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The Emergence of Grammar in the Brain: A comparative study of acquisition, processing and cortical organization of the structural aspects of language in bilingual and monolingual populations

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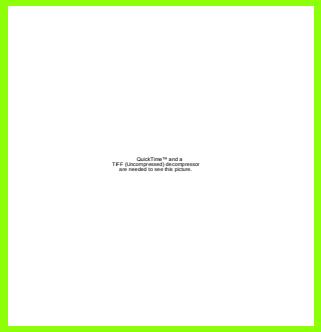

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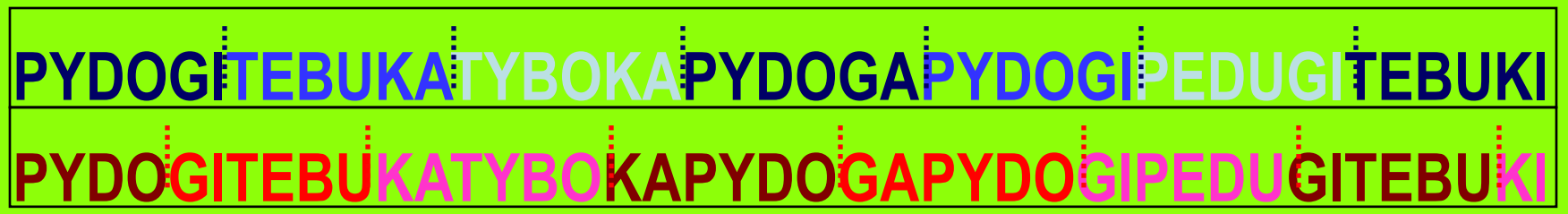
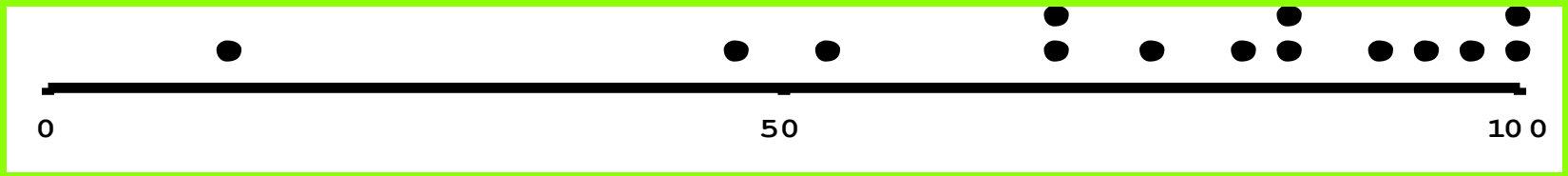
- Relative role of prosody and statistical computation in the segmentation of continuous speech
- Role of prosody and distributional regularities in the acquisition of word order
- Why linguistic change goes in one direction?

- For each of these 3 areas I will make a brief summary of the progress we made.

- Phonemic distinctions, in particular consonantal distinctions (Nespor, Peña and Mehler 2002; Bonatti, Peña, Nespor and Mehler 2005; Nazzi 2005), give primarily cues to the lexicon, and much less to grammar.
- Humans can segment continuous speechstreams exclusively on the basis of TP calculation between syllables.
- If TPs are kept high between Cs but not between syllables (the syllables contain many different vowels) the ability to detect words is still very high.
- If the TPs are high between Vs (the syllables contain many different consonants) the ability to parse the stream is destroyed. (Peña 2002; Bonatti, Peña, Nespor and Mehler 2005)

- C and V comparison:





vowel word

consonant word

14 min. habituation

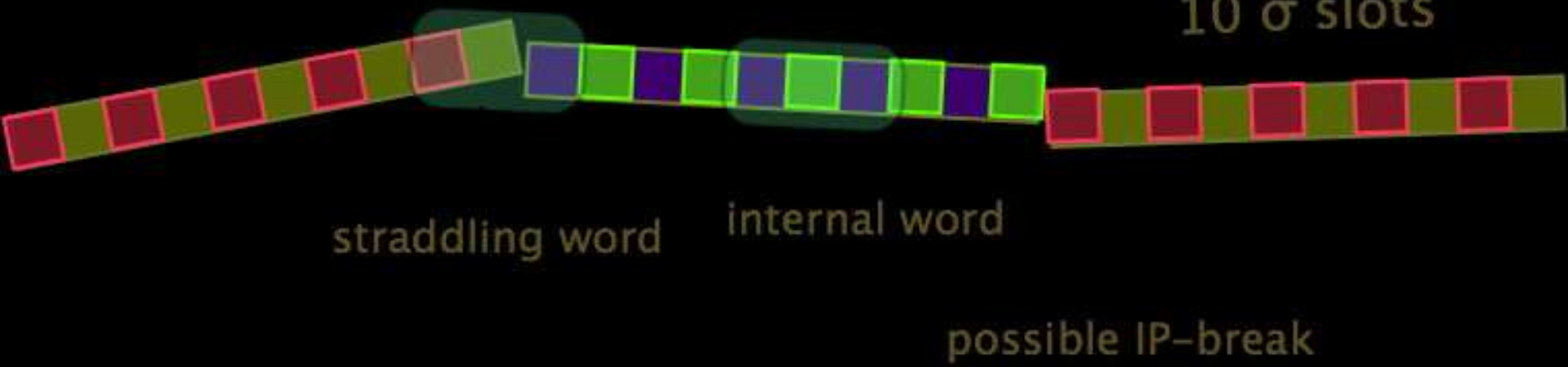
- TPs vs prosody in speech segmentation
  (Shukla, Nespor and Mehler 2007)

- We added prosodic characteristics to frames of 10 syllables such that the prosodic constituents would be aligned with the frames.
- The prosodic characteristics were those of different Italian Intonational Phrases (Nespor & Vogel 1986).
- In each pitch contour: an initial syllable is 200msec long, followed by eight syllables of 240msec each, and a final, lengthened syllable of 280msec.

- In the test phase, the subjects were presented orally with pairs of words and part-words with a *flat prosody* (a constant pitch of 100Hz and all phonemes with the same length of 120msec).

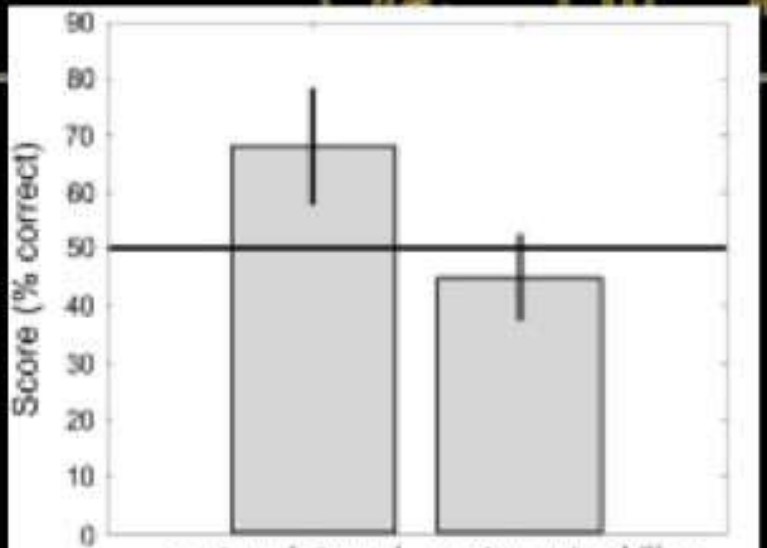
Adding Prosody

- Each FRAME is given the acoustic pattern of one of a series of recorded Italian IPs
  - Pitch + Length characteristics of IPs



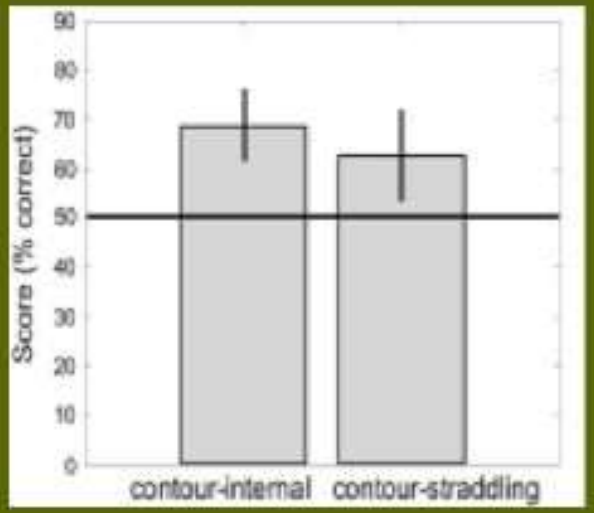
segmenting nonce-'IPs'

Familiarization	Intonated (IT)
Test	Flat, acoustic
Result	"Internal": 68.13% ** ": 45%!



Notes

Comparison with Exp. 1: Position** Pos X Exp *

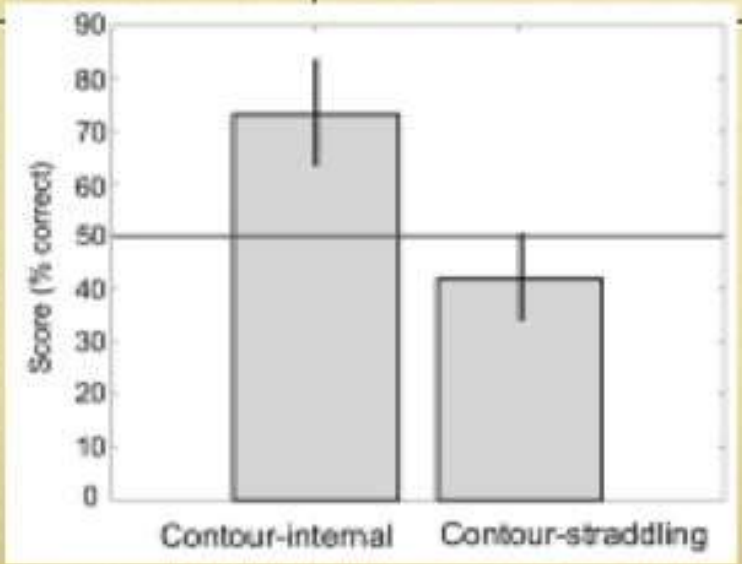


- Given that we are interested in language acquisition in the first months of life, we must show that the effect of prosody is due to universal properties.
- It could in fact be the case that Italian adults might have learned to associate the edges of IPs to the edges of words.

- We thus need evidence that prosody never heard before can aid in segmenting fluent speech. We decided to superimpose Japanese contours to the same stream used in the first experiment.

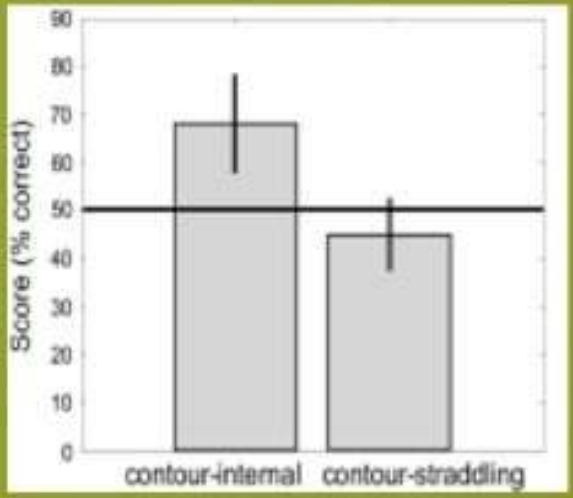
japanese nonce-'IPs'

Familiarization	Intonated (JP)
Test	Flat, Acoustic
Result	"Internal": 73.2%*** "Straddling": 42%!



Notes

Comparison with Exp. 2: Position***



- Thus some aspects of the prosody of IPs, common also to phrases in music, appear to offer a universal signal to subsequences of streams of fluent speech (e.g. pitch decline at the right edge).
- We have also shown that TPs are in fact calculated automatically in all positions and that prosody has the effect of filtering out those words that are prosodically ill-formed.

Role of prosody and distributional regularities in the acquisition of word order

- We hypothesized that the iambic - trochaic law determines the physical realization of prominence at the level of the phonological phrase: if both pitch and intensity are strongest on the same syllable, then grouping is trochaic; else it is iambic. (Nespor, Shukla, Avesani, van de Vijver, Schraudolf and Donati, submitted).

- We have shown this to be the case both interlinguistically (French and Turkish) and intralinguistically (German).
- Since the iambic trochaic law is a mechanism of percpetion also for music (Bolton 1894, Woodrow 1951, Cooper and Meyer 1960), we conclude that a general mechanism of perception can give a cue to the relative order of heads and complements.

Distributional cues to word order

- Prosody is not the only cue to word order:
- Frequency provides reliable cues to functional categories
- The relative order of frequent and infrequent words provides reliable cues to word order
- Are infants able to pick up these cues?
- Even in the prelexical stage?

- We tested prelexical infants (7 months old) with the headturn preference paradigm.

- Italian and Japanese infants show opposite preference for initial or final functor
- Thus one more proof that the acquisition of structure proceeds independently of the knowledge of the lexicon

Gervain, J., M. Nespor, R. Mazuka, R. Horie and J. Mehler (in press)

Material

…AXBYAXBYAXBYA…

where A and B are frequent items

and X and Y less frequent ones

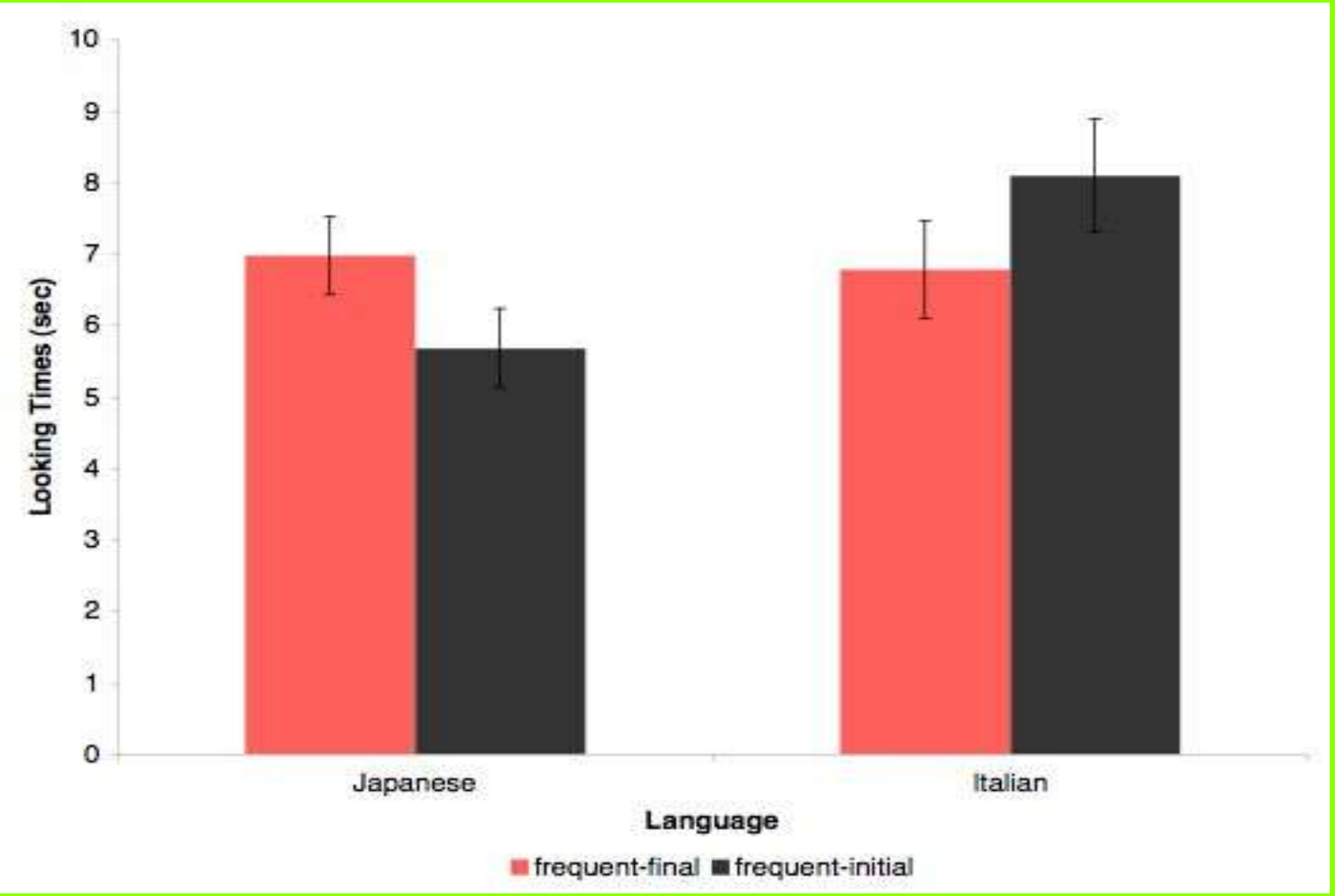
Familiarization

…gefofibugedefikogepafimoge

Test

fifogebi or bagebofi

Results


10
9
8
7
6
5
4
3
2
1
0
Looking Times (sec)
Japanese
Italian
Language
frequent-final
frequent-initial

Why does (attested) changes in word order go in only one direction?

- If languages undergo change in word order, this goes from OV to VO.
- Thus there must be an advantage for VO.
- The question is then why so many languages are OV, even the ancestors of many VO.
- Hypothesis: VO is preferred for grammatically governed language; OV is the preferred order for communication.

Evidence for SOV in Communication in the gestural modality

- Home-signs

  (Goldin-Meadow & Feldman, 1977; Goldin-Meadow et al, 1994)
- Nicaraguan Sign Language

  (Kegl, In Press; Senghas, 2003; Senghas et al., 2004)
- Al-Sayyid Bedouin Sign Language

  (Sandler et al., 2005; Padden et al., In Press)

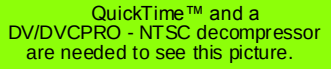
Evidence for SVO in grammatically governed languages

- Creole languages are universally SVO (Bickerton, 1984; 1990)
- Both Ijo (SOV) and Zeelandic Dutch (SOV) →Berbice Dutch (SVO)

- without morphology, SVO resolves the 'Who-Did-What-To-Whom' ambiguity most effectively, in case of pro-drop.

Gesture experiment

- Participants: native speakers of Italian
- Material: 22 cartoon clips containing S, V, O
- Task: to gesture the clips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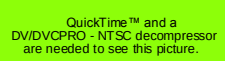
are needed to see this picture.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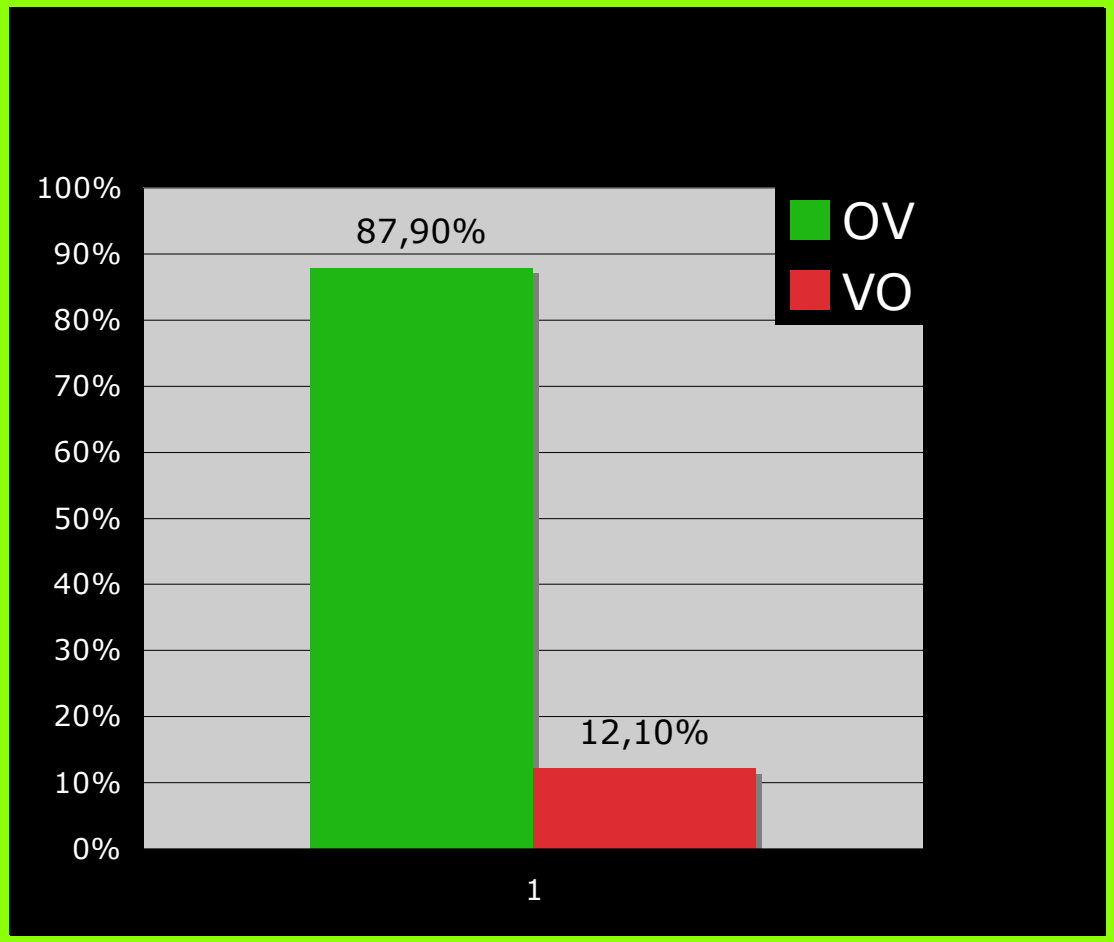
Preliminary results gesture experiment

OV (87,9%) VO (12,1%)



THANK YOU