

AOTA Evidence Briefs

Attention Deficit/Hyperactivity Disorder

*A product of the American Occupational Therapy Association's Evidence-Based Literature Review Project

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Background illumination can affect attention

Bylsma, F. W., & Pivik, R. T. (1989). The effects of background illumination and stimulant medication on smooth pursuit eye movements of hyperactive children. *Journal of Abnormal Child Psychology*, 17, 73–90.

Level: IA1a

Randomized control trial, 20 or more participants per condition, high internal validity, high external validity

Why research this topic?

Some children with attention-deficit/hyperactivity disorder (ADHD) have difficulty processing visual information. The problem may occur because the children cannot efficiently place a visual target on their fovea (an "area of the retina that affords acute vision"—*Merriam Webster's Collegiate Dictionary,* 10th ed.). To do so, the children need accurate control of their eye movements. Two previous studies found inadequate control of eye movement among children with ADHD who were not receiving medication or performing a task designed to enhance their attention. However, some problems with the studies' methodology limited the extent to which the results could be generalized.

What did the researchers do?

Bylsma and Pivik (1989), of the University of Ottawa (Ontario, Canada), decided to examine the relative contributions of three types of influences on the eye movement of children with ADHD: medication, specifically methylphenidate (Ritalin); behavior, represented by a particular task to be performed under certain circumstances; and physiology (particularly the influence of the cerebellum, the part of the brain that coordinates muscles and maintains equilibrium), represented by varying lighting conditions.

The participants in the study were 40 children who averaged 9.5 years of age. Twenty children with ADHD (17 boys, 3 girls) constituted the experimental group, 20 children without ADHD (11 boys, 9 girls) constituted the control group. The latter were matched for age with the former. To be eligible for participation, the children in the experimental group had to score greater than 1.5 on the Hyperactivity/Impulsivity Index of the revised Conners Parent/Teacher Rating Scale, meet the criteria for ADHD identified in the *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed.), be on methylphenidate and be responding favorably to it; and have been exhibiting ADHD symptoms since the age of 3 years.

The children in both groups performed a task that required them to track a moving light with their eyes. Electrodes applied to the skin surrounding the children's eyes and scalp (three sites) recorded eye movements and changes in alertness, respectively. The researchers asked the children to press a hand-held button when they saw an interruption of the light. This task represented the behavioral method of enhancing attention. Both groups performed the tracking task for 15–20 "oscillations" (target light was extinguished in a random fashion) under each of two conditions: light and dark. In the light condition, the children performed with the lights on; in the dark condition, in a darkened room. The dark condition represented an attempt to determine cerebellar involvement in impaired Pursuit Eye Movement (PEM). The sequence of the conditions was varied randomly within the testing session.

The experimental group also performed the task under medicated and nonmedicated conditions. A child's parents or physician decided the sequence of these sessions. For the nonmedicated condition, the child had to be medication-free for at least a week.

The researchers were interested in *velocity arrests* (determined by the number of times that the velocity of eye movement was less than 2° per second); *root mean square error* (roughly, an average of the varying extents to which the eye was off target during a trial); and *corneoretinal potential* (the difference in electrical charge between the cornea and the retina, known to vary from dark to light conditions and thought to affect accuracy of tracking). All these outcome areas were measured by special equipment. The children in the control group were tested once. The children in the experimental group were tested twice: once under the medicated condition and once under the nonmedicated condition.

What did the researchers find?

When they were not medicated, the children with ADHD produced **significantly** (see *Glossary*) more velocity arrests than the control group under both light and dark conditions. When they were medicated, the children with ADHD did not differ from the control group in velocity arrests. Both groups, regardless of medication condition, produced significantly more velocity arrests under light conditions than under dark ones. There was no difference between ADHD medication and nonmedication in velocity arrests.

In all the groups, significantly decreased root mean square error scores occurred under dark conditions than under light ones.

What do the findings mean?

For therapists and other providers, the findings corroborate previous reports that children with ADHD have difficulty with visual tracking. However, they fail to corroborate a previous report that medication improved such tracking. "For all subjects, dark condition testing was associated with significant reductions in [velocity arrest] scores and [root mean square] error values relative to the light condition. Combining medication and dark testing tended to normalize [velocity arrest] scores" (p. 84). In addition, the study points to the utility of compensatory methods for visual tracking in this population. Further studies are needed on subcortical structures' role in PEM dysfunction.

What are the study's limitations?

The authors use a somewhat weak and questionable method to assess cerebellar involvement in PEM dysfunction in ADHD (light versus dark conditions). Because both control and ADHD groups benefitted from dark conditions, it is difficult to conclude anything regarding cerebellar pathophysiology in ADHD.

This is a well-designed and -executed study. However, the argument for cerebellar dysfunction as the cause of the aberrant PEMs is weak because all groups benefitted from dark testing. Furthermore, tracking ability (other than number of velocity arrests) was normal. More studies, using more sensitive measures of cerebellar function, are needed to speculate on the functional state of the cerebellum in children with ADHD.

Glossary

significance (or significant)—A statistical term, this refers to the probability that the results obtained in the study are not due to chance, but to some other factor (such as the treatment of interest). A significant result is likely to be generalizable to populations outside the study.

Significance should not be confused with clinical effect. A study can be statistically significant without having a very large clinical effect on the sample. For example, a study that examines the effect of a treatment on a client's ability to walk may report that the participants in the treatment group were able to walk significantly longer distances than the control group. However, if you read the study you may find that the treatment group was able to walk, on average, 6 feet, whereas the control group was able to walk, on average, 5 feet. Although the outcome may be statistically significant, a clinician may not believe that a 1-foot increase will improve his or her client's function.

Terminology used in this document is based on two systems of classification current at the time the evidence-based literature reviews were completed: <i>Uniform Terminology for Occupational Therapy Practice—Third Edition</i> (AOTA, 1994) and <i>International Classification of Functioning, Disability and Health (ICIDH-2)</i> (World Health Organization [WHO], 1999). More recently, the <i>Uniform Terminology</i> document was replaced by <i>Occupational Therapy Practice Framework: Domain and Process</i> (AOTA, 2002), and modifications to <i>ICIDH-2</i> were finalized in the <i>International Classification of Functioning, Disability and Health</i> (WHO, 2001).	
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