
Print-specific multimodal brain activation in kindergarten improves prediction of reading skills in second grade

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abstract

Children who are poor readers usually experience troublesome school careers and consequently often suffer from secondary emotional and behavioural problems. Early identification and prediction of later reading problems thus are critical in order to start targeted interventions for those children with an elevated risk for emerging reading problems. In this study, behavioural precursors of reading were assessed in nineteen (aged 6.4 ± 0.3 years) non-reading kindergarteners before training letter-speech sound associations with a computerized game (Graphogame) for eight weeks. The training aimed to introduce the basic principles of letter-speech sound correspondences and to initialize the sensitization of specific brain areas to print. Event-related potentials (ERP) and functional magnetic resonance imaging (fMRI) data were recorded during an explicit word/symbol processing task after the training. Reading skills were assessed two years later in second grade. The focus of this study was on clarifying whether electrophysiological and fMRI data of kindergarten children significantly improve prediction of future reading skills in 2nd grade over behavioural data alone. Based on evidence from previous studies demonstrating the importance of initial print sensitivity in the left occipito-temporal visual word form system (VWFS) for learning to read, the first pronounced difference in processing words compared to symbols in the ERP, an occipito-temporal negativity (N1: 188–281 ms) along with the corresponding functional activation in the left occipito-temporal VWFS were defined as potential predictors. ERP and fMRI data in kindergarteners significantly improved the prediction of reading skills in 2nd grade over behavioural data alone. Together with the behavioural measures they explained up to 88% of the variance. An additional discriminant analysis revealed a remarkably high accuracy in classifying normal ($n = 11$) and poor readers ($n = 6$). Due to the key limitation of the study, i.e. the small group sizes, the results of our prediction analyses should be interpreted with caution and regarded as preliminary despite cross-validation. Nevertheless our results indicate the potential of combining neuroimaging and behavioural measures to improve prediction at an early stage, when literacy skills are acquired and interventions are most beneficial.