



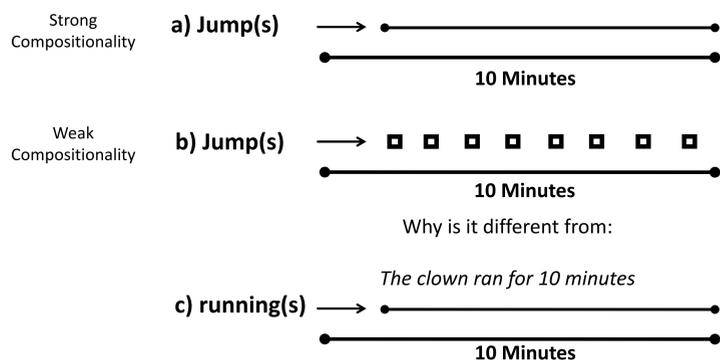
Can Time Perception be observed in Language Processing? Behavioral Self-Paced Reading evidences of ‘Durational’ Coercion

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1) What do we understand when someone says something as:

The clown jumped for 10 minutes



Considering the context of a sentence as being fully specified by the coherent combination of their lexical items and their syntactic structures (*Strong Compositionality*), sentences like (1a-b) should have similar meanings. However it's not the case as (1a) is not understood as if the clown performed a very long jump lasting for about ten minutes, neither (1b) is understood as if the clown did several running events. In this sense we need an explanation of how our linguistic processor can assign different meanings to verbs inserted in the same syntactic and lexical contexts (*Weak Compositionality*). The difference between these verbs should thus lie in their in their lexical semantics.

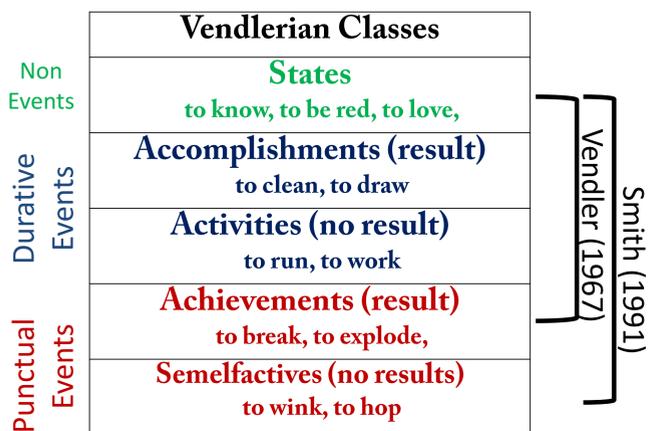
Where does this piece of meaning come from? A linguistic point of view

Philosophers of language argues that verbs have different structural, aspectual and eventive properties. Typological studies thus proposed a categorization of verbs into different event classes.

In this sense, some linguists proposed the **Iterative Coercion Hypothesis** (Pustejovsky 1995; Jackendoff 1997) **punctual verbs** inserted in **durative contexts** induce an **aspectual mismatch**, which should be somehow solved during the course of processing.

- However, as pointed by Rosen (1999:02): *"[Event Classification...] is not explanatory: It does not address how events are represented in the grammar; nor does it try to determine where events are encoded – within the lexicon, the semantics or the syntax. Explanatory or not, event classification research has pinpointed the basic features of events that need to be represented."*

Linguistics / Philosophy of Language



Discussion: In sum, As a reflect of the non-explanatory approach of Event Classification studies, several proposals have been presented since Vendler (1967) and at least up to Dölling (2011), each one working on their own parameter-combination set-up. Even if a great number of studies are based on vendlerian/smithian classification, the large number of proposals still lacks an empirical basis. Also, Generative Linguists just don't address the question arguing that the answer lies in the world knowledge. Other theories will look at Gricean Conversation Principles (Grice, 1975) or at Pragmatics.

Experimental Linguistics

Iterative Coercion is na accepted theoretical Hypothesis and Experimental Linguistics evidences have been supporting it:

a) **Negative evidences on Eye Tracker and Self-Paced Reading:** Pickering et al. 2006

b) **Psycholinguistic evidences on A/V Dual Task Paradigm:** Piñango et al. 1999, 2006; **on different Self-Paced Reading Protocols:** Todorova et al. 2000a,b; Proctor et al. 2004; Husband, Beretta & Stockall 2006, 2008; Brennan & Pykkänen 2008 ; Bott 2008, 2010; **on EyeTracker:** Pickering (2006); Townsend 2012;

c) **Neurophysiological evidences on RSVP:** Brennan & Pykkänen 2008 (RSVP - 400ms AMF @vmPFC), Packzynsky & Kuperberg 2011 (N400-like component)

The (probable) linguistic problem

Once a traditional non-empirical feature is enough to predict the behavior of the so tested punctual events, no one has even asked a very trivial question:

What if the same happens to durative verbs??

If durative verbs present the same behavior, aspectual categorization will loose it's explanatory power

Experiment – Word by word Self-Paced Reading

- Stimuli were presented in a word-by-word Self Paced Reading with an interpretation question at the end of each stimulus;
- The volunteers use the [spacebar - in yellow] to navigate between the words of the sentence and the [k] and [l] to answer [yes] or [no] respectively.
- Stimuli were presented in a **black background**
- Font: **Times New Roman 24 white**

Materials:

12 sentences in four different conditions

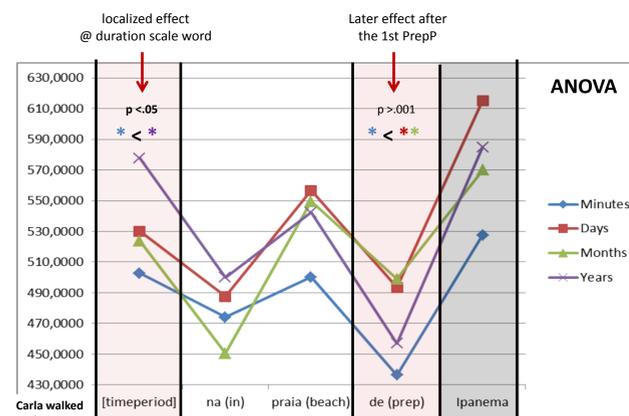
Example: Carla caminhou por dez [time period] na praia de Ipanema

Carla walked for ten [time period] on Ipanema Beach

Task: simple questions = Did Carla walk on Ipanema Beach? [yes/no]

Conditions: a. [minutes]; b. [days]; c. [months]; d. [years]

- 36 subjects participated in this test



Discussion:

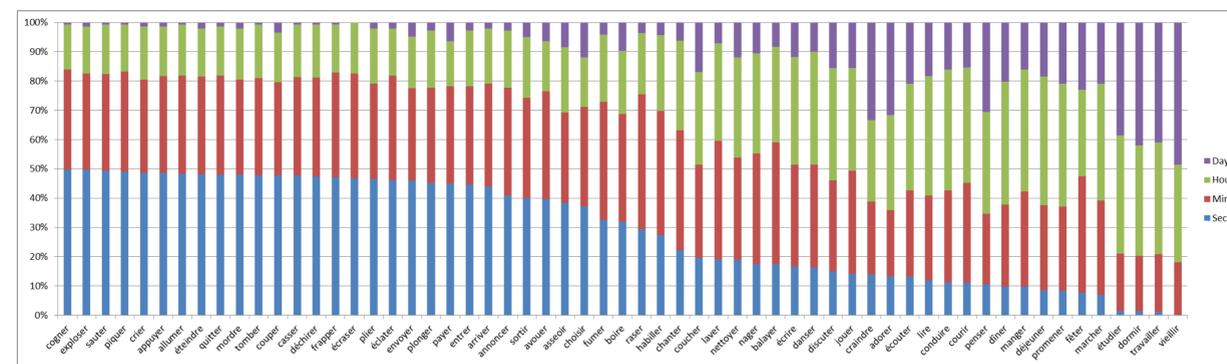
- Our experiment fills the gap from Iterative Coercion Hypothesis in Theoretical Linguistics;
- This effect seems to be related to the logical impossibility of events to last longer than an average duration we'd experienced it in our lives. If our hypothesis is consistent, how do we get a mean duration of events? Time Perception Internal Clock Models (Treisman 1984; Meck 1995) seems to be an elegant way to address the question;

Problems:

- Why do we have different effects for different durations?
- *"In general, semantic properties have greater effects at the end of a clause rather than its middle (Green et al. 1981; Just and Carpenter 1980; Mitchell and Green 1978; Rayner et al. 2000; Townsend and Bever 1988). These "wrap-up" effects apparently involve fixing an interpretation for a structural unit."* (Townsend, 2012);
- Our materials are not controlled by duration, so we probably have some verbs which lasts for minutes and others which lasts for hours. How should we control it?

Improvements of a [new] ongoing experiment (in collaboration with Virginie van Wassenhove):

- Control of the mean duration of events and test verbs having a similar mean duration;
- Concentrate materials on seconds-minutes-hours scale. Days-months-year scale may be interpreted as a cyclical event instead of just a repetitive event.



Mean duration for french verbs: Sampaio & van Wassenhove (in progress)
Y axis: % relative % of choices in a word-categorization test

BRENNAN, J. & PYLKKÄNEN, L. Processing Events: Behavioral and Neuromagnetic Correlates of Aspectual Coercion. *Brain and Language*, 106, 132-143, 2008.

BOTT, Oliver, Doing it again and again may be difficult, but it depends on what are you doing. In: *Proceedings of the 27th West Coast Conference on Formal Linguistics*, ABNER, Natasha & BISHOP Jason (eds.), 63-71. Somerville, MA: Cascadilla Proceedings Project, 2008

CHURCH, R.M. Properties of the Internal Clock. In GIBBON, J. & ALLAN, L. (eds.), *Timing and Time Perception*, p. 566-582, New York: New York Academy of Sciences, 1984

DÖLLING, J. Ontological domains, semantic sorts and systematic ambiguity. In: *International Journal of Human-Computer Studies*, 43, 785-807. 1995

_____. Aspectual Coercion and Eventuality Structure. Draft to appear in: ROBERING K. & ENGERER, V. (eds.), *Verbal Semantics*, 2011

JACKENDOFF, Ray. *The architecture of the language faculty*. Cambridge, MA: MIT Press. 1997.

MECK, W. Neuropharmacology of timing and time perception, *Cognitive Brain Research*, Vol.3, p. 227-242, Elsevier, 1996

MOENS, M., & STEEDMAN, M. Temporal ontology and temporal reference. *Computational Linguistics*, 14, 15-28. 1988

PACZYNSKI, M., DITMAN, T., CHOI, A, JACKENDOFF, R, KUPERBERG, G.R. The immediate cost of embodied processing in aspectual coercion: Evidence from event related potentials. *23rd Annual CUNY Conference on Human Sentence Processing*, 2010.

PICKERING, M. J., MCELREE, B, FRISSON, S, CHEN, L, & TRAXCLER, M. J. Aspectual Coercion and underspecification. *Discourse Processes*, 42, 131-155. (2006)

PIÑANGO, M., ZURIF, E., & JACKENDOFF, R., Real-time processing implications of enriched composition at the syntax-semantics interface. *Journal of Psycholinguistic Research*, 28, p.395-414, 1999

PUSTEJOVSKY, J. *The generative lexicon*. Cambridge, MA, USA: MIT Press. 1995.

PYLKKÄNEN, Liina. & MCELREE, B. An MEG Study of Silent Meaning. *Journal of Cognitive Neuroscience*, 19, 126-149, 2007

ROSEN, S.T., *The Syntactic Representation of Linguistic Events* (ms.). 1999

<<http://www-bcf.usc.edu/~borer/LSA/readings/Rosen-1999.pdf>, accessed: 22/06/2012>

TODOROVA, Marina, STRAUB, K., BADECKER, W. & FRANK, R. *Aspectual coercion and the online computation of sentential aspect*. Proceedings of the 22nd Annual Conference of the Cognitive Science Society, p. 3-8, 2000a

_____. *Processing correlates of aspectual computation*. Presented to the Workshop on Events and Paths, ESSLI XII, Birmingham, England. 2000b

TREISMAN, M. Temporal Rhythms and Cerebral Rhythms. In: GIBBON, J. & ALLAN, L. (eds.) *Timing and Time Perception*, p. 542-565, New York, New York Academy of Science, 1984.

VENDLER, Z. *Linguistics in Philosophy*, Ithaca: Cornell University Press. 1967

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