



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

Children with Attention Deficit/Hyperactivity Disorder (ADHD) benefit in arithmetic performance from background music of their own choice

CITATION: Abikoff, H., Courtney, M. E., Szeibel, P. J., & Koplewicz, H. S. (1996). The effects of auditory stimulation on the arithmetic performance of children with ADHD and nondisabled children. *Journal of Learning Disabilities, 29*, 238-246.

LEVEL OF EVIDENCE: IIA1a

RESEARCH OBJECTIVE/ QUESTION

To evaluate the impact of commonly occurring forms of extra-task stimulation on the academic task performance of children with ADHD and children without ADHD; examined effects of auditory distracters on the arithmetic performance of the 2 groups

DESIGN

| | | | | | |
|--|--------|---|--------------|--|-----------------|
| | RCT | | Single case | | Case control |
| | Cohort | X | Before-after | | Cross-sectional |

RCT = randomized control trial

Non RCT 2 groups.

SAMPLING PROCEDURE

| | | | |
|---|------------|--|-------------|
| | Random | | Consecutive |
| X | Controlled | | Convenience |

SAMPLE

| | | | | |
|--------|--|-----------|----------------|------------|
| N = 40 | M age = 9.9 years, (range 7.5–13 years) | Male = 40 | Ethnicity = NR | Female = 0 |
|--------|--|-----------|----------------|------------|

NR = Not reported

PARTICIPANT CHARACTERISTICS

Inclusion criteria:

- ADHD (DSM-III)

- 1.5 on the hyperactivity factor of the Conners Teacher Rating Scale (CTRS)
- Scale score of 8 on the Wechsler Intelligence Scale for Children–Revised (WISC–R)--vocabulary subtest
- Children receiving psychostimulant medication, medication free for at least 24 hours before testing

Exclusion criteria:

- Wide Range Achievement Test–Revised (WRAT–R)--Arithmetic subtest, standard score of 85 or less
- WRAT–R Arithmetic score 15 or more points below estimated intellectual ability (based on WISC–R)
- Psychotic or concomitant diagnosis of major affective disorder, separation anxiety disorder, pervasive developmental disorder, or developmental arithmetic disorder
- Functional score on Arithmetic Screening Test (AST) lower than 2nd grade

MEDICAL DIAGNOSIS/CLINICAL DISORDER

ADHD

OT TREATMENT DIAGNOSIS

N/A

OUTCOMES

Arithmetic performance

| Measures | Reliability | Validity |
|--|--------------------|-----------------|
| WRAT–R Arithmetic subtest | Y, but NR | Y, but NR |
| WISC–R Vocabulary subtest | Y, but NR | Y, but NR |
| AST | NR | NR |
| 3 arithmetic exams at grade level corresponding to functional performance on AST | NR | NR |

NR=Not reported

Outcome—OT terminology

Performance areas:

- Work and productive activities
- Educational activities

Outcome—ICIDH-2 terminology

Activity limitations

INTERVENTION

3 experimental conditions: Arithmetic exams were administered

1. 10 min of music

2. 10 min of background speech
 3. 10 min of silence
- 6 groups, each receiving a different sequence of conditions

Description

- 1) Child's favorite music
- 2) Nightly business report aired on local television
- 3) Silence

Experimenter present

Who delivered

Not specified

Setting

Not specified

Frequency/Duration

30 min

Follow-up

N/A

RESULTSArithmetic performance:

Problems attempted: Groups did not differ significantly in the number of arithmetic problems attempted.

Number of correct answers: No significant main effect for group or condition; significant group X condition interaction [$F(2, 68) = 5.94, p < .004$]. Follow-up analysis of simple main effects for the ADHD group was significant [$F(2, 76) = 5.36, p < .01$]. Newman-Keuls post-hoc tests indicated that, under the music condition, the children with ADHD had more correct answers than during the speech ($p < 0.1$) or silence ($p < .05$) conditions. No difference was found in the performance of the children with ADHD between the speech and silence conditions. Children without ADHD performed similarly under the 3 background conditions.

Accuracy: Groups did not differ significantly in their overall accuracy scores [$F(1, 26) = .03$], nor was there a significant main effect for conditions or for the interaction of group X condition [$F(2, 52) = 1.62$].

Order effect: Children with ADHD who had music presented as the first condition had more than twice as many correct answers as those with ADHD who received music as the 2nd or 3rd condition.

Analysis of variance: Indicated a significant order effect [$F(2, 34) = 5.03, p < .02$].

CONCLUSIONS

Results contribute to the understanding of the impact of auditory distracters on the arithmetic performance of children with ADHD.

- Overall auditory stimulation did not adversely affect the performance of either the children with ADHD or those without. Moreover, the arithmetic performance of the children with ADHD actually benefited from music, whereas those without performed similarly under the 3 auditory conditions.
- When music was playing, the children with ADHD increased their number of correct answers by 33% and 23% relative to their performance during speech and silence, respectively. In comparison, the children without ADHD averaged 9% fewer correct answers when exposed to music than when working under silence or background speech (a nonsignificant difference).
- Benefits associated with music in the group with ADHD appear to be related to the facilitative effects of appealing, highly salient stimulation for these children.
- An unanticipated serial order effect indicated that music's facilitative effects were contingent on when the music was presented. The significant increase in number of arithmetic problems attempted and in number of correct answers resulted only when music occurred during the first 10-min block and not when it occurred during the subsequent 10-min blocks.

LIMITATIONS

Limited generalizability with respect to the effects of other types of stimulation and academic tasks other than extra task stimulation (auditory) on the academic (arithmetic) performance with ADHD. Effect on “arithmetic performance” (more problems completed) reported, but there was no difference in accuracy (i.e., percent correct). The significant order effect reported is based on three to four subjects, and music had an effect only in the first 10 minutes.

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

This work is based on the evidence-based literature review completed by Erna Imperatore Blanche, PhD, OTR/L, FAOTA, and Gustavo Reinoso, OTR/L. Contributions to the evidence brief were provided by Michele Youakim, PhD.

For more information about the Evidence-Based Literature Review Project, contact the Practice Department at the American Occupational Therapy Association, 301-652-6611, x 2040.

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