Higher-Order Phonological Processing in Pre-Readers with and without Familial Risk of Dyslexia

Maaike Smit[1], Ana B. Carbajal Chavez[1], Marlies Gillis[1, 2, 4], Maaike Vandermosten[1], Pol Ghesquière[4], Jan Wouters[1]

[1]Experimental Oto-, Rhino-, Laryngology (ExpORL), Department of Neurosciences, KU Leuven; [2]Laboratory of Functional Anatomy (LAF), Université libre de Bruxelles; [3]Laboratoire de Neuroanatomie et Neuroimagerie translationnelles, UNI – ULB Neuroscience Institute, Université libre de Bruxelles; [4]Parenting and Special Education Research Unit, KU Leuven

Developmental dyslexia is characterised by severe and persistent literacy deficits despite adequate instruction and intelligence (Peterson & Pennington, 2015). Its phonological origins and developmental trajectory, particularly before reading acquisition, remain insufficiently understood. Identifying early neural markers of phonological processing is key to improving diagnostics and enabling timely intervention.

According to the Double Deficit Hypothesis (Vukovic & Siegel, 2006; Wolf & Bowers, 1999) people with dyslexia show impairments in phonological processing that extend beyond low-level auditory difficulties to higher-order operations involving linguistic context and lexical access.

In this study, 3-year-old (N = 46) and 5-year-old (N = 32) children with and without a genetic risk of dyslexia listened to naturalistic spoken stories while EEG was recorded. We examined phonological encoding by modelling neural responses to two features central to predictive phonological processing: phoneme surprisal and phoneme entropy. Surprisal reflects how unexpected a phoneme is given its context, while entropy quantifies uncertainty in phoneme prediction (Shannon, 1948), indexing competition among phonological candidates (Gillis et al., 2021). Encoding models were applied to derive temporal response functions (TRFs), allowing us to assess both the latency and the strength of neural responses (Gillis et al., 2022). Analyses are ongoing and results will be presented at the conference.

References

Gillis, M., Van Canneyt, J., Francart, T., & Vanthornhout, J. (2022). Neural tracking as a diagnostic tool to assess the auditory pathway. *Hearing Research*, *426*, 108607. https://doi.org/10.1016/j.heares.2022.108607

Gillis, M., Vanthornhout, J., Simon, J. Z., Francart, T., & Brodbeck, C. (2021). Neural Markers of Speech Comprehension: Measuring EEG Tracking of Linguistic Speech Representations, Controlling the Speech Acoustics. *Journal of Neuroscience*, *41*(50), 10316–10329. https://doi.org/10.1523/JNEUROSCI.0812-21.2021

Peterson, R. L., & Pennington, B. F. (2015). Developmental Dyslexia. *Annual Review of Clinical Psychology*, *11*(1), 283–307. https://doi.org/10.1146/annurev-clinpsy-032814-112842

Shannon, C. E. (1948). A mathematical theory of communication. In *The Bell System Technical Journal* (Issue 3).

Vukovic, R. K., & Siegel, L. S. (2006). The Double-Deficit Hypothesis: A Comprehensive Analysis of the Evidence. *Journal of Learning Disabilities*, *39*(1), 25–47. https://doi.org/10.1177/00222194060390010401

Wolf, M., & Bowers, P. G. (1999). The Double-Deficit Hypothesis for the Developmental Dyslexias. *Journal of Educational Psychology*, *91*(3), 415–438. https://doi.org/10.1037/0022-0663.91.3.415