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Attention performance in young adults with learning disabilities

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Abstract

Attention acts as the mind's "gatekeeper" by regulating and prioritizing the stimuli processed by the central nervous system. It is essential for cognitive performance, memory, and behavior, and we know that even slight deficiencies in attention compromise learning. Basic neuroscience research further indicates that attention consists of (fairly) independent subcomponents, which rely on distinct neural structures, and serve different functions in everyday behavior. Disturbances of brain function, such as those suggested to be related to learning disabilities, may lead to different patterns of attention performance (i.e., some attention systems may work sufficiently well, while others are substantially impaired). The present experiment describes a pilot study that aimed to characterize the extent and range of individual variations in attention performance in persons classified as learning disabled. Specifically, we tested the hypothesis that attention is not uniformly impaired in these individuals. Rather, we expected some subcomponents to be more severely impaired than others, and substantial heterogeneity in the individual "deficit patterns."

The Test of Everyday Attention (TEA) was used to assess visual selective attention, attentional switching, sustained attention, and auditory–verbal working memory in students with nondyslexic learning disability (LD group) and matched controls. The group comparison revealed a significantly weaker performance in the LD group. Analysis of subtest-specific scaled scores further indicated great individual differences in the performance pattern. Thus, in each student with LD, we found normal performance in at least two subtests, while other subcomponents where severely impaired. The study supports the idea of differential attention deficits in the learning disabled, and suggests individual patterns of "strengths and weaknesses." Taking the relationship of attention and learning into account, this finding is important with respect to the design of individual learning programs and the teaching techniques chosen for the acquisition of skills and knowledge.

Keywords: Test of Everyday Attention; Visual selective attention; Attentional switching; Sustained attention; Auditory–verbal working memory; Nondyslexic learning disability

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1. Introduction

The term *learning disability* (LD) describes a condition generally characterized by a partial diminution in cognitive performance. More specifically, while performance in most cognitive functions and the intelligence quotient (IQ) are within the normal range, a severe impairment in a subset of cognitive abilities is observed (Hatton, 2000). A critical issue with respect to the definition of LD concerns its segregation from other clinical categories associated with learning difficulties, such as primary physical problems (visual or hearing problems, physical handicap), psychological conditions, and societal factors (e.g., environmental, ethnic, or economic disadvantage).

At present, the etiology of learning disabilities is not fully understood. However, evidence for basic science, in particular developmental neurobiology experiments, suggests a dysfunction of pre- and/or postnatal neurodevelopmental processes as the main contributing factors for LD (Emerson, Hatton, Bromley, & Caine, 2000). The hypothesis of a physiological origin is further supported by the general observation that LD is frequently associated with other neurological disorders, such as epilepsy and cerebral palsy (McLaren & Bryson, 1987).

LD is a very heterogeneous condition in terms of both phenomenology and severity (Fletcher et al., 2002). On an *interindividual level*, different cognitive functions, language (reading, writing, spelling, and/or speaking), thinking and problem solving, mathematical abilities, social interaction, and communication, can be affected. On an *intraindividual level*, the disability is typically very specific (e.g., language performance is fine but mathematical performance is very poor, or vice versa). Accordingly, different LD subgroups have been specified, dyslexia (a reading disability typified by problems in expressive or receptive, oral or written language; problems may emerge in reading, spelling, writing, speaking, or listening), dyscalculia (problems with arithmetic operations and mathematical concepts), and auditory memory-processing disability (Clements, 2000).

Cognitive performance, memory, and learning depend heavily on the functionality of attentional mechanisms. For example, it was shown that the learning is compromised by slight deficiencies in attention control (Robinson & Winner, 1998). Furthermore, Johnson, Altmaier, and Richman (1999, also Hooper & Willis, 1989) suggested that LD can occur along with and be complicated by problems in attention. In line with this proposition, a recent neuroimaging study (Hari, Renvall, & Tanskanen, 2001) found evidence for a functional selective attention deficit in persons with dyslexia. Given the important role of attention in learning and cognitive performance and the initial evidence for attention deficits, the present study aimed to investigate the functionality of attention performance in non-dyslexic LD.

The specific role of attention in mental life is still under debate (Parasuraman, 1998; Posner & Dehane, 1994; Robinson & Winner, 1998). Some researchers regard attention as a semi-independent supramodal control system for action (Downar, Crawley, Mikulis, & Davis, 2000; Pashler, 1992; Posner & Peterson, 1992). Others have argued against a supramodal mechanism and proposed highly modality-specific mechanisms instead (Allport, 1992; Morrone, Denti, & Spinelli, 2002). While there is increasing evidence for the existence of a supramodal attention system (Eimer & Driver, 2000; Eimer, Velzen, & Driver, 2002; Kennett, Eimer, Spence, & Driver, 2001; McDonald, 2000 #15), modality-specific effects can hardly be ignored. Hopfinger, Jah, Hopf, Girelli, and Mangun (2000) therefore propose a coexistence of supramodal and modality-specific systems, which support different and discrete functional subsystems. The latter represent (fairly) independent entities and rely on distinct neural structures, and, most importantly serve different functions in everyday behavior. From these findings follows the hypothesis that disturbances of