

Cognitive profiles of children with dyslexia with and without dyscalculia

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Keywords: comorbidity; dyslexia; dyscalculia; dyslexia and dyscalculia; learning disabilities.

Dyslexia (RD) and dyscalculia (MD) are learning disabilities that often co-occur. In Italy the comorbidity of dyslexia and dyscalculia (MD/RD) is between 45% [1] and 70% [2]. Despite this high comorbidity only few researches investigated its etiology bringing contrasting results. So far three main hypotheses can be found in the literature. Due to the overlap in brain networks (Angular Gyrus) of reading and mathematics abilities, a deficit in phonological processing has been hypothesized at the basis of this comorbidity [3]. Another hypothesis claims that a domain general process could have a role in the comorbidity between RD and MD. Several studies found working memory impairment in individuals with MD/RD [4], whereas other studies found processing speed and executive function impairments [5]. Finally, a last hypothesis states that children with MD/RD have an additive profile of the domain specific impairments of the two single deficits, that is an impairment in phonological processing and in the approximate number system (ANS) [6].

The aim of our study was to explore these hypotheses testing dyslexic children with and without MD in a large battery of tests including number and phonological processing and executive functions. After a screening procedure that involved a large number of children attending the 4th grade of 17 primary schools of two North-East towns in Italy, we selected 9 children (7 males) with RD-only, 8 children with MD/RD (2 males) and 10 children without learning disabilities, as control group. The three groups were matched for IQ level.

An Analysis of variance (ANOVA) revealed that groups presented significant differences in phonological processing ($F_{2,24} = 3.87, p = 0.035$), number processing ($F_{2,24} = 12.75, p < 0.001$) and inhibition ($F_{2,24} = 5.72, p = 0.010$) evaluated in a stroop task. Post-hoc analysis revealed that phonological processing (Spoonerism test) was impaired only in the RD group compared to Control group ($p = 0.035$) while the MD/RD group had a significantly worse performance on the symbolic number comparison test compared to Control group ($p = 0.007$) and RD group ($p = 0.010$), on number reading with respect to both Control group ($p < 0.001$) and RD group ($p = 0.003$) and on inhibition test compared to Control group ($p = 0.007$).

Our results support the hypothesis that comorbidity presents important differences with respect to pure dyslexia: at phonological level the group with RD presented more impairment than the group with MD/RD not supporting the phonological processing hypothesis in the etiology of the comorbidity. In addition, the group with MD/RD presented more impairment in inhibition, an executive function recognized as important in both reading and math, suggesting that this lack could be a key factor of the comorbidity of dyslexia and dyscalculia.

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