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Letter-Speech Sound Learning in Children with Dyslexia. From Behavioral Research to Clinical Practice.

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The current dissertation aimed at expanding our knowledge of letter-speech sound learning and its relation to dyslexia, with an emphasis on bridging the gap between fundamental research and educational and clinical practice.

We started our project with a systematic literature review (Chapter 2). Amalgamating insights from cognitive and neurobiological studies, connectionist models, and expert learning, we concluded that massive exposure to letter-speech sound correspondences has a potential catalytic effect on reading fluency. We also concluded that educational computer games provide unique possibilities for establishing this massive exposure.

With the conclusions from our literature review (Chapter 2) in mind, we set up our first empirical study (Chapter 3) in which we focused on the initial learning of letter–speech sound associations, as well as on the influence of type of instructional approach. Children with dyslexia and typical readers engaged in a 1-hour training aimed at learning eight basic letter–speech sound correspondences within an artificial orthography. By adopting an artificial orthography we were able to rule out a-priori differences in exposure to the experimental stimuli. Children from both groups were assigned to one of three different training conditions: (a) explicit instruction, (b) implicit associative learning within a computer game environment, or (c) a combination of (a) and (b) in which explicit instruction was followed by implicit learning. Both letter knowledge and word reading ability within the artificial script were assessed during the training session. This experimental design allowed us to examine the temporal dynamics of letter–speech sound learning. We obtained convincing behavioral evidence for disrupted letter–speech sound learning in dyslexia. Children with dyslexia were outperformed by typical reading peers on a time-pressured binding task and on a word reading task with the artificial orthography. Furthermore, we found support for the added value of implicit learning techniques in promoting letter-speech sound integration in children with dyslexia.

The results that emerged from this first project encouraged us to refine and optimize the training for further study and to make it suitable for the diagnostic assessment of dyslexia. We therefore developed a 30-minute dynamic assessment (DA), which was used in the subsequent three studies. This DA consisted of a 20-minute training that was based on the computer game from the previous study and that was dedicated to learning the artificial orthography, followed by a short assessment of the mastery of the newly learned correspondences. The assessment included a computerized letter-speech sound identification task that directly measured both accuracy and speed of recognition of the learned letter-speech sound correspondences, and a time-limited word-reading task within the artificial orthography.

In the first study involving this DA (Chapter 4), we performed an experimental analysis of letter-speech sound learning in dyslexic and typical readers vis-à-vis phonological awareness, rapid automatized naming, reading, and spelling. Our results indicated that the artificial script-based measures from the DA were related to phonological awareness and rapid automatized naming, and made a unique contribution to the prediction of individual differences in reading and spelling ability as well as in predicting group membership (dyslexic vs. typical readers).

In a subsequent study (Chapter 5) we focused on the prognostic value of the DA and examined its value for predicting responsiveness to reading intervention for children diagnosed with dyslexia. Children diagnosed with dyslexia engaged in specialized intervention during approximately 10 months and their reading and spelling abilities were assessed before and after. Our results indicated that the DA predicted variance in reading skills at posttest, over and above traditional static measures, such as phonological awareness and rapid naming.

The results from the first three empirical studies thus provided strong evidence for compromised letter-speech sound learning in children with dyslexia. As our stimuli involved an artificial orthography it is unlikely that these findings can be attributed to differences in reading experience between the typical readers and the children with dyslexia. However, our paradigm was not able to fully rule out a possible advantage of typical readers having more reading experience. We therefore took the DA one step further and explored letter-speech sound learning in preliterate children (Chapter 6). More specifically, at the end of kindergarten, we administered our DA to children at familial risk of dyslexia and their typical risk peers. Word reading fluency was assessed two years later at the end of Grade 2. Our findings indicated that the at-risk children performed less well on the DA than their typical peers. Crucially, even though this DA had been administered before the onset of reading instruction, it significantly predicted word-reading performance at the end of Grade 2 and also identified children with below average reading scores at the end of Grade 2. Our data thus indicated that compromised letter-speech sound learning is a causal factor in dyslexia that cannot be attributed to differences in reading experience.

Taken together, our findings confirm that there is a fundamental difference between letter knowledge and automatic letter-speech sound integration, provide strong empirical support for the view that a letter-speech sound learning deficit is a key factor in developing dyslexia, and plead for a more prominent role for letter-speech sound learning in educational and clinical practice.