

Defining learning disabilities: The contribution of latent-profile-analysis to the debate on criteria for learning problems

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There has been an ongoing debate on the classification criteria used to identify math and/or reading learning disabilities in children. Mostly, either a cut-off or a discrepancy-based criterion on achievement outcomes and general cognitive abilities are used for classification. However, results vary as a function of the chosen criteria (Mazzocco & Myers, 2003) and children's allocation to certain categories has been shown to be fairly unstable over time. Further, the theoretical and empirical basis of both classification approaches is weak. Most studies used small sample sizes, which resulted in small groups of students with specific phenomena making it difficult to judge the quality of the chosen criteria (e.g., Mazzocco & Myers, 2003).

When taking into account cut-offs based on individual performance on standardized tests as classification criteria, children can be classified as either learning disabled or typical achieving (e.g., Geary, Hoard, Nugent, & Bailey, 2012; Mazzocco & Myers, 2003). Accordingly, children were classified as learning disabled in math (MD) or reading (RD) if they either scored below the 11th percentile of their age group in the present study. Children whose percentile was between 11 and 25 were considered to have mild math disabilities (MMD). Children who met the criterion of learning disability in both domains were classified as combined learning disabilities (CD). All others were considered as typical achieving (TA).

Moreover, based on the International Classification of Diseases (ICD-10) of the World Health Organisation (WHO), children can also be considered as learning disabled if their performance in one or more domains of scholastic skills lies significantly below their intellectual ability (discrepancy-based criterion). Even though this procedure has been shown to lack validity, it is still used within clinical and scientific contexts. In this study, children were classified as learning disabled in math (MD) or reading (RD) if their achievement was 1.5 SD below their intellectual ability.

The major objective of the present study was to assess the quality of discrepancy- and cut-off-based criteria. More specifically, two research questions were tested. First, it was explored how stable these criteria are over time, and second, if similar groups of children with learning problems could be found using a person-centered approach (latent-profile analysis; LPA). To this end, longitudinal data of N = 2008 students was investigated.

Regarding the first research question, analyses revealed that the CD group was the most stable group over time. In contrast, categorization of MD/SMD and RD students varied substantially between the two time points. Comparing classification groups (cut-off vs. discrepancy-based) analyses revealed a trend for a higher stability of group assignment when applying cut-offs.

Addressing research question two, we conducted latent-profile analyses (LPA). With LPA, students with a similar profile learning abilities (considering different indicators of students' achievement on standardized tests) can be classified to distinct types. Thus, LPA can be applied to explore the specific configurations of ability levels in students and the number of distinct groups.

Applying LPA, five profiles were identified based on students' achievement that. Based on their profiles of achievement, they were labeled *average achieving*, *high achieving*, *low intellectual ability*, *supported over-achiever* and *reading disabled*. No distinct group of mathematically low performing students could be found.

The comparison of the classifications yielded with LPA to the classification yielded with the cut-off-based criteria revealed that most of the CD students would be allocated to the *low intellectual ability* profile. This finding is in line with former research showing lower abilities of children with CD combined to all other groups.

Children with MD or MMD mainly corresponded to the *low intellectual ability* (MD: 58.2%; MMD: 37.2%) or the *supported over-achiever* (MD: 37.3%; MMD: 57.0%) profile. Almost 40% of the children with RD based on cut-offs were allocated to the *reading disabled* profile yielded by the LPA; 43.8% corresponded to the *low intellectual ability* profile.

However, when comparing the classifications yielded with LPA to the classification based on the discrepancy-based criteria, the correspondence of groups were much lower. Even though most children with CD were allocated to the *low intellectual ability* profile, the percentage was considerably lower. Children with MD were mainly classified as the *supported over-achiever* (62.4%)

Interestingly, when considering the RD group only less than 12% of those who had been classified as RD using the discrepancy criterion were allocated to the *reading disabled* profile. Most of the RD children were allocated to the *low intellectual ability* profile. This finding seems to be contradictory to research showing average IQ scores in children with RD.

To our knowledge, this study is the first one applying LPA on a large-scale longitudinal sample in order to assess learning disabilities. Overall, results suggest a higher validity and robustness of the cut-off-criterion compared to the discrepancy-based approach. However, the LPA could not identify a profile or students with distinct math disabilities which points to the fuzziness of the construct of MD. Implications of the study will be discussed.

Mazzocco, M. M. M., & Myers, G. F. (2003). Complexities in identifying and defining mathematics learning disability in the primary school-age years. *Annals of Dyslexia*, 53, 218-253.

Geary, D. C., Hoard, M. K., Nugent, L., & Bailey, D. H. (2012). Mathematical cognition deficits in children with learning disabilities and persistent low achievement: A five-year prospective study. *Journal of Educational Psychology*, 104(1), 206-223. doi: 10.1037/a0025398