale (Eskenazi, 1993)

Methodology

- Perceptual localization of prominence (3 experts)
  - Marking of 1) prominence, 2) degrees of boundary, and 3) focus
- Durational correlates of prominence
  - Syllabic
  - Infra-syllabic (Campbell, 1992)
- Dynamic local F0 variations
  - Tonal configurations (F0 slopes) ('t'Hart et al., 1990)
- Temporal organisation of prominence
  - Syllables vs. Stress groups variance (Wenk & Wioland, 1984;Fant et al., 1991)

Duration - *Results*

- Duration helps signal the information structure (boundaries, prominence)
  - Left (Initial) and right (Final) prominence ≈ degree of prosodic boundary
- Differential lengthening of syllabic Onset and Rime distinguish Initial and final prominence (Campbell, 1992 and foll. For English; Fant et al., 1991, for Swedish and French; Astésano et al., 1995, for French; Hofhuis, 1993, for Dutch)
  - Initial prominence => Onset > Rime
  - Final prominence => Rime > Onset

Tonal configurations - *Results*

Functional distinction

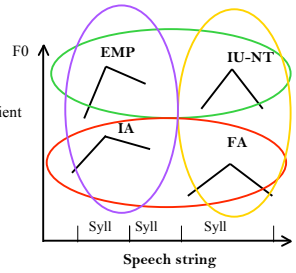
Semantico-pragmatic ≠ Word level

> F0 and < syllabic span => more salient

Distributional distinction

Word-Initial (IA, EMP) : Asymmetric Configurations

Word-Final (FA, IU-N): Symmetric Configurations



Temporal organisation of prominence - *Results*

- Prominence every 3 or 4 syllables (see Delais, 1994)
  - {-FA} ~ 3.4 syllables
  - {IA-FA} ~ 5 syllables (longer words or clitic groups)
  - ↪ Rhythmic function of IA
- Variation coefficient (σ/mean ms):
  - UN syll. 38% vs. {- FA} 33% vs. {IA-FA} 25%
  - ↪ Spontaneous speech (46% vs. 36.5% vs. 26.5%)

➢ Accentual rhythm more salient than syllabic rhythm

- 'Accentual arches' {IA-FA} = relevant phonological unit

Discussion of the results

- Validation of the functional and distributional distinction of prominence
  - Functional: semantic-pragmatic accents ≠ lexical word accents
  - Distributional: IA ≠ FA
- Quantified data ***on continuous, non controlled speech***
  - Core linguistic system, whatever the speaking style
  - Robust results that can be implemented in models of speech technologies

IA

- IA ≠ EMP
- Central role in description of accentual system in French: {IA-FA}
  - ➢ Spontaneous speech

Comparison with existing models

- Jun & Fougeron (2000)
  - IA is a left boundary marker of sense units
- Post (2000)
  - IA's tonal characteristics (H & L tones' alignment) tend to indicate IA is a 'pitch accent'
- Welby (2004 & following)
  - IA is not a pitch accent but rather a 'loosely-attached' marker of left boundary, that does not belong to the domain of the lexical word

Comparison with existing models

- 'Accentual arches' {IA-FA} ~ comparable to [LHiLH*] AP (Jun & Fougeron, 2000)
  - Cohesive unit : similar form of F0 movements (Jun & Fougeron, 1995)
  - Similar size (4 syllables or more)
  - Hi (may) mark onset of first lexical word in AP
- But …
  - AP (lowest tonal unit) => more than one lexical word
    - Minor or Major Phrase? (Selkirk, 1981)
  - AP ~ 'prosodic word' (Vaissiere, 1992) or 'syntagme prosodique' (Vaissiere, 1997), 'intoneme mineur' (Rossi, 1985), 'intonation groups' (Mertens, 1993)…

➢ How does Hi occurrence depend on AP structure?

Question…

More precisely,

How can we predict IA occurrence?

Structural influence on IA placement

(Astesano, Bard & Turk, 2007: *Language & Speech, 50 (3), 423-446*)

1. What type of structure influences IA placement?
   a. Syntactic constituent structure?
   b. Prosodic constituent structure?

✓ In either case, what level of structure does IA mark?

Design

1. Structure type
   a. To test for syntactic effects
      - Vary structures assigned to same string of words e.g. '*Old men and women*' has 2 possible readings.
   b. To test for prosodic effects
      - Vary length of N2 and A (1-4 syllables)

✓ If IA occurrence influenced by *syntactic* structure => Syntax effect ; no Length effect

✓ If IA occurrence influenced by *prosodic* structure => Syntax effect + Length effect

Materials

- Phonetically controlled material

Nouns (N2)	Adjectives
Bas	lisses/ licites/ licencieux/ libérateurs
Balises	vertes/ vermeilles/ verticales/ vertigineuses
Balivernes	sottes/ saumâtres/ saugrenues/ somnambuliques
Baratineurs	fades/ fameux/ fabuleux/ fabulateurs

- 4 different sets of sentences each containing 64 sentences.
- Target Phrases embedded in carrier sentences

Speakers and Procedure

- Instructions to deliver each meaning/structure
- All sentences read in both scopes 3 times.
- 6 native speakers of French

Methodology

- To diagnose IA on N2 and A
  - Used an automatic F0 peak detection algorithm on smoothed f0 contours (Hirst & Espesser, 1993)
- We assume that F0 Turning Points correspond to pitch accents (Ladd, 1996)

➢ 1296 sentences

Results

- Structural effect – (i)

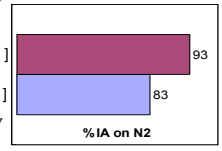
a. Syntactic effect

Do speakers use IA to mark the beginning of syntactic constituents?

[…] [N2 A]

[… N2] [A]

F (1, 71) = 18.27
P = .00059



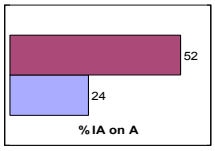
✓ *Yes*

More IA at onset of syntactic constituent than elsewhere

[… N2] [A]

[…] [N2 A]

F (1, 213) = 110.46
P < .0001



Results

- Structural effect - (ii)

b.Prosodic effect

If prosodic constituents influence IA occurrence, we expect to see effects of constituent length in addition to syntactic effects.

- Broad scope: […N2] [A]
  - More IA on longer A (*F* (2, 426)= 45.8; *p* < .0001)
- Narrow scope: [N2 A]
  - More IA on N2 in longer [N2 + A]
    (R^2 = .02; *F* (1, 646)= 10.8; *p* = .001)

➢ *More IA at syntactic boundaries at onset of long constituents*

Results

- Structural effect - (iii)

In addition, IA on long constituents in some cases when syntax does not predict them

- Broad scope : […N2] [A]
  - More IA on longer N2 (*F* (2, 142)= 27.3; *p* < .0001)
- Narrow scope : [N2 A]
  - More IA on longer A
    (R^2 = .05; *F* (1, 646) = 35.4; *p* < .0001)

➢ 'breaks' the [N2 + A] unit in 2 (phonological) phrases

Results

- Structural effect - (iv)

- Is IA's incidence on longer units just a rhythmic effect or is IA really attracted by preceding prosodic boundaries?
- N2 lengthening as an independent indication of boundary
  - ✓ Presence of IA on A is correlated to pre-boundary lengthening of monosyllabic N2

➢ *Tends to be a prosodic boundary before IA.*

Summary

- Structural effect -

- More IA at syntactic boundaries
- More IA at onsets of long constituents
- Long words can induce a preceding prosodic boundary in some cases when syntax does not predict it

➢ *IA is a marker of* prosodic *structure*

Results

- Prosodic level marking -

2. What level of *Prosodic* structure does IA mark?
   - IA applies syntactic phrase medially
     - ✓ Mostly at onset of single *nouns*: […N2] (83%) and [N2+A] (93%)
     - ✓ But less on *A* in [N2 + A] units (24%)

➢ The lowest level of prosodic structure that IA marks is the Minor Phrase

Conclusion of Structural marking of IA

✓ IA in French marks *prosodic* rather than purely syntactic constituent structure

✓ IA has similar role as English 'early' accent but appears to work at a lower level, i.e. the Minor Phrase.

Summary on IA placement and characteristics

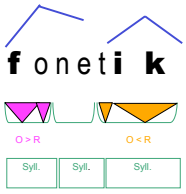
- Marks small speech units
  - Minor Phrases: Noun (+ Adj.)
- Left marker of prosodic structure and lexical word
  - Durational pattern: Onset > Rime
  - F0 pattern: Asymmetric tonal configuration
- Forms cohesive prosodic unit with FA

- Initial Accent
  - Pitch
    - Duration

F0 patterns

Phonetically distinct

- Phrase Final Accent
  - Duration
    - Pitch



Durational patterns

Implications for language processing

- IA Perfect candidate for SOSH
  - to lower lexical alignment probabilities
- Compatible with MSS
  - IA ∈ metric structure and linguistic system
- Not compatible with SBS
  - IA 'secondary' accent.

However…

Implications for language processing

- Problem of salience of FA
  - Listeners do not perceive FA in French (House, Hermes & Beaugendre, 1997)
  - Acoustic 'chiasmus' at prosodic boundaries (Fonagy, 1980)
- IA : pitch accent => more salient?
  - Phonological expectancy of IA in French (Jankowski, Astésano & Di Cristo, 1999)
- {IA-FA}
  - 'Grouping', along with metric strength, is important for lexical access (Cutler, 1999)
  - Higher score for AP segmentation when [LHiLH] (Rolland & Loevenbruck, 2002)

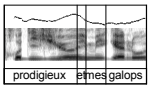
➢ {IA-FA} compatible with SBS?

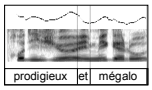
Future lines of research: Phonetics

- Phonetic characteristics of IA and FA
  - Alignment of Elbow (L tone) and Peak (H tone) on IA and FA
  - ➢ Boundary marker, but pitch accent (Post, 2000) or not (Welby, 2004)?
  - Distribution of IA in relation to FA
    - Deaccenting phenomenon ('accentual arch') (eg. « La MAjeure parTIE »)
    - Stress clash avoidance
  - ➢ Disentangle rhythmic effects from proper structure marking
  - ✓ On existing massive corpus of lab speech (Edinburgh) + of semi spontaneous speech (Map Task, Aix)

Future lines of research: Psycholinguistics

- Role of IA (and {IA-FA}) in speech segmentation & lexical access
  - Listeners rely on 'early rise' to segment lexical words (Welby, 2003)





Background

- Implement fine acoustic-phonetic cues in experiments
  - Differential lengthening of IA (Onset>Rime) and FA (Rime > Onset)
  - Tonal configurations of IA and FA
  - ➢ Test relevance and ranking (weight) of these cues
- Test if {IA-FA} is the basic processing unit in French

Proposed experiments (1)

- Gating
  - Homophone sentences
  1. « Jean portait (sa chemise) » vs. 2. « J'emportais (sa chemise) »
     - 1 = FA « Jean »
     - 2 = a) {IA-FA} « J'emportais » vs. b) {-FA} « J'emportais »
  - Stimuli presented with 50 ms gates incrementation
  - Aim: How many gates necessary for listener to abandon hypothesis « Jean » for longer word « J'emportais »
  - Hypothesis:
    - Fewer gates necessary in 2 a) than in 2 b)

Proposed experiments (2)

- Word monitoring
  - Aim: test {IA-FA} as cohesive unit
  - Spot embedded word «port » [por] in carriers with different metric patterns
    - 1 = FA « Jean portait»
    - 2 a {IA-FA} « J'emportais »
    - 2 b {-FA} « J'emportais »
  - Hypothesis for RTs
    - Faster in 1 (preceded by boundary tone) than in 2a & 2b (embedded)
    - Slower in 2a than in 2b (cohesive {IA-FA} : [por] impossible word onset)

Proposed experiments (3)

- Cross-modal priming
  - Aim: Role of IA as phrase marker (in syntactic disambiguation)
  - Stimuli:
    - Visual
    - 1. 'Les bagatelles [et les balivernes sottes]
    - 2. '[Les bagatelles et les balivernes] sottes
    - Aural
  - a) /bali/ with IA
  - b) /bali/ without IA
  - Hypothese
    - RT shorter when listener hear a) and see 1., and hear b) and see 2.

Other experiments…

- Lexical decision with cross-modal semantic priming
  - Faster RTs to decide word/non word when {IA-FA} ?
- Replication of learning of artificial language (Banel et Bacri, 1994; Bagou et al., 2002)
  - Is {IA-FA} pattern facilitating over {-FA} pattern?
- Lexical competition *inside* a phrase, not across boundaries (Christophe, 2002)
  - « Chat grincheux » vs. « Chat drogué »: downplayed by {IA-FA} pattern?

Conclusion

- Recent descriptions of French prosody integrate IA in a model of French
  - Robust phonetic characteristics (various speaking styles)
  - Particular role in spontaneous speech: word level prosody? (See Kohler, 1991)
  - ➢ Interesting perspective in the light of psycholinguistic models

Linguistics		*Psycholinguistics*
System description	⟺	Cognitive models

Adjective Scope	**Narrow**		
Syntactic Structure	*N1* [[les gants	*N2* et [les [BAS	*A* LISSES]]] [1]
Adjective Scope	**Broad**		
Syntactic Structure	*N1* [[[les gants]	*N2* et [les BAS]]]	*A* [LISSES]]

[1] '*Smooth gloves and stockings*'

Adjective Scope	**Narrow**	
	N2 and A lengths: 1 syllable … to 4 syllables	
Syntactic Structure	[[les gants et [les [BAS LISSES]]]	[[les bonimenteurs et [les [BARATINEURS FABULATEURS]]]
Adjective Scope	**Broad**	
	N2 and A lengths: 1 syllable … to 4 syllables	
Syntactic Structure	[[[les gants] et [les BAS]]] [LISSES]]	[[[les bonimenteurs] et [les BARATINEURS]]] [FABULATEURS]]

Adjective Scope	**Narrow**	
	N2 and A lengths: 1 syllable … to 4 syllables	
Syntactic Structure	[[les gants et [les [BAS LISSES]]]	[[les bonimenteur s et [les [BARATINEURS FABUL ATEURS]]]
Adjective Scope	**Broad**	
	N2 and A lengths: 1 syllable … to 4 syllables	
Syntactic Structure	[[[les gants] e t [les BAS]]] [LISSES]]	[[[les bonimenteurs] et [les BARATINEURS]]] [FA BULATEURS]]

Adjective Scope	**Narrow** **N2 and A lengths: 1 syllable … to 4 syllables**	
Syntactic Structure	[[les gants et [les [BAS LISSES]]]	[[les bonimenteur s et [les [BARATINEURS FABULATEURS]]]
Adjective Scope	**Broad** **N2 and A lengths: 1 syllable … to 4 syllables**	
Syntactic Structure	[[[les gants] e t [les BAS]]] [LISSES]]	[[[les bonimenteurs] et [les BARATINEURS]]] [FA BULATEURS]]

Materials
- Carrier sentences -

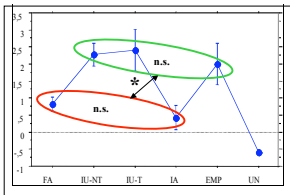
Adjective Scope	**Narrow**
Syntactic Structure	'les gants et les BAS LISSES , en fait, sont relativement rares ' [2]
Adjective Scope	**Broad**
Syntactic Structure	'les gants et les BAS LISSES , en fait, sont relativement rares '

[2] '*Smooth gloves and stockings, in fact, are quite rare*'

Adjective Scope	**Narrow** ***Si les bas sont lisses, mais les gants ne le sont pas, vous dîtes :***
Syntactic Structure	'les gants // et les BAS LISSES '
Adjective Scope	**Broad** ***Si les gants et les bas sont lisses, vous dîtes :***
Syntactic Structure	'les gants et les BAS (//) LISSES '

Functional polyvalence of IA
(Rossi, 1987; Vaissiere, 1997)

- Rhythmic function (Fonagy, 1980; Martin, 1980; Lucci, 1983; Pasdeloup, 1990; Mertens, 1992; Delais, 1994; Hirst & Di Cristo, 1996; Fougeron & Jun, 1997; Jun & Fougeron, 2000)
  - Stress clash avoidance
  - Introduced in long stretches of speech
- Hierarchical function (Llorca, 1987; Pasdeloup, 1990)
  - Initial articulatory strengthening of prosodic structure (Keating & Fougeron, 1998)
  - Topic marker (Marandin et al, 2002)
- Lexical demarcation function (Fonagy, 1980; Vihanta, 1993; Hirst & Di Cristo, 1996; Vaissiere, 1997)
  - ↪ Highlighting of semantic/syntactic units
- Socioprofessional marker : 'Accent didactique' (Lucci, 1983; Leon, 1993)
- Intensification phenomenon: 'Accent d'insistance'



Final prominence Initial prominence

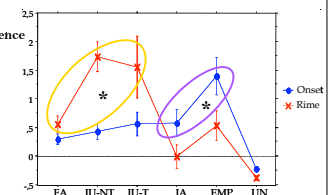
Functional distinction

Semantico-pragmatic > Word level

Distributional distinction

Word-Initial (IA, EMP)
= Onset > Rime

Word-Final (FA, IU-N, IU-T)
= Rime > Onset



Final prominence Initial prominence