Book Chapter

"Attentive Kindergarten": A Small Group Intervention Boosting Attention among Kindergarten Children

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Abstract

(1) Background: The purpose of this study was to investigate the effectiveness of a small group intervention program named "Attentive Kindergarten" (AK), aimed at enhancing attention functioning among typically developing preschool-aged children. The program focuses on improving sustained attention, selective spatial attention, and response inhibition based on cognitive training principles.

(2) Methods: The study's sample included 51 children, 15 of whom received the AK intervention and 36 of whom served as a control group. Computerized cognitive tests were used for pre- and postintervention evaluations to assess sustained attention, response inhibition, and selective spatial attention. Quantitative analyses were conducted to examine the differences between the two groups as a result of the intervention program.

(3) Results: The AK group demonstrated improvements in all attention functions that were measured. These improvements were larger than those obtained in the control group.

(4) Conclusions: The results suggest that cognitive training programs, such as Attentive Kindergarten, can enhance attention functioning in young children. The present findings have important implications for early intervention programs aimed at improving young children's cognitive skills, which, in turn, can decrease the likelihood of future attention problems and other related difficulties.

Keywords

Attention Functioning; Cognitive Training; Sustained Attention; Selective Spatial Attention; Response Inhibition; Preschoolers

Introduction

Over the years, the role of cognitive factors in early childhood development has gained significant attention [1,2]. Cognitive functions have been found to play a crucial role in academic performance throughout an individual's lifespan [3-7]. Given this importance, previous studies have explored targeted training as a means to enhance cognitive functions, including attention functions, working memory, and cognitive control, and have demonstrated its potential to enhance these functions [8-12]. This is especially relevant for preschoolers, who are at an ideal age for boosting cognitive development, making it an opportune time for cognitive training activities [13,14]. As attention is a central and vital component of the cognitive system, attention difficulties can have broad implications that may negatively

impact children's scholastic, social, and emotional functioning throughout their development.

One prevalent disorder that affects attention is attention deficit hyperactivity disorder (ADHD), which is characterized by high levels of inattention, hyperactivity, and impulsivity, significantly reducing the quality of social, school, or work functioning [15,16]. According to a national survey in the United States, 6 million children between the ages of 3 and 17 (9.8%) were diagnosed with ADHD between 2016 and 2019 [17]. As ADHD persists throughout life, individuals with the disorder experience reduced quality of life in multiple domains, including psychosocial and achievement-related aspects, when compared with their typically developing peers [18-20]. It is important to acknowledge that accurate diagnosis of ADHD is a complex task, as symptoms of inattention, hyperactivity, and impulsivity can stem from other factors as well [18,21]. Furthermore, it is worth noting that preschool-aged children who exhibit attention difficulties and excessive movements often go undiagnosed, as professional assessments are commonly conducted during the elementary school years. The participants of the current study were preschoolers who had not been diagnosed with ADHD and were therefore considered to have typical development. However, the children who participated in the intervention program were selected by their teachers based on suspicions of attention difficulties.

Various theoretical models of attention have been suggested in the literature to explain the cognitive mechanisms underlying attention difficulties [22-24]. The theoretical framework of this study was the four functions of attention model, which treats attention as a multifaceted cognitive construct. This model refers to four distinct attentional functions: (a) sustained attention, (b) selective spatial attention, (c) orienting of attention, and (d) executive attention, which includes response inhibition and conflict resolution [24].

Cognitive training, also known as brain training or cognitive enhancement, is a method that focuses on the development of different cognitive mechanisms through repeated exposure to

various tasks and activities, gradually increasing the level of difficulty based on each trainee's progress. To achieve the most from cognitive training, it should be based on three main principles: (a) structured intensive practice—each activity repeats itself several times; (b) graduality—a change in the level of difficulty according to the progress of each individual trainee; and (c) use of feedback—information given to the trainee about their performance that nurtures their learning. The feedback has three main goals: (a) cognitive goal—feedback on the quality of performance; (b) emotional goal—the experience of success and achievement that contributes to self-confidence; and (c) motivational goal—maintaining the learner's active involvement and investing their efforts in the trained activities and tasks [25,26]. Implementing the principles of cognitive training in different learning environments and settings can create multiple opportunities for a successful learning experience for all learners, especially those with difficulties. Moreover, since the trained functions and skills are general cognitive functions, their improvements are assumed to be transferable and generalizable [26].

A number of cognitive training intervention programs for preschoolers and primary school children yielded very positive and encouraging findings in children with ADHD or at risk for ADHD, such as a decline in inattention symptoms [11,12,27-29] and significant improvements in the cognitive skills that were trained [10,12,27,30] and in academic performance [11]. Cognitive training intervention programs have also shown promising results with children with autism [31,32], children with fetal alcohol syndrome [33], as well as in children with low socioeconomic backgrounds [14,34]. Nevertheless, the findings regarding cognitive training for preschool children are inconsistent, as some studies failed to demonstrate any improvement as a result of the interventions [13,35]. In the present study, we investigated the effects of a new small group cognitive intervention, led by the teachers, on attention functioning specifically designed for preschool-aged children.

The Attentive Kindergarten Program

In this innovative project, a noncomputerized cognitive training program for preschoolers (aged 4–7 years) named "Attentive Kindergarten" was developed to enhance children's readiness for the transition to elementary school. The program serves as a preventive measure that aims to significantly reduce the likelihood that young children at risk of various difficulties will suffer the long-term negative consequences of their difficulties (e.g., with relationships, at school, at work, or at home) [36]. This objective can be achieved through a well-informed and appropriate investment in the development of effective cognitive mechanisms and coping strategies that will enhance preschool children's resilience.

The Attentive Kindergarten program is based on Tsal and colleagues' model [24] and is comprised of theory-driven structured activities from the preschool teacher toolbox, mostly based on familiar games. Therefore, the program is easy to implement and manage by teachers.

The various program activities aim to develop and train:

(a) *Sustained attention*—the ability to maintain attention during a task/activity for an extended period of time, especially when the task does not allow ongoing active participation (e.g., activities that require taking turns, demanding the child to patiently and passively follow the sequence of a game for an extended period of time while remaining attentive to process important, relevant information) [24].
(b) *Selective spatial attention*—the ability to focus attention on a restricted area while ignoring adjacent distractions (e.g., activities that require searching for a specific object in a crowded place, searching for a certain word in a text, and activities that involve copying text or a visual pattern). Even social abilities, such as listening and interacting with others through spoken language, involve parsing word boundaries and extracting meaning from a continuous stream of auditory input. Research has found that selective attention can help listeners identify and predict initial word segments and

selectively direct attention to those points in time to aid in processing [2].

(c) *Response inhibition*—the ability to delay reaction through the practice of playful activities, especially when those activities are very familiar. These activities involve controlling the onset and termination of motor activity according to rules and cues for change and participating in activities where one must wait one's turn. Response inhibition is highly important in developing the ability to self-regulate [**37**].

Several studies have emphasized the importance of the attention functions mentioned above for academic performance. For instance, children with low learning-related skills during kindergarten (such as response inhibition) were found to perform worse than children with high learning-related skills in reading and mathematics, with the gap widening during the elementary school years [3]. Another study demonstrated the importance of response inhibition in preschool as a predictor of children's mathematics achievement in the first year of school [4].

In addition, the significance of selective spatial attention for reading acquisition has been emphasized [5,38], as all written scripts across languages require the serial search of the letters as the words' building blocks [2]. Casco and colleagues [39] found that children who performed poorly on a letter search task also showed slow reading speed and a high rate of reading errors compared with children who performed better on the letter search task. Furthermore, reading speed and comprehension are related to sustained attention, showing that the more severe the sustained attention deficiency, the less effective the reading becomes [6]. Other studies have also found a relationship between sustained attention and math achievements [7,40].

Studies examining the academic performance of children with ADHD indicate that many of them receive poor grades in academic subjects, including reading, mathematics, spelling, and writing [7,41-43]. Research attempting to find associations between ADHD's behavioral characteristics and academic performance indicates that parent- or teacher-reported ADHD

symptom severity may predict poor performance in mathematics, reading, and writing, as sustaining attention, avoiding distractors, and avoiding careless mistakes are crucial for effective performance on achievement tests [7,44-48].

Attentional functions also play an important role in social skills, as they contribute to the ability to maintain focus during social interactions, filter irrelevant information and focus on social cues, and adapt to changes in social situations. In this vein, previous studies examining the relationship between attention and social skills showed a link between ADHD and deficits in interpersonal functioning [49,50] and a correlation between poor sustained attention and social behavior problems [51]. Various studies suggest that children who are well-accepted by their peers during preschool and demonstrate social competence and skills in early childhood are more likely to successfully navigate their relationships with peers, develop positive peer relationships, and exhibit better academic achievement, school adjustment, and psychological well-being in adulthood [52,53].

Overview of the Current Study

This study aimed to investigate the cognitive outcomes of the Attentive Kindergarten program for typically developing young children. Our intervention program was meticulously designed for practicing various attentional components through a variety of engaging games. Therefore, the current research addresses a gap in the field of early childhood interventions. As numerous intervention programs exist to enhance academic skills such as numeracy and early literacy, there is a scarcity of evidence-based cognitive interventions specifically tailored for preschoolers. Furthermore, interventions targeting attentional functions in this age group are notably limited in number [54,55]. Given the crucial role of attentional functions in both academic and socio-emotional spheres, it is of paramount importance for teachers to be able to identify attentional difficulties as early as possible and have basic tools to address them. One of the unique characteristics of our training program is the training provided to the teachers in the field of attention.

Materials and Methods

Participants

This study's sample included 51 children from three kindergarten classes. Parents of all participants had signed a written consent form allowing their children to participate in the study. From these children, each teacher selected 5 participants to take part in the "Attentive Kindergarten" (AK) intervention—a total of 15 children (10 boys and 5 girls; mean age = 5.13, *SD* = 0.32) based on predetermined criteria such as suspected attention difficulties. The remaining children were assigned to the "business as usual" (BAU) group—a total of 36 children (18 boys and 18 girls; mean age = 5.20, *SD* = 0.48).

The Attentive Kindergarten (AK) Program

The AK program includes nine games divided into three categories: three for sustained attention training, three for selective spatial attention training, and three for response inhibition training. Each game has three difficulty levels: basic, intermediate, and advanced. All training sessions have a similar structure consisting of a session opening, followed by one game from each of the three categories, and a session summary.

vThe program follows the principle of graduality: In the first three weeks, all nine games are played at the basic level. In weeks four through six, all nine games are played at the intermediate level, and in weeks seven through nine, all nine games are played at the highest level (advanced). Another important principle of the intervention program is the implementation of feedback throughout the training activities. Two types of feedback were included. The first was given through the various activities: Teachers were instructed to provide immediate, relevant, and accurate feedback on children's performance during the games (e.g., not just: "well done"; instead, the teacher was instructed to say: "great that you were able to hold back until the question was completed"). The second type of feedback was given at the session summary stage, in which positive feedback was given to all participants that could include aspects that went beyond the program's training foci and

could relate to behavioral, social, and emotional factors (e.g., "today you offered your friends help, which created a very pleasant feeling for them").

The Assessment Tools

As part of the program protocol, pre- and postintervention computerized cognitive tests were administered to participants in both groups by research assistants. The research assistants explained the instructions to the participants and verified their understanding. To adjust the tasks to young children, the instructions were gamified, concrete examples were included, and additional practice was provided to encourage cooperation and to ensure comprehension. The order of the tasks was predetermined and consistent, with short breaks included between tasks.

Conjunctive Continuous Performance Test (CCPT)

The CCPT was used to assess sustained attention and response inhibition. In this task, a series of geometric shapes in different colors were displayed on the monitor. Participants were asked to respond to the target stimulus by pressing the spacebar and to delay their responses when other stimuli were displayed [8]. This task was adapted for preschool children ("CCPTag") and consisted of a single block of 160 trials (rather than 320 trials) in which the target stimulus appeared in 70% of them (Figure 1a). Two measures were used to assess sustained attention: (a) the standard deviation of response times (SD of RTs) for correct responses, reflecting the inconsistency of RTs, and (b) the percentage of omission errors, reflecting lapses of attention. Higher values of these measures indicate lower sustained attention levels. A third measure, commission errors ("false alarms"), was used to measure response inhibition.

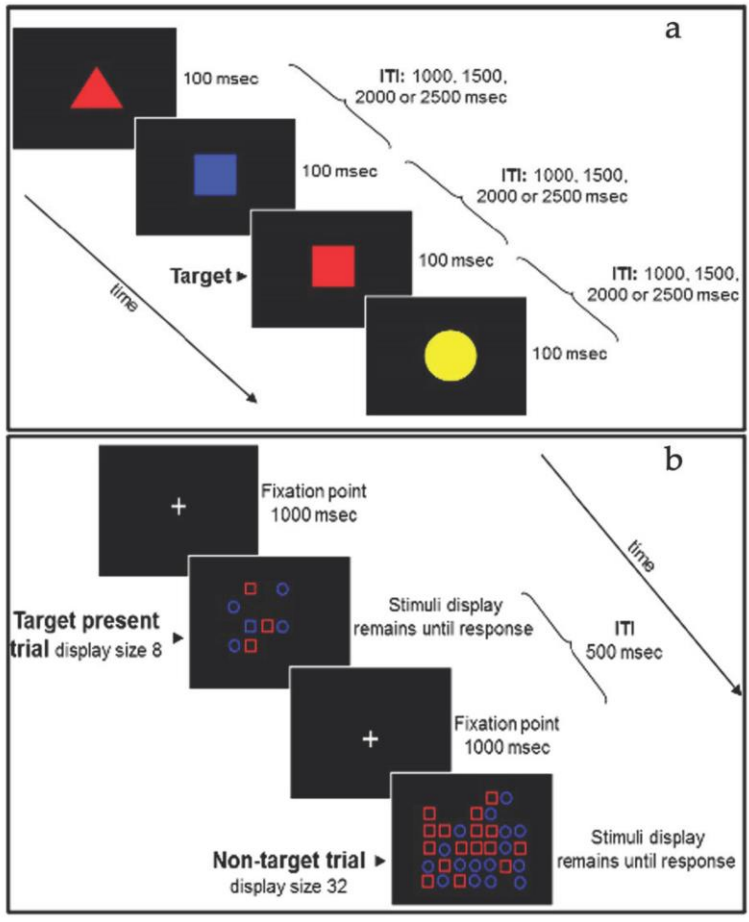

Figure 1: (**a**) Design of the conjunctive continuous performance task (CCPT); (**b**) design of the conjunctive visual search task (CVST).

Conjunctive Visual Search Task (CVST)

This task was designed to assess selective spatial attention. In this task, participants were asked to search for a blue square that appeared among an equal number of red squares and blue circles [8]. This task was also adapted for preschool-aged participants ("Hide-and-Search") and included three blocks of 42 trials each (rather than four blocks) and three display sizes of 8, 16, or 32

items (Figure 1b). The dependent measures were the mean RT and the accuracy rate for the most crowded condition (i.e., 32 items with target).

Procedure

The study received the approval of the chief scientist of the Ministry of Education as well as the university ethics committee. Informed consent was obtained from the parents of all participants after they received a letter from the kindergarten teacher that included explanations about the research. Each teacher selected participants for the AK group based on predetermined criteria.

The AK program was delivered separately in each kindergarten class (n = 3) as part of its routine. Prior to the intervention, teachers received theoretical and practical training on how to deliver the AK program in a small group setting and a kit developed specifically for this purpose. The kit included the training games' accessories, along with a detailed manual of the program. The training program consisted of small group sessions of 30 min twice a week for nine weeks (18 sessions in total), during which teachers received professional guidance from research assistants. After each training session, teachers completed a structured form on which they documented summary information.

To assess changes in participants' attentional functioning, pre- and postintervention assessments were conducted by research assistants who were blinded to group affiliation. Assessments were conducted individually in a quiet room in the junior division.

Data Analysis and Design

To examine the differences between the AK and BAU groups resulting from the intervention program, quantitative analyses were performed. We compared the baseline performances between the AK and BAU groups by conducting a series of two-sample t-tests for all measures, including CCPT SD of RTs,

CCPT omission errors, CCPT commission errors, CVST mean RTs, and CVST accuracy rates. Additionally, we employed a series of mixed ANOVA models to assess the performance changes of kindergarten children who underwent the AK program in comparison to those who underwent the BAU condition. In each model, group (AK vs. BAU) was the between-subject variable, and time (before vs. after intervention) was the within-subject variable. The statistical significance threshold was set at $p \leq 0.05$, and $0.05 \leq p \leq 0.1$ was considered marginally significant. Effect sizes are reported as partial eta squared (η_p^2(. All figures include the standard error of each mean. The analyses were carried out using SPSS Statistics 28.0.1.1, and the figures were created using JASP.

Results

Descriptive Statistics

Table 1 presents descriptive statistics for all study measurements for both the AK and BAU groups.

Table 1: Means and SDs for AK and BAU groups before and after the intervention (n = 51).

Time	Measure	AK Group n = 15		BAU n = 36	
		M	***SD***	***M***	***SD***
Before intervention	CCPT SD of RT (ms)	224	75	148	37
	CCPT omission error rate	0.15	0.11	0.10	0.08
	CCPT commission error rate	0.12	0.07	0.07	0.07
	CVST mean RT (ms)	2090	339	1850	396
	CVST accuracy rate	0.82	0.13	0.88	0.10
After intervention	CCPT SD of RT	191	55	146	54
	CCPT omission error rate	0.11	0.13	0.06	0.08
	CCPT Commission error rate	0.07	0.06	0.07	0.08
	CVST mean RT	1928	310	1683	431
	CVST accuracy rate	0.92	0.05	0.91	0.10

Note. CCPT, conjunctive continuous performance test; CVST, conjunctive visual search task; SD, standard deviation; RT, reaction time; ms, millisecond.

Baseline Comparison between Groups

Five two-sample t-tests were performed to compare all attention measures in the AK and BAU groups before the intervention. Significant differences were found for all measures, indicating that the AK group had lower baseline scores compared with the BAU group. The t-tests results are presented in Table 2.

Table 2: The *t*-tests results comparing the AK and BAU groups on all measures before the intervention.

Measure	Group	*n*	*M*	*SD*	*t*	*df*	*p*	Cohen's *d*
CCPT SD of RT (ms)	AK	15	224	75	3.61	49	0.001	1.511
	BAU	36	148	37				
CCPT omission error rate	AK	15	0.15	0.11	1.97	49	0.027	0.622
	BAU	36	0.10	0.08				
CCPT commission error rate	AK	15	0.12	0.07	2.49	49	0.008	0.785
	BAU	36	0.07	0.07				
CVST mean RT (ms)	AK	15	2090	339	2.05	49	0.023	0.620
	BAU	36	1850	396				
CVST accuracy rate	AK	15	0.82	0.13	−1.76	49	0.047	−0.615
	BAU	36	0.88	0.10				

Note. CCPT, conjunctive continuous performance test; CVST, conjunctive visual search task; SD, standard deviation; RT, reaction time; ms, millisecond.

Mixed ANOVA Models

Sustained Attention—CCPT SD of RT

For the CCPT SD of RT measure of sustained attention, there were significant main effects found for time ($F(1,48) = 4.26$, $p = 0.044$, $\eta^2_p = 0.082$) and group ($F(1,48) = 18.83$, $p < 0.001$, $\eta^2_p = 0.282$), indicating that the AK group had higher SDs of RT compared with the BAU group, and all participants had higher SDs of RT before the intervention compared with after. There was also a marginally significant interaction effect ($F(1,48) = 3.61$, $p = 0.063$, $\eta^2_p = 0.070$). Post hoc analysis using the Bonferroni correction showed that participants in the AK group had significantly smaller SDs of RT after the intervention ($M = 191$, $SD = 56$) compared with before ($M = 224$, $SD = 75$; $p =$

0.024). However, the SDs of RT in the BAU group were not significantly different before (M = 148, SD = 37) and after (M = 146, SD = 54) the intervention (p = 0.879). The marginally significant interaction can be seen in Figure 2.

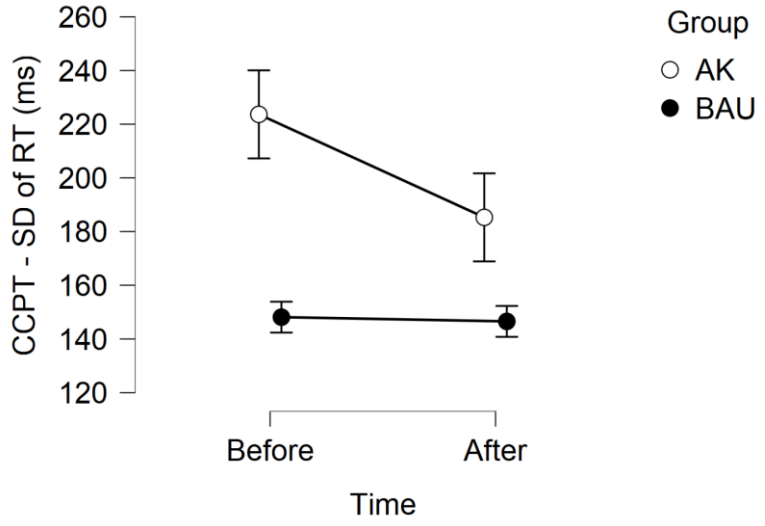

Figure 2: Sustained attention as measured by CCPT SD of RT—a comparison by group and time.

Sustained Attention—CCPT Omission Errors

A significant main effect of time (F(1,48) = 9.65, p = 0.003, η^2_p = 0.167) was found for CCPT omission errors, indicating that these errors were significantly higher before (M = 0.11, SD = 0.09) compared with after the intervention (M = 0.07, SD = 0.09). However, there was no significant main effect of group (F(1,48) = 3.08, p = 0.086, η^2_p = 0.060) and no significant interaction (F(1,48) = 0.69, p = 0.410, η^2_p = 0.014).

Response Inhibition—CCPT Commission Errors

A significant main effect of time was found for CCPT commission errors (F(1,48) = 8.22, p = 0.006, η^2_p = 0.146), indicating that these errors were significantly higher before compared with after the intervention. Importantly, there was a

significant time X group interaction effect ($F(1,48) = 13.02$, $p = 0.001$, $\eta^2_p = 0.213$). Bonferroni post hoc analysis of the interaction showed that participants in the AK group had significantly fewer commission errors after the intervention ($M = 0.07$, $SD = 0.06$) compared with before ($M = 0.12$, $SD = 0.07$; $p = 0.004$). In the BAU group, commission errors were the same before ($M = 0.07$, $SD = 0.07$) and after ($M = 0.07$, $SD = 0.08$) the intervention ($p = 0.470$). The interaction pattern can be seen in Figure 3.

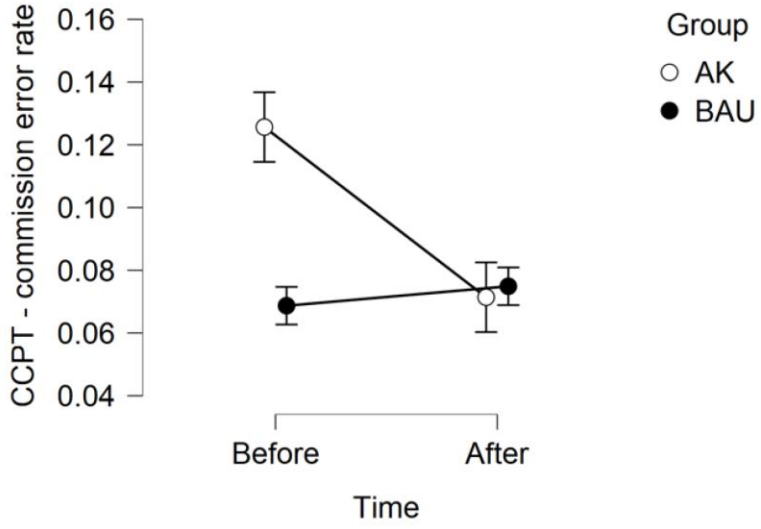

Figure 3: Response inhibition as measured by CCPT commission errors—a comparison by group and time.

Selective Spatial Attention—CVST Mean RT

There were significant main effects of time ($F(1,49) = 12.86$, $p = 0.001$, $\eta^2_p = 0.208$) and group ($F(1,49) = 4.78$, $p = 0.033$, $\eta^2_p = 0.089$), indicating that the AK group had slower mean RTs ($M = 2008$, $SD = 324$) compared with the BAU group ($M = 1766$, $SD = 413$) and that all participants had slower mean RTs before ($M = 1920$, $SD = 392$) compared with after the intervention ($M = 1754$, $SD = 412$). There was no significant interaction effect ($F(1,49) = 0.04$, $p = 0.948$, $\eta^2_p < 0.001$).

Selective Spatial Attention—CVST Accuracy Rate

There was a significant main effect of time ($F(1,49) = 15.44$, $p < 0.001$, $\eta^2_p = 0.240$), indicating that participants had a higher accuracy rate after compared with before the intervention. Importantly, there was a significant interaction effect ($F(1,49) = 4.44$, $p = 0.040$, $\eta^2_p = 0.083$). Bonferroni post hoc analysis of the interaction revealed that participants in the AK group had significantly higher accuracy rates after the intervention ($M = 0.92$, SD = 0.05) compared with before ($M = 0.82$, $SD = 0.13$; $p = 0.003$). However, the BAU group did not exhibit a significant difference in accuracy rate before ($M = 0.88$, $SD = 0.10$) and after ($M = 0.91$, $SD = 0.10$) the intervention ($p = 0.101$). The interaction pattern can be seen in Figure 4.

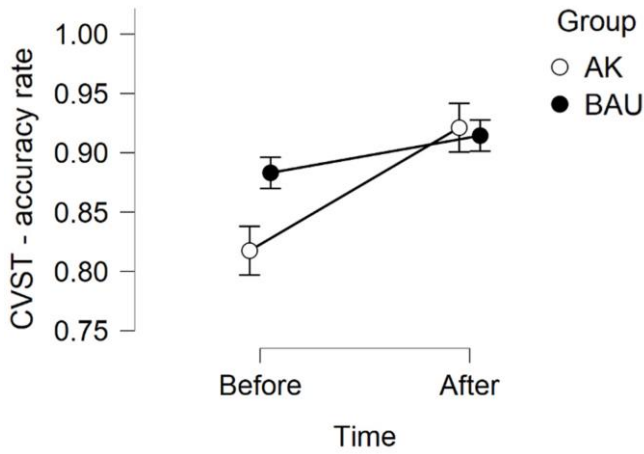

Figure 4: Selective spatial attention as measured by the CVST accuracy rate—a comparison by group and time.

Discussion

The purpose of this study was to investigate the impact of the AK program on the attentional functioning of kindergarten children. The AK program included small group structured training sessions comprised of games designed to enhance sustained attention, selective spatial attention, and response inhibition. The study's findings demonstrated that the AK group

showed a marginally significant improvement in sustained attention as measured by consistency of responses, reflecting a better ability to stay focused during the task, while the BAU group showed no significant differences between the two assessments. Note, however, that in terms of error rate ("misses"), both groups exhibited better performance after training, which could be attributed to natural development or familiarity with the task (or both). Taken together, the results suggest that the AK group showed a tendency for improved sustained attention.

Additionally, the results indicated that the AK program had a significant impact on response inhibition. The AK group demonstrated fewer "false alarms" errors after the intervention, while the BAU group showed no improvement. Regarding selective spatial attention, the results revealed that both groups exhibited faster reaction times after training, which could be due to increased familiarity with the task in the second assessment. However, only the AK group also demonstrated improved accuracy. Thus, the results suggest that the AK program is also effective in enhancing selective spatial attention in kindergarten-aged children. The observed improvements can be interpreted as indicating near-transfer effects, that is, improvement in functions similar to those that were trained in the intervention. Nonetheless, there were substantial differences between the assessment tools and the intervention activities.

These results are consistent with a growing body of research that has demonstrated the potential effectiveness of cognitive training for improving cognitive functioning in young children. For example, previous studies have found that cognitive training interventions can lead to improvements in cognitive functioning in children with ADHD [10,12,27,30], as well as in children with autism [31,32] and low socioeconomic backgrounds [14,34]. The current study adds to this literature by demonstrating the effectiveness of the AK intervention in a sample of kindergarten-aged children who were not diagnosed with any specific difficulties by a qualified clinician prior to the research and who did not come from a challenging socioeconomic background. As such, the findings imply that cognitive training interventions

may be beneficial for improving the cognitive performance of young children in general.

Yet, it is noteworthy that participants in the AK group were children who had difficulty following various routines in kindergarten, as reported by their teachers. These children, selected by the kindergarten teachers, also exhibited lower attention function scores compared with the BAU group, reflecting convergence between teachers' subjective impressions and objective cognitive measures. These findings, along with the results obtained by the AK group, suggest that the intervention may be particularly beneficial for children at risk of attention deficits or other cognitive difficulties in the future, and not just those with specific diagnosed deficits or disorders.

The findings also suggest potential benefits of early cognitive training, which may offer a feasible way to forestall the emergence of cognitive difficulties that could hinder children's academic and social development. This is in line with the objectives of the AK program, which seeks to decrease the possibility of negative effects induced by attention deficits. Future studies are required to assess the effects of the AK in this context.

It is worth emphasizing that these findings are noteworthy in light of the fact that the small group intervention sessions were delivered by kindergarten teachers rather than research assistants, as was common in many previous intervention studies [14,27,28]. This is in accordance with the goals of the AK program, which not only strives to improve the cognitive skills of preschool children but also aims to enhance the professional development of teaching personnel. By participating in the program, preschool teachers can gain a better understanding of the different attention functions and learn how to identify and address children's needs. In addition, it enhances their familiarity with the children, enabling them to adapt their teaching methods and personalize their kindergarten activities accordingly. The knowledge and practical experience can lead to valuable professional growth and empowerment.

Furthermore, the program includes a straightforward documentation method that outlines the children's performance, the intervention received, and its effectiveness. This documentation provides a structured record of children's performance, enabling educational personnel to make personalized adjustments and seek further professional consultation and treatment when necessary.

Limitations and Future Research Directions

One limitation of the current study is the small sample size of the AK group. This might limit the generalizability of our findings. Future studies should examine the effectiveness of the AK intervention in a larger and more diverse sample of young children to confirm the current findings and investigate its efficacy in different populations.

It is also important to consider the use of an active control group instead of a passive control group to ensure that the results are exclusive to the training activities. In the current study, the pre- and postintervention assessments were administered by research assistants who were blind to the children's group affiliation. In addition, the differences between the assessment tools and the intervention activities were substantial, so that the training games did not provide prior familiarization with the computerized assessment tasks.

Another limitation is that the impact of the intervention was assessed by cognitive tasks solely. Future research should strive to employ a more comprehensive set of measures to also evaluate (pre)academic performance, social skills, and additional cognitive functions.

Finally, the current study did not include a follow-up assessment to determine the long-term effects of the AK intervention. Therefore, while the significant improvements in attention seen in the AK group are encouraging, it is important to note that there is no information about the sustainability of the improvements over time. Future research should include a follow-up assessment if possible.

Implications

The findings of this study have significant educational implications for early intervention programs. They provide encouraging support for the effectiveness of the AK intervention in enhancing attention functioning in kindergarten-aged children. The games used in the intervention can be integrated into everyday preschool activities, enabling teachers to proactively address preschoolers' attention difficulties and empower them with effective tools to enhance attention functioning. Furthermore, the guidance provided to teachers in implementing the AK program equips them with valuable knowledge and skills that can be applied beyond the intervention itself. Teachers can leverage the principles they have learned to adjust other activities and tailor them to better fit the individual needs of different children.

The implications of this study extend beyond the immediate benefits for participating children. Attention difficulties often have long-term consequences, impacting developmental milestones throughout life. By implementing the AK program, we have the potential to significantly improve the ability to provide young children with attention difficulties the opportunity to experience meaningful learning, thereby improving their chances of reaching their full potential.

Conclusions

In conclusion, the AK program demonstrated promising results in improving attentional functioning in kindergarten children. The findings indicate that the AK group showed improvements in sustained attention, response inhibition, and selective spatial attention compared with the BAU group. These results suggest that the AK intervention has the potential to enhance attention skills in young children, particularly those at risk of attention difficulties. The study contributes to the growing body of research supporting the effectiveness of cognitive training interventions in improving cognitive performance, particularly in young children. The integration of the AK program into preschool activities not only benefits participating children but

also enhances the professional development of teachers. Further research with larger and more diverse samples, active control groups, and comprehensive assessment measures is recommended to validate these findings and explore the long-term effects of the AK intervention.

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