Original Research Article

Behavioral Modification and Cognitive Development in Children with Autism — A Pilot Case Series

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ABSTRACT

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by challenges in communication, social interaction, and behavior. This paper explores the behavioral development of individuals with autism through the game of Go, with a focus on Areum Go. Areum Go is a simplified and adapted version of the game designed for individuals with developmental disabilities. Traditional methods such as speech therapy, sensory development therapy, music therapy, and art therapy often do not help foster intrinsic motivation or social engagement. Additionally, most of these methods take place in a one-on-one setting, which reduces opportunities for peer learning, socialization, and natural reinforcement. Areum Go integrates principles of Applied Behavior Analysis (ABA), including physical or verbal prompts, task modification, discriminative stimuli, reinforcement, errorless teaching, and individualized adaptations to each learner's receptive and expressive language abilities. Instructors employ both positive and negative reinforcement, personalized interventions, strong nonverbal feedback, and systematic checking of student responses. This structured yet adaptable approach fosters focus, perseverance, and problem-solving skills while minimizing incorrect learning pathways. Through qualitative instructor interviews with Go professionals and instructors, there were improvements in: (1) Attention and cognitive engagement, (2) Increased social interaction and peer awareness, and (3) emotional regulation and resilience. Our findings support Areum Go having a positive impact on cognitive skills, social engagement, and emotional regulation in neurodiverse learners. As this study included only three instructors, the results may be interpreted as preliminary and may not be generalizable to broader populations.

Keywords: Baduk; Go; Weiqi; Autism Spectrum Disorder (ASD); Cognitive Development; Applied Behavior Analysis (ABA)

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by challenges in communication, social interaction, and behavior. It affects approximately 1 in 36 children in the United States (1) and 1 in 38 in South Korea (2). Individuals on the spectrum often face daily obstacles in sustaining attention, communication, engaging in

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social interactions, regulating emotions, and keeping motivation to learn. Without support and interventions, these challenges can lead to long-term consequences such as social isolation, anxiety, depression, and even a significantly reduced life expectancy due to factors like suicide, accidents, or inadequate medical care. A recent study reported a higher risk of all-cause mortality in Korean children with ASD (hazard ratio = 2.34) than those without (3). A substantially higher risk among girls than boys was also noted.

Current methods include speech therapy, sensory integration therapy, music therapy, art therapy, and pharmacological treatment. While these approaches can improve specific skills and help manage symptoms, they often fall short in fostering long-term cognitive growth, intrinsic motivation, and independence. Additionally, most of these therapies are handled in one-on-one settings, which, while structured, limit opportunities for peer learning, natural social reinforcement, and skill generalization to real-world contexts.

Go (also known as baduk or weiqi) is a strategic East Asian board game that is widely popular in Korea, China, and Japan; it is also gaining interest in the U.S. The game requires only simple equipment, a board, and stones of 2 colors (Figure 1), making it simple yet powerful for developing real-world skills. Areum Go is a modified version of the traditional game designed specifically for individuals with disabilities. It has been postulated that board game instruction could be beneficial to children with ASD, but published

data supporting this notion for Go is scarce in the literature. The objective of this pilot study was to explore the effectiveness of Areum Go in supporting cognitive development, social interaction, and emotional regulation among individuals with autism.

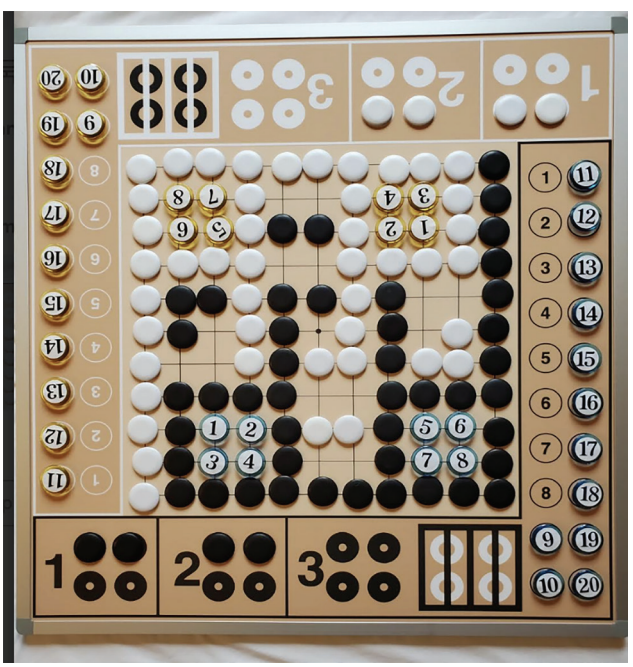

Figure 1. Typical equipment required for Areum Go (Baduk).

METHODS AND MATERIALS

This study employed a qualitative descriptive design using open-ended questionnaires administered via email. Qualitative inquiry offers an appropriate choice when we are interested in a better understanding of the potential benefits of Areum Go instruction. This method allows participants to provide thoughtful, self-paced responses without time pressure, potentially providing richer and more reflective data. A case study framework was used to describe the context of behavioral modification(s). As a pilot study, we chose a single-case study of 3 Areum Go instructors who have taught for one year.

Instructors from different disability welfare centers in South Korea participated in the study. Each had at least one year of teaching experience and was actively instructing 4–8 students, primarily with developmental differences such as autism spectrum disorder, ADHD, or intellectual disabilities. Participants were recruited through email and were given a standard questionnaire consisting of 8 questions (Table 1). Interviews were conducted in Korean and recorded with consent, using both audio recordings and written notes to ensure accurate transcription and analysis. All instructors had prior training in Applied Behavior Analysis (ABA) principles and practical experience applying them in educational settings. Interviews were analyzed following the general procedures of Braun and Clarke's thematic analysis.

The fundamental research question we were trying to explore was: how can Areum Go, when integrated with Applied Behavior Analysis (ABA) principles, support cognitive development, social interaction, and emotional regulation in individuals with autism? A secondary question was: to what extent does participation in Areum Go sessions, incorporating ABA-based teaching strategies, improve attention span, working memory, and social communication skills in children with autism over time?

Table 1. Standard questions in the questionnaire

Q1. *Have you noticed improvements in the children's attention span over time? Could you share a specific example?*
Q2. *Are there specific elements or methods in Areum Baduk that you feel are particularly effective in enhancing memory or concentration?*
Q3. *Can you describe how Go has helped neurodiverse students who struggle with social interaction or communication?*
Q4. *Have you seen moments when students spontaneously initiated conversation or expressed emotions differently than before?*
Q5. *How do you apply ABA principles in your teaching? How do you tailor your methods for each student's needs?*
Q6. *How do you respond when older students or adults show unexpected reactions (e.g., physical outbursts)?*
Q7. *What kinds of reinforcement do you find most effective for maintaining motivation?*
Q8. *Do you think students struggle more with organizing and expressing thoughts, or is it a fundamentally different way of thinking?*

Data Privacy & Consent

Due to the nature of research, instructors were already acquainted with the students they were working with. However, all analyses and written results were conducted and presented without any personally identifying information of the students. Any personal details about the participants were not included, and informed consent was obtained from all participating instructors prior to data collection.

RESULTS

Analysis of the instructor interviews revealed three main themes (detailed below). The findings also highlight how the usage of ABA principles within Areum Go instruction is effective for behavioral modification among learners with autism.

Improvements in attention and cognitive engagement

All 3 instructors consistently mentioned that children who had difficulty maintaining focus were able to extend their attention spans over time while learning Areum Go. One instructor described how "a student who could only remain engaged for 10 minutes could focus for an entire 50-minute session after a couple of sessions". Another instructor said, "One student who used to go to the bathroom at the start of every class no longer does so during Areum Go. He wants to win and improve, so he focuses hard during his turns." Task modification, errorless teaching, and systematic prompting appeared to help prevent frustration and reinforce persistence. 2 out of 3 instructors also observed improvement in working memory, as students began to remember the rules and to recognize repeated patterns within one year of lessons. They also collectively mentioned they were able to see their student anticipating their opponent's moves, suggesting early development of planning and executive function skills.

Increased social interaction and peer awareness

Since Areum Go is played in pairs, instructors noted increased opportunities for natural social engagement. One instructor said, "As they got to know each other, they started cheering, clapping, and showing sportsmanship, including congratulating the other team even after losing." Peer interaction encouraged patience and empathy, as children learned to wait their turn and respond appropriately to both winning and losing, distinguishing Areum Go from other one-on-one therapies.

Emotional Regulation and Resilience

Another theme was growth in emotional self-regulation. Instructors described students who initially displayed frustration or avoidance when losing, but who later developed strategies to deal with the loss. One instructor said, "He used to cry or leave the table if he lost a stone exchange, but now he stays and congratulates the winner instead". This improvement reflects resilience, an important component of emotional regulation. The instructors have linked this progress to the structured reinforcement of Areum Go, where every move provides immediate feedback and opportunities for correction.

DISCUSSION

The purpose of this research is to investigate whether a modified version of Go, Areum Go, can be used as an instrument of cognitive and social-emotional

training for kids with autism. Several studies reported that board games such as chess and Go could enhance one's attention, patience, planning, etc. However, their application to neurodiverse students has not been well established. Evidence from chess research shows that structured, strategic play has measurable advantages in cognition and emotions. Parents across the board describe chess as making kids more patient, focused, and better at controlling their emotions, and learning to win and lose graciously. Meta-analytic measures also confirmed moderate positive influences of chess training on school and cognitive functioning (mean effect size = 0.34) and particularly on mathematical reasoning, with larger effects occurring after more intense training (4). There is also research that generally supports the idea that strategy games contribute to cognitive and neural development (5).

Formal Go training, for example, has been shown to improve attention and executive function in kids with ADHD, with gains that are quantifiable in working memory and attentional control (6). Neuroimaging studies reveal that Go experts possess brain adaptations in regions associated with reward processing (nucleus accumbens), emotion regulation (reduced amygdala volume, increased orbitofrontal-amygdala connectivity), and general network efficiency, all of which reflect increased integration of cognitive and affective control. Other studies demonstrate Go expertise to engage cerebellum-based number estimation networks and harden domain-general working memory systems, demonstrating its ability to enhance skills far beyond the board game itself (7).

Areum Go is different from chess and regular Go. It is pair-based and simplified, lowering the threshold and emphasizing cooperative play. While chess and Go are typically competitive, Areum Go is deliberately social in character, allowing cooperation, turns, and communication, and appropriating the central core element of the game of Go. These features complement the developmental demands of children with autism, who can benefit from restricted opportunities for social reinforcement. This study builds on existing literature by demonstrating that teachers observed Areum Go facilitating not only cognitive growth, but also socio-emotional learning, including patience, resilience with adversity, and understanding for peers.

The integration of ABA principles into the instruction of Areum Go encouraged motivation through natural consequences present in play. This combination of strategy-based cognitive training, visual-spatial problem-solving, and socially interactive design leverages the established cognitive benefits of Go while directly addressing the social and emotional needs of children with autism.

If extended over time, such interventions may support improvements in daily functioning and health in the long term. By improving executive function, social interaction, and emotional regulation, Areum Go could have potential implications for reducing social withdrawal or depression and provide a motivating, challenging environment for skills development. Larger samples, longitudinal follow-up, and direct academic or functional outcome measures are suggested in future studies to determine whether the benefits of Areum Go generalize beyond the training context.

In this study, a semi-structured interview guide was developed to explore instructors' perspectives on the cognitive and socio-emotional effects of Areum Go, as well as how ABA principles were integrated into teaching. We anticipate that Go instruction would foster attention, communication, and self-regulation through motivation rather than repetition, while building essential skills like turn-taking, planning, and hand-eye coordination. Since Areum Go is played in pairs or groups, it naturally promotes social interaction within a structured and rewarding environment. By addressing these core developmental challenges, this method directly supports the needs of individuals with autism who often lack engaging, socially reinforced opportunities to grow. If successful, it is expected that these individuals would experience improved daily functioning and reduced long-term risks. For example, social isolation and depression could be improved through strengthening their cognitive development (improved attention span over time, enhancing working memory, strengthening numerical and spatial reasoning, building executive function), social interaction (building peer empathy and patience), and emotional regulation (being able to process loss and being able to be resilient after defeat).

This study had several limitations. First, the findings were based on a small pool of sample and relied on qualitative, self-reported experiences rather than direct observational or longitudinal data. Therefore, the results may be influenced by teacher perception and may not be generalizable to all learners with autism or other developmental differences. Second, cultural and contextual factors in South Korea may limit applicability to other settings. Third, the instructors interviewed are themselves proponents of Areum Go. There is a potential for positive bias in reporting.

Future research should include larger sample sizes and incorporate standardized cognitive and behavioral measures to more rigorously evaluate the benefits of Areum Go. Longitudinal studies can also be helpful in assessing whether the benefits in attention, communication, and emotional regulation are sustained over time. Finally, future studies should explore how Areum Go can be adapted across different cultures and educational systems, potentially offering a scalable model for neurodiverse learners worldwide.

CONCLUSION

This study shows that Areum Go, integrated with ABA principles, suggests improvements in attention, social interaction, and emotional resilience in children with autism. By incorporating both strategies with peer-based engagement, Areum Go offers a promising tool for cognitive and socio-emotional development. Beyond Go instruction, these findings suggest potential applications of Areum Go in classrooms, therapy centers, and family settings, where structured play and social reinforcement can foster motivation, communication, and adaptive behaviors. Future studies with larger, more diverse samples and objective outcome measures are needed to validate and expand upon these results.

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CONFLICT OF INTERESTS

All research concepts and manuscript structure are original from the authors, but ChatGPT 3.0 assisted in language translation (Korean to English) and sentence paraphrasing.

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