



ERP and behavioral evidence for interaction/cascade between central (linguistic) and peripheral (motor) processes during word handwriting

Mélanie Jucla, Samuel Planton, Jean-François Démonet, Christiane Soum-Favaro

► To cite this version:

Mélanie Jucla, Samuel Planton, Jean-François Démonet, Christiane Soum-Favaro. ERP and behavioral evidence for interaction/cascade between central (linguistic) and peripheral (motor) processes during word handwriting. International workshop on writing, Jul 2015, Poitiers, France. 2015. hal-01224891

HAL Id: hal-01224891

<https://univ-tlse2.hal.science/hal-01224891>

Submitted on 26 Feb 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License

ERP and behavioral evidence for interaction/cascade between central (linguistic) and peripheral (motor) processes during word handwriting.

Mélanie Jucla¹, Samuel Planton^{1,2}, Jean-François Démonet^{2,3} & Christiane Soum¹

¹E.A Octogone. Laboratoire Jacques-Lordat, E.A 4156, Université Toulouse II Le Mirail, Toulouse, France

²Inserm; Imagerie cérébrale et handicaps neurologiques UMR 825; F-31059 Toulouse, France.

³Centre Leenaards de la Mémoire, CHUV Département des neurosciences cliniques, Lausanne, Switzerland

Contact : melanie.jucla@univ-tlse2.fr



Background

Models of handwritten language production make a distinction between central (access to semantic, orthographic and phonological information) and peripheral (allographic and gesture planning) processes (see van Galen, 1991; Rapp, 2002). Though, this is still a matter of debate whether these central and peripheral modules are processed in a cascaded or in a serial way (Delattre, Barry & Bonin, 2006; Damian & Stadthagen-Gonzalez, 2009). In the same view, another question still debated is "do central and peripheral processes 'interact' in handwritten word production compared to oral naming"?

ERP data

POPULATION : 16 French adults (mean age = 25 years old)

•THE STROOP TASK

- Word Processing
- Color Processing
- Response modality
 - Oral response
 - Written response
- Stimuli
 - Color words (blue - red - green) printed either in a congruent or incongruent color
 - 36 stim/condition

Data ACQUISITION & ANALYSIS

- RT recording
 - Oral response : Microphone
 - Written response : Wacom digitizing tablet
- EEG recording
 - 64 electrodes cap
 - NuAmpsTM amplifier (500 Hz)
 - Acquisition software : Neuroscan®
 - Analysis software = SPM EEG
 - HP and LP filters [0.1 – 30 Hz], mean reference
- Mean Amplitude detection: in 50 ms windows in the 300-600 ms interval

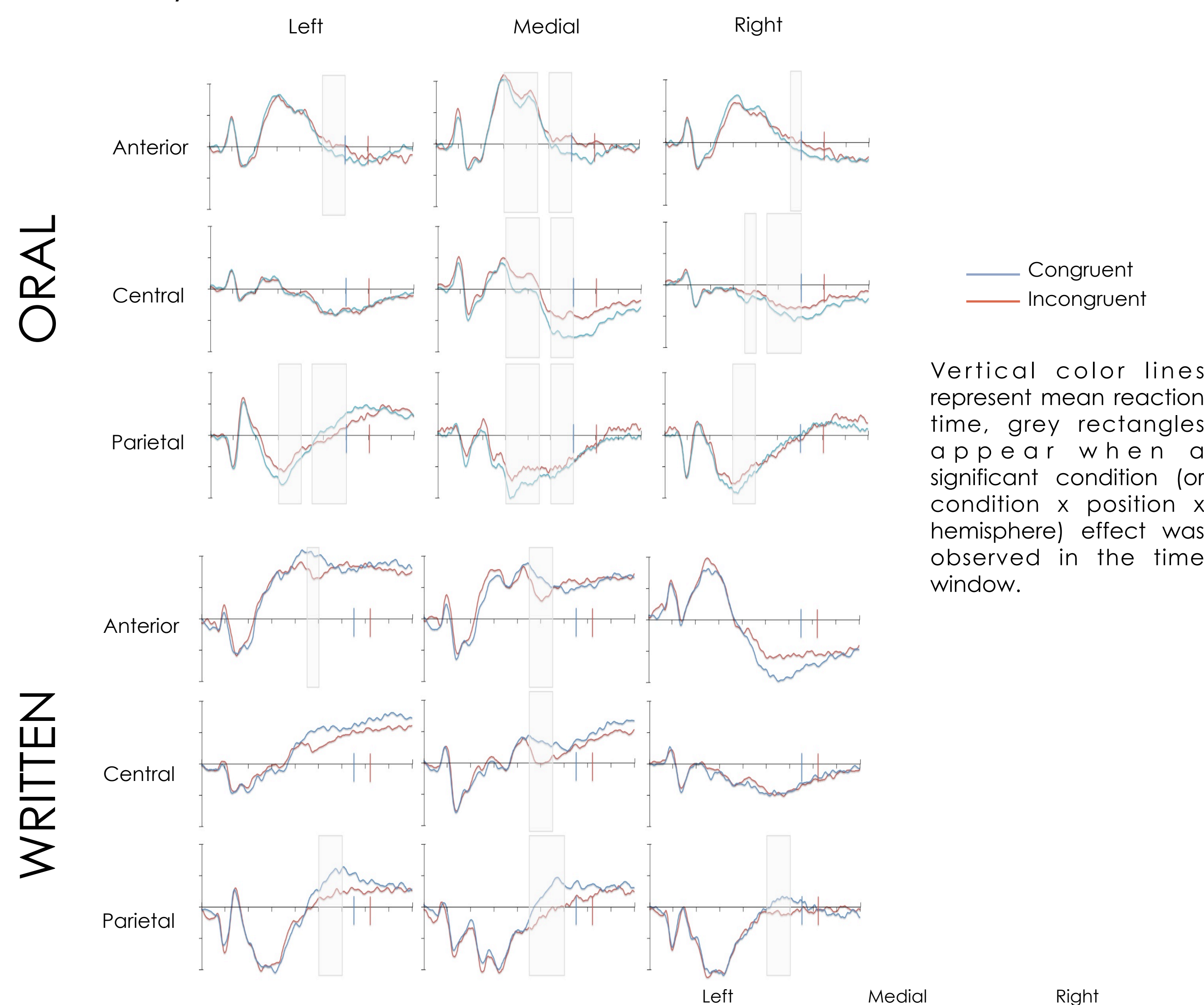


Figure 1 : ERPs acquired in the a) oral and (b) written color Stroop task. Waveforms were obtained from linear derivation of:

	Frontal	F1, F3, F5, FC1, FC3, FC5	Fz, FCz	F2, F4, F6, FC2, FC4, FC6
Central	C1, C3, C5, CP1, CP3, CP5	Cz, CPz	C2, C4, C6, CP2, CP4, CP6	
Posterior	P1, P3, P5, PO3, PO7, O1	Pz, POz	P2, P4, P6, PO4, PO8, O2	

RESULTS and DISCUSSION

We obtained typical 'N400' interference effect in the Stroop task mainly at medial sites in the oral modality. We put forward a different scalp topography in the written modality (Perret & Laganaro, 2012) with an interference effect that only starts around 450 ms. Lateralization is partly due to motor response and thus could partially explain the late interference effect. This effect could account for the specificity of hand-written language production supporting the view that peripheral processing start before lexical and orthographic selection ends and might impact the 'conflict resolution' → **In favor of interaction between central and peripheral processes**

Regularity and length effects

TASK : Written spelling under dictation of isolated words

POPULATION : 26 (exp. 1) and 27 (exp. 2) French adults

Data ACQUISITION & ANALYSIS

Written response registered on a Wacom digitizing tablet (via Matlab)

Variables measured : Errors, writing latencies and duration, relative writing speed

STATISTICS: Linear mixed models (subjects and items as random effects). Length x regularity x position effects

Experiment 1

STIMULI : 64 monomorphemic nouns, varying on length (short -1 syll.- vs. long -3 syll.-) and regularity paired on frequency (Lexique.org). Irregularity at the beginning or at the end

RESULTS:

- Regularity effect

Latencies ↗ (Fig. 2) and speed ↘ for words irregular at the beginning

- Length effect (controlled for stimulus length)

Latencies ↗ and speed ↗ for short words

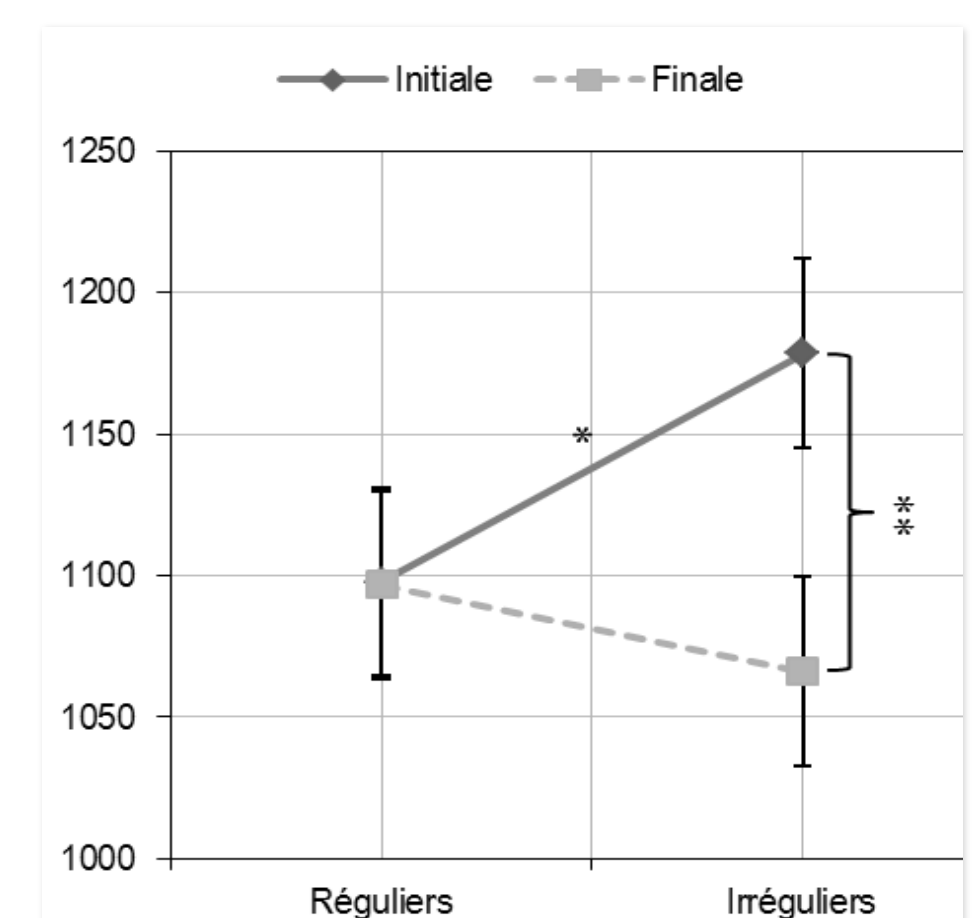


Figure 2 : Latencies are longer for words irregular at the beginning

Experiment 2

Stimuli : 180, monomorphemic nouns of 1, 2 et 3 syllables. Consistency manipulated on the first and last segment (→ 4 conditions, in/consistent at the beginning and/or at the end)

RESULTS:

- Consistency effect

Latencies ↗ (Fig. 3) for words inconsistent at the beginning

Speed ↘ for words inconsistent at the end

- Length effect (controlled for stimulus length)

Latencies ↗ for one syllable words

Further analysis on writing speed (Fig. 4) : In long words inconsistent at the end, speed ↘ at the beginning of word writing

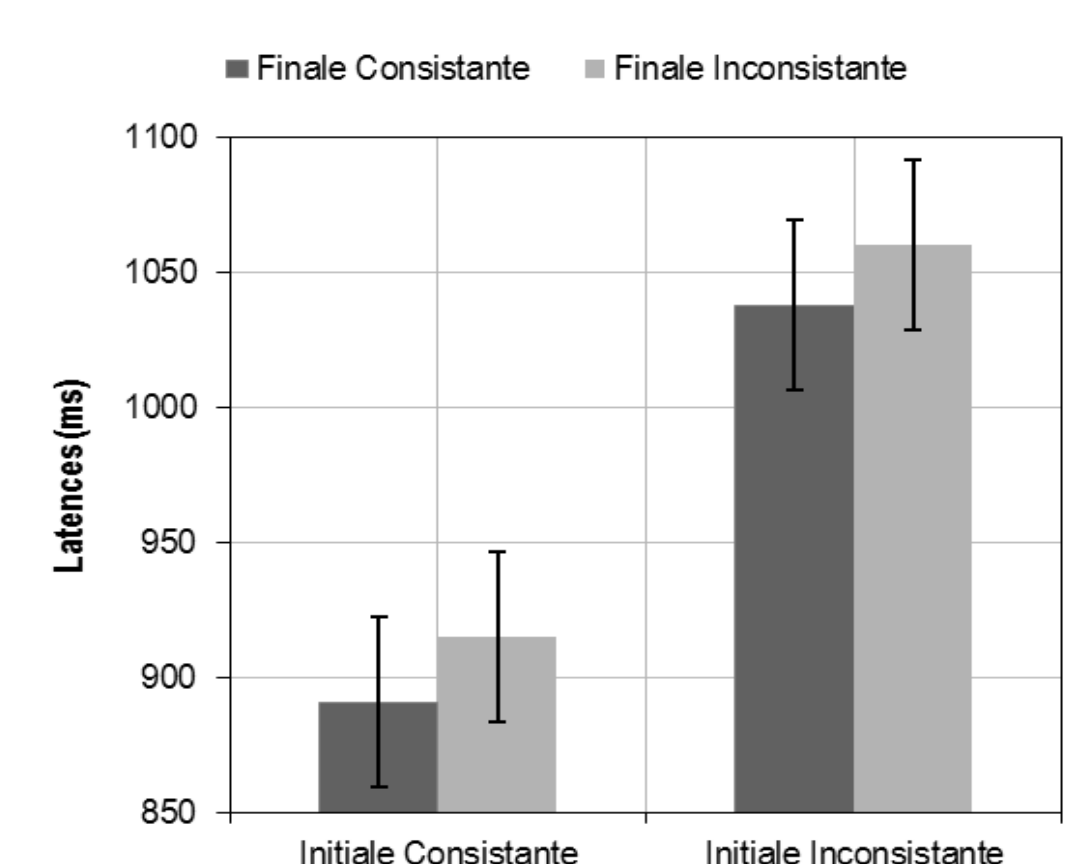


Figure 3 : Latencies are longer for words inconsistent at the beginning

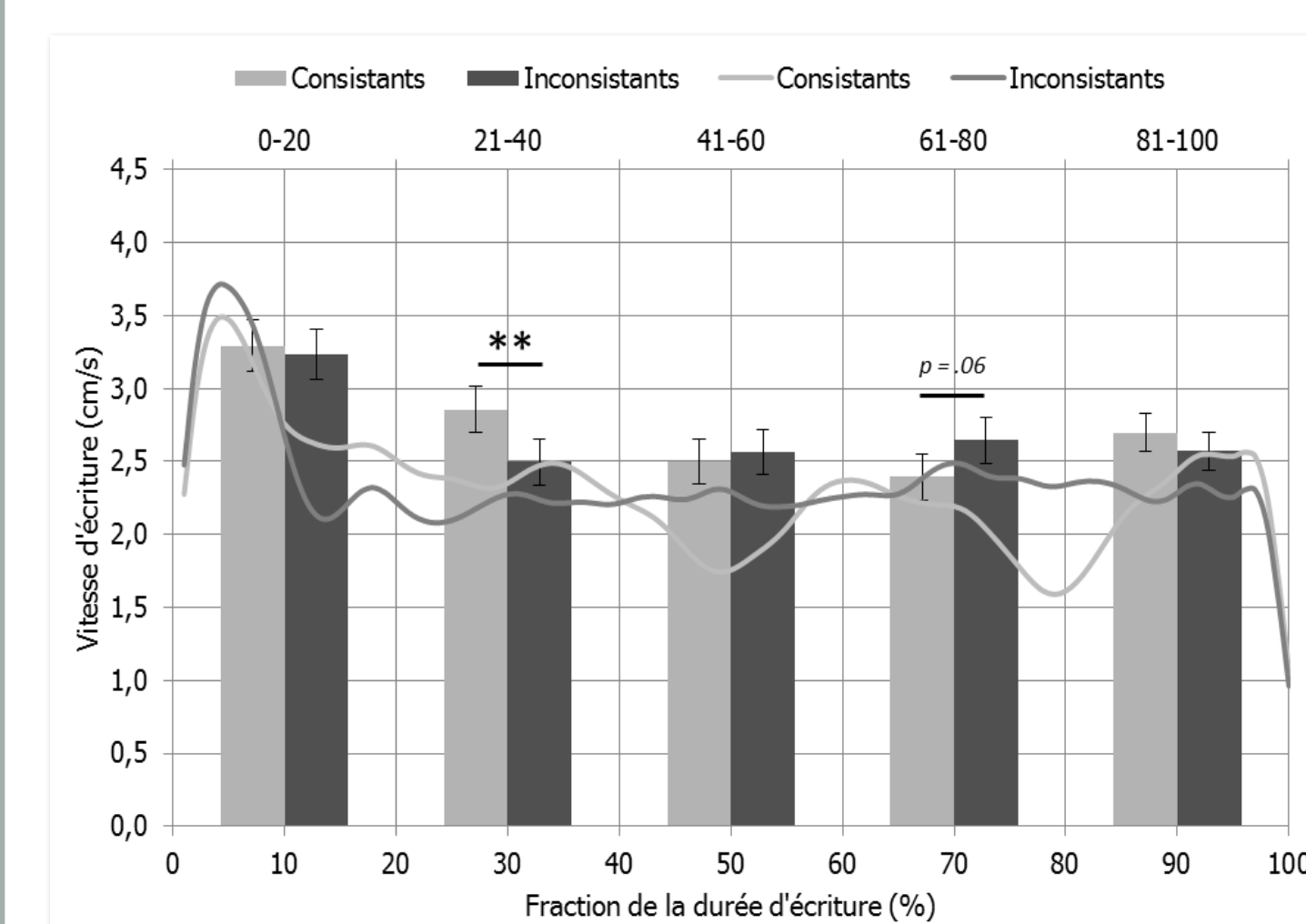


Figure 4 : Relative writing speed during word writing for long consistent and inconsistent words

DISCUSSION

Effects on latencies (no effect of final inconsistencies, of the increased number of letters) contradicts a purely serial conception. Inconsistencies at the end of long words seem to reduce writing execution speed during the production of the first syllable.

→ **In favor of a parallel/cascaded view of central and peripheral processes during writing**

References

Damian, M.F.E. & Stadthagen-Gonzalez, H. (2009). Advance planning of form properties in the written production of single and multiple words. *Language and Cognitive Processes*, 24, 555-579

Delattre, M., Bonin, P., & Barry, C. (2006). Written spelling to dictation: Sound-to-spelling regularity affects both writing latencies and durations. *J Exp Psychol Learn Mem Cogn*, 32(6), 1330-1340.

Indefrey, P. & Levelt WJ (2004) The spatial and temporal signatures of word production components. *Cognition*, 92(1-2), 101-44.

Perret, C., & Laganaro, M. ((2012) Comparison of electrophysiological correlates of writing and speaking: a topographic ERP analysis. *Brain Topogr*, 25(1), 64-72.

Rapp, B., Epstein, C., & Tainturier, M. J. (2002). The integration of information across lexical and sublexical processes in spelling. *Cogn Neuropsychol*, 19(1), 1-29.

van Galen, G. P. (1991). Handwriting: Issues for a psychomotor theory. *Human Movement Science*, 10(2-3), 165-191.