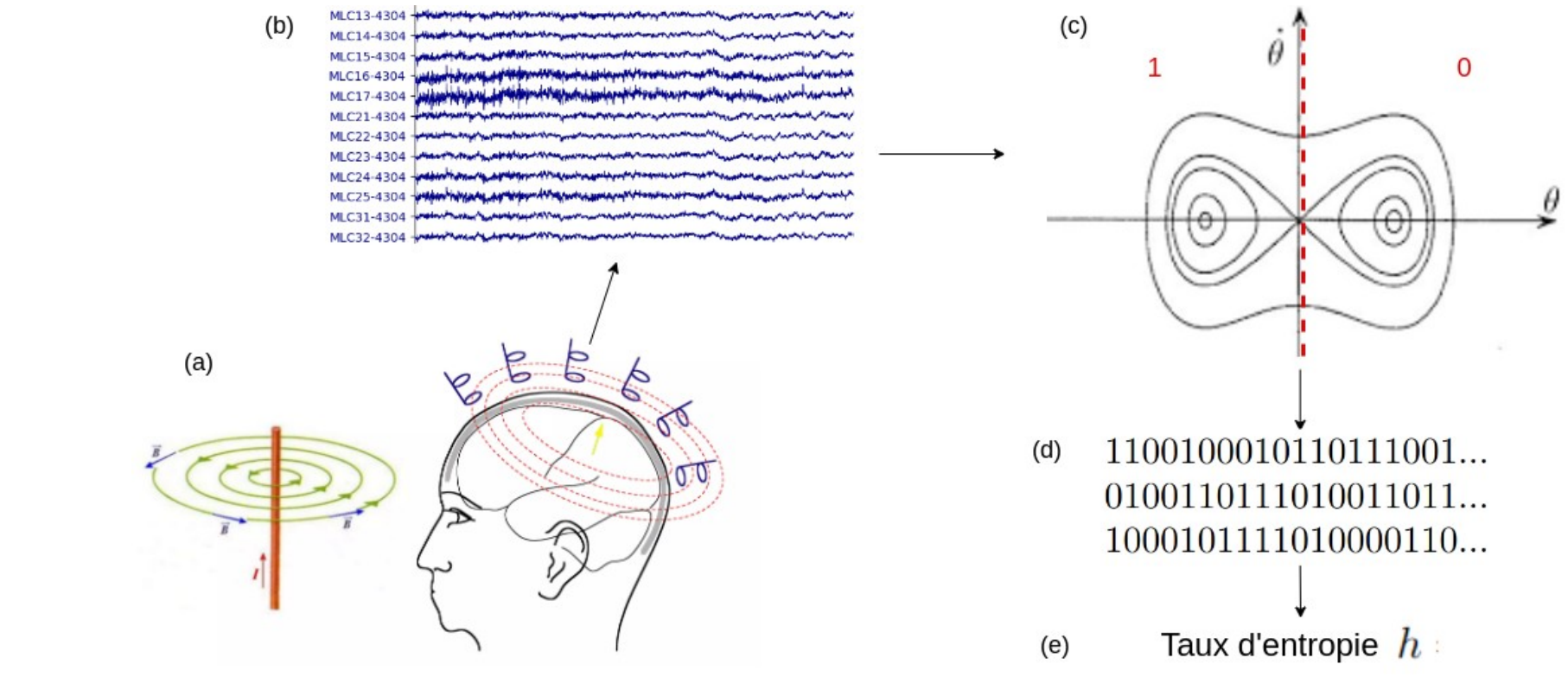
Indexer la complexité linguistique en lien avec la dynamique cérébrale à partir de signaux MEG

Lucas Becquet 10/2023

Schéma de l’algorithme mis en place

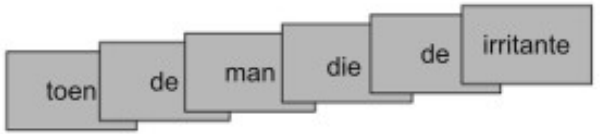


Présentation du dataset MOUS

N=204

Resting state measurement
Language task
Diffusion weighted imaging
Structural imaging

Resting state measurement
Language task



A 204-subject multimodal neuroimaging dataset to study language processing, *Jan-Mathijs Schoffelen and Robert Oostenveld and Nietzsche H.L.Lam and Julia Uddén and Annika Hultén and Peter Hagoort*, 2019

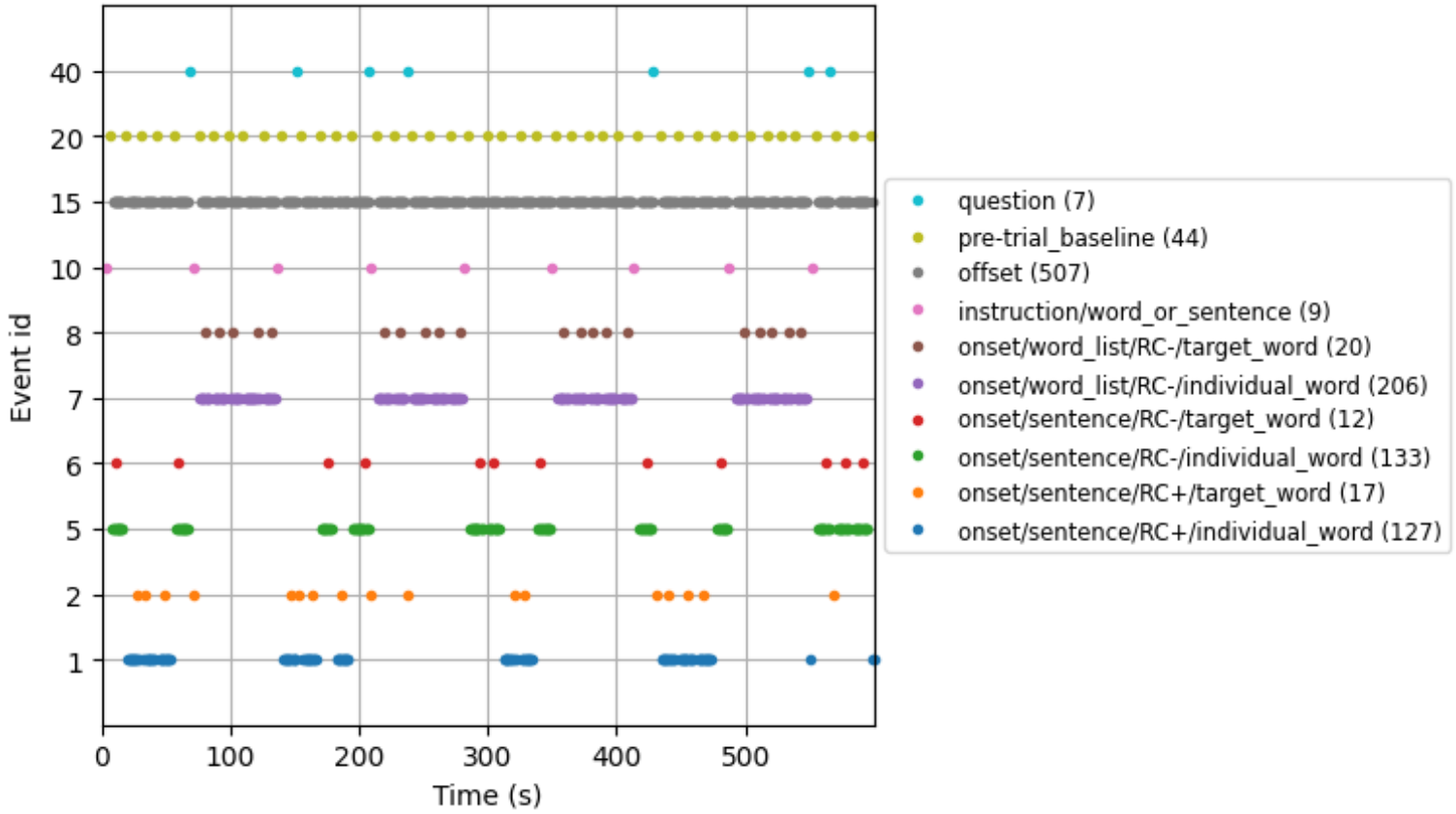
Stimuli

	Sentence	Word list
Complex (Relative Clause, RC+)	Het aardige vrouwtje gaf Henk die een kleurige **papegaai** gekocht had een zak pitjes *The nice lady gave Henk, who had bought a colorful parrot, a bag seeds.*	Zak een kleurige aardige een had die vrouwtje **papegaai** gaf het gekocht pitjes Henk *Bag a colorful nice a had who lady parrot gave the bought seeds Henk*
Simple (RC−)	Dit zijn geen regionale **problemen** zoals die op de Antillen. *These are no regional problems such as those on the Antilles.*	zoals geen die Antillen **problemen** regionale zijn de dit op *such as no those Antilles problems regional are the these on*

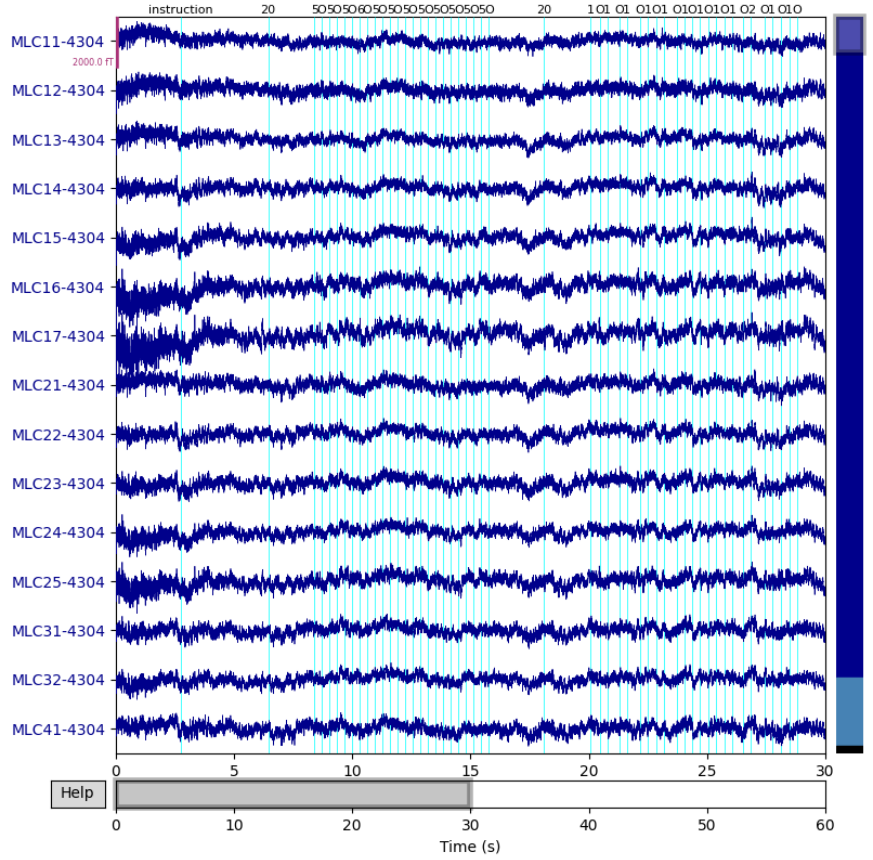
Identification des différents évènements

Trigger value	meaning
1	Onset of individual word (visual task) or first word (auditory task) in a Relative Clause containing sentence (RC+).
2	Onset of 'target' word in a RC+ sentence.
3	Onset of individual word (visual task) or first word (auditory task) in a word list derived from a RC+ sentence.
4	Onset of 'target' word in a word list derived from a RC+ sentence.
5	Onset of individual word (visual task) or first word (auditory task) in a sentence without a relative clause (RC−).
6	Onset of 'target' word in a RC− sentence.
7	Onset of individual word (visual task) or first word (auditory task) in a word list derived from a RC− sentence.
8	Onset of 'target' word in a word list derived from a RC− sentence.
10	Mini block instruction stimulus 'WOORDEN' (words) or 'ZINNEN' (sentences)
11	Response (index), auditory task (in visual task, this event has value 1)
12	Response (middle), auditory task (in visual task, this event has value 2)
13	Experimenter response to continue after break, auditory task (in visual task, this event has value 3)
14	Start of audio file (auditory task only)
15	Offset of word picture (visual task) or audio file (auditory task)
20	Fixation picture, pre-trial baseline.
30	Pause
40	Question

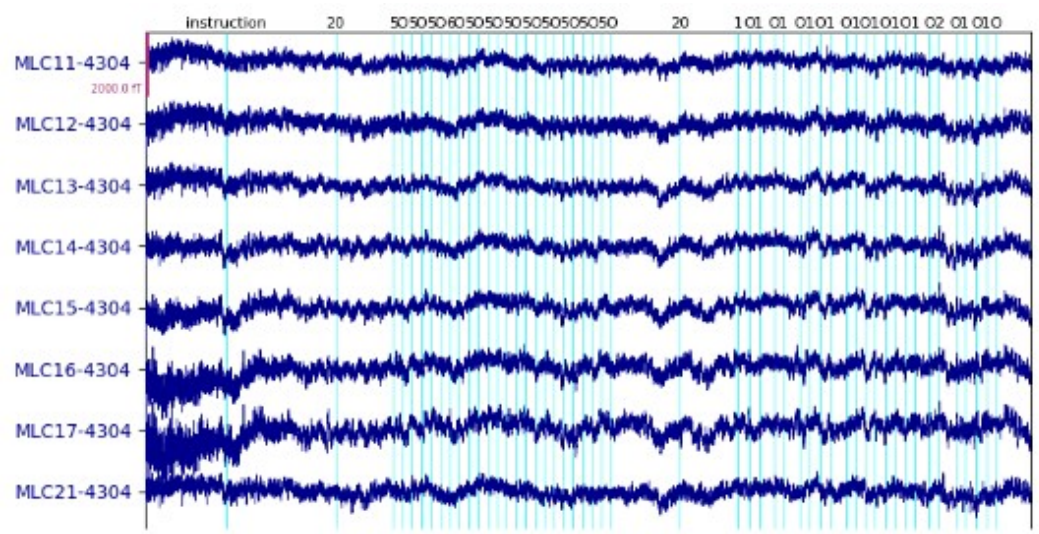
Structure des données et événements

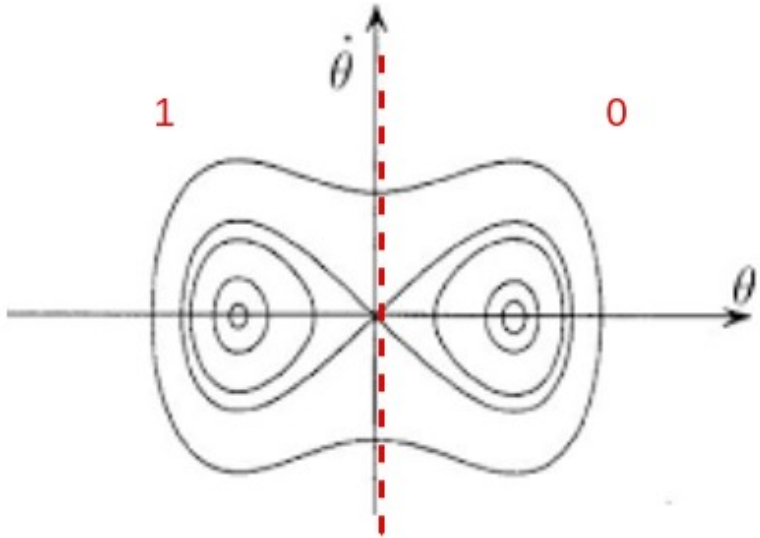


Segmentation des séries temporelles autour des événements d’intérêt

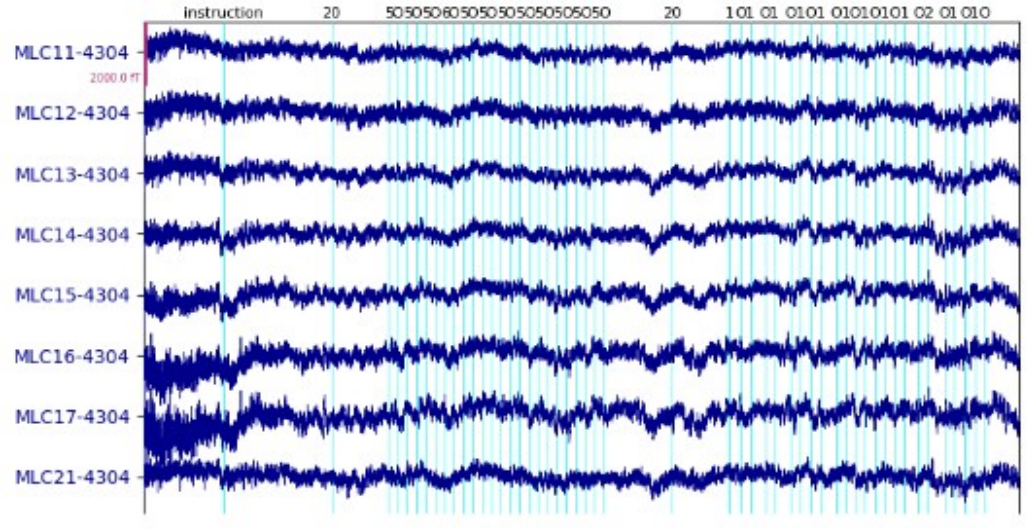


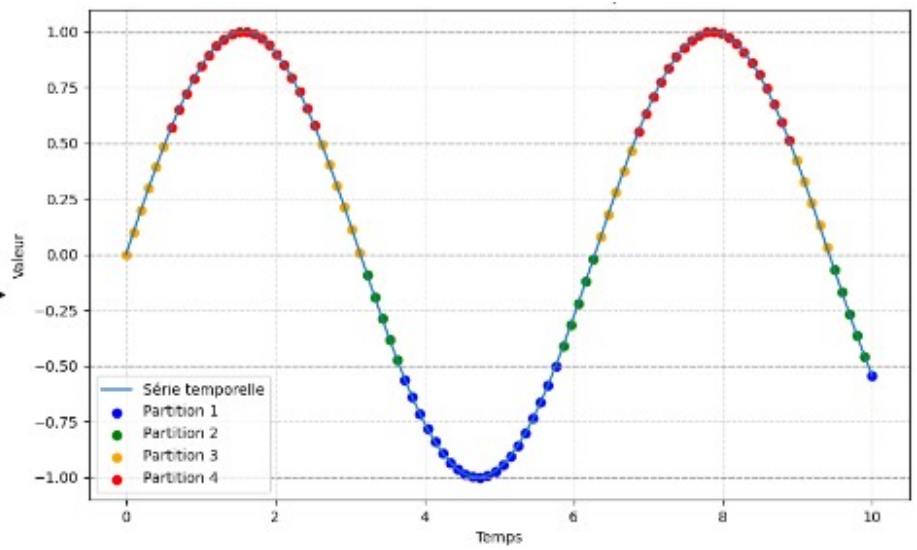
Représentation symbolique



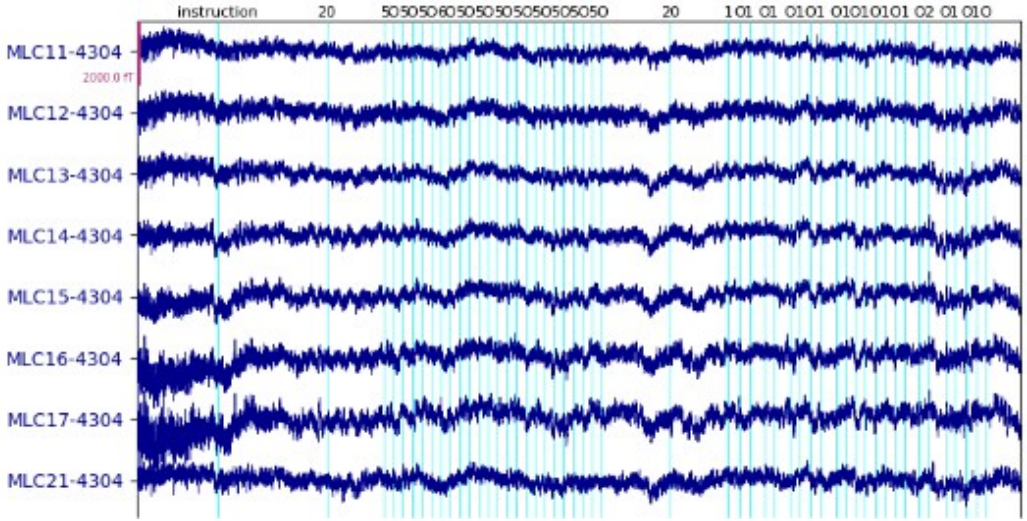


Représentation symbolique



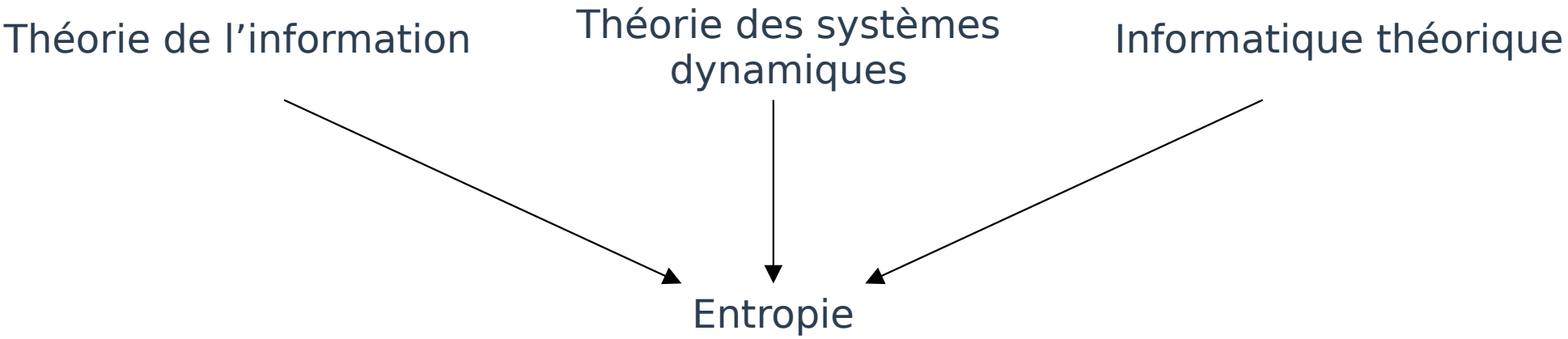


Représentation symbolique



1100100010110111001...
0100110111010011011...
1000101111010000110...

Entropie d’une séquence symbolique



Entropie d’une séquence symbolique

$$H_n = -\sum_w p_n(w) ln p_n(w)$$

1. w mot de longueur n
2. $p_n(w)$ distribution de probabilité

$$h = \lim_{n\to\infty} H_{n+1} - H_n = \lim_{n\to\infty} \frac{H_n}{n}$$

Estimateur algorithmique de Lempel-Ziv

$$1 \cdot 0 \cdot 01 \cdot 11 \cdot 100 \cdot 101 \cdot 00 \cdot 010 \cdot 11....$$

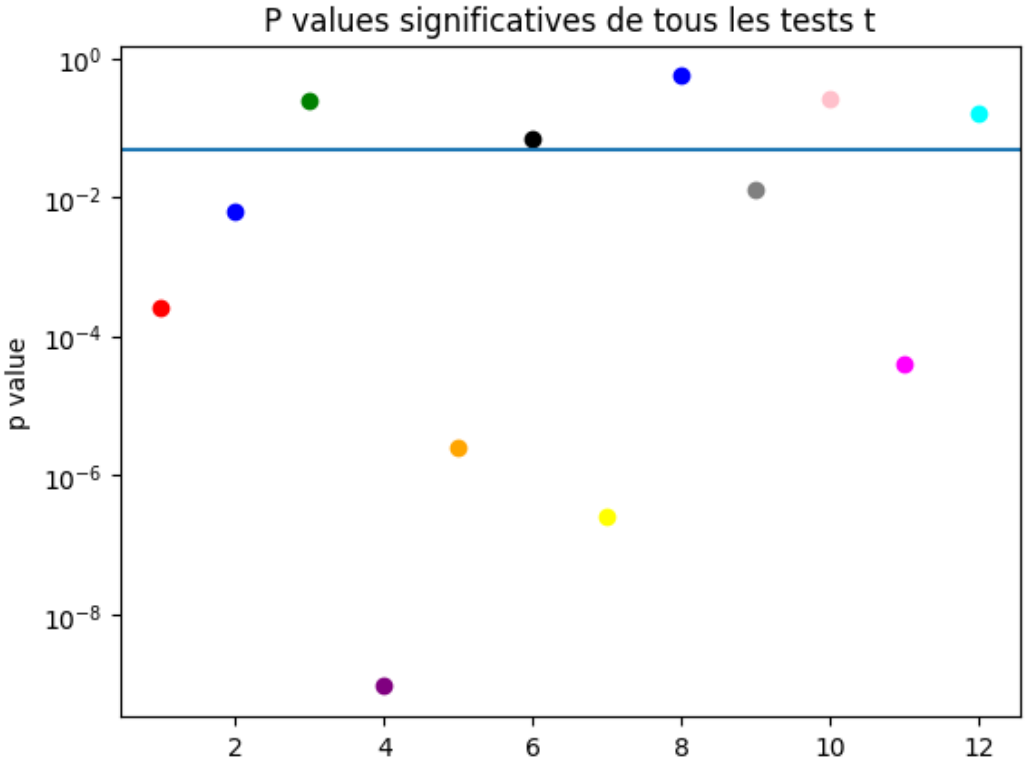
$$\hat{L} = \frac{\mathcal{N}_w[1 + log_k \mathcal{N}_w]}{N}$$

où

$$\lim_{n \to \infty} \hat{L} = \frac{h}{lnk}$$

1. k taille de l'alphabet
2. $\mathcal{N}_w$ nombre de mots du dictionnaire
3. N taille de la séquence symbolique

Test t apparié des vecteurs d’entropie pour comparer les conditions expérimentales



Interprétation des p value significatives

Quelles informations pouvons-nous extraire des ces résultats en termes de compréhension linguistique ?
Comment interpréter ces résultats ?