Game-based collaborative interactions among moderately functioning autistic adults

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Abstract

This study focused on examining the motivation of moderate-low functioning autistic adults to establish interaction, cooperation, and interpersonal communication through group activities with the BlazePod platform. The study was based on a pre-intervention, intervention, and post-intervention paradigm. The pre- and post- setup included building a model by using Lego bricks. The results of this study show a significant increase in verbal and nonverbal initiative and cooperation during the intervention with BlazePod platform. The study concludes that a reaction-based game platform is an effective motivation tool for social connections and cooperation, but human mediation is required to transfer these skills to natural environments.

1. Introduction

Adolescents diagnosed on the moderate-to-low functioning autism spectrum require substantial support. They face complex and significant challenges in social communication with restricted and repetitive behaviours. These difficulties are manifested in a limited ability in verbal and nonverbal social communication skills, and in the absence of spontaneous cooperation with their peers. This phenomenon is especially pronounced even when students study together in the same educational setting for years. Although the school provides a stable, safe, and supportive educational environment, including lessons aimed at encouraging interpersonal relationships, natural communication between students remains very poor and is often practically non-existent. This situation raises the need to search for innovative intervention channels that will encourage communication. To try to break through this communication barrier, this study examines the use of the BlazePod system as a game-based collaborative interaction tool. The system provides a structured and clear environment that reduces the social and sensory overload that characterizes face-to-face interactions. The research goal is to examine if the BlazePod system is able to support game-based collaborative interactions between research participants such as waiting in line working together to complete a task without requiring high language and expressive abilities.

Autism spectrum disorder (ASD) is a complex developmental disorder that affects behaviour, social interaction, communication, and academic skills. Its exact causes are unknown, although it is thought to involve genetic, psychological, neurological, fragile health, and environmental factors. Baird et al. (2006) and Brugha et al. (2011) have described deficits in social communi-

cation and interaction across multiple contexts. Children with ASD have repetitive patterns of behaviour, interests, and/or activities and can have a wide range of symptoms, skills, and levels of impairment. Some are mildly impaired by their symptoms, while others are severely disabled. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) defines three severity levels for ASD: Level 1–requiring support; Level 2–requiring substantial support; Level 3–requiring very substantial support. These three levels differ in social communication and restricted, repetitive behaviours. Among people with moderate-to-low functioning autism, social interaction, both verbal communication and nonverbal cues such as eye contact and body gestures, is often limited. Social impairments are apparent even with supports in place, including limited initiation of social interactions and reduced or abnormal responses to social overtures from others. additionally, inflexibility of behavior, difficulty coping with change, and other repetitive behaviours appear frequently.

The study by Shattuck et al. (2011) revealed that adolescents with autism participate less in organized or informal social activities, especially when there is a decrease in the level of independent functioning and communication ability. The difficulty is not only manifested in a lack of initiative, but also in a lack of response to requests from the environment. Rosenberg et al. (2017) also emphasized that there is a clear link between the level of communication skills and participation in daily activities. Shattuck et al. (2011), argue that social connection does not develop naturally among students with autism, even when they are in a group setting over time. However, Rosenberg et al. (2017) found that when group activity includes tasks that require physical or cognitive coordination, such as collaborative solution or mutual response, the emergence of communication can be identified. Therefore, the structure of the activity and mediation are critical for transforming the group into an active social space for this population. These difficulties emphasise the importance of structured group activity as a tool to encourage interactions. Weiss and her colleagues (Weiss et al. 2011) presented in their research the multi-user touch tables that "forced collaboration" – the technology requires two users to work together to complete a task. Their research showed that cooperation in children with autism can be improved by defining game rules that require joint actions, interactions, and cooperation between the participants. Likewise, research on cooperative puzzle games using touch technology succeeded in encouraging social initiatives and coordination between participants (Battocchi et al. 2009). These environments allow for the creation of "joint attention" around an external object, thereby reducing the direct social barrier.

The above introduction indicates that people with moderate-to-low functioning autism face significant difficulty with initiative and social functioning, even in a familiar group setting. On the other hand, it appears that structured "forced collaboration" activity may stimulate basic communication. The current study aims to examine the power of game-based collaborative interactions with a reaction-based training platform (BlazePod) and its effect on interpersonal communication among participants with moderate-to-low functioning autism. The BlazePod is an interactive, reaction-based training platform. This system provides cognitive and physical challenges in an engaging environment. While the motor benefit of BlazePod is clear, we aim to examine whether the collaborative game activity may encourage initiative or social cooperation.

The main focus of this study is to examine the social ability of participants with moderate-to-low functioning autism to enhance their verbal communication and nonverbal cues such as eye contact and body gestures through their group activity with the BlazePod platform, and whether they

able to transfer and apply social skills in other domain activities (e.g., building with Lego bricks). The two research questions were:

1. What social interaction characteristics (verbal and nonverbal initiative, cooperation, level of mediation) and interaction patterns (post-response, attentional bias), do participants initiate during the Lego task? (pre- and post-BlazePod intervention)
2. What social interaction characteristics (verbal and nonverbal initiative, collaboration, level of mediation) and interaction patterns (reaction after, attentional bias), do participants initiate during BlazePod activity?

2. Methods

2.1. Participants

Four participants aged 19–20 years old participated in this study. All the participants are diagnosed as having moderate-low functioning autism. All participants study in an inclusive school for students with moderate-low functioning autism. All are verbal but with significant difficulties in the area of social communication, and without motor problems.

2.2. Research Instruments

Lego set – The participants were asked to perform a free building task using the Lego bricks.

Figure 1: Building with Lego bricks.

BlazePod – The BlazePod is an interactive, reaction-based training platform. This system provides cognitive and physical challenges in an engaging environment. The BlazePod consists of light 'Pods' (See Fig. 2) that illuminate and can be placed on any surface. The Pods are connected to an app which stimulates light-activated reaction training. The BlazePod's app includes over 200 pre-designed drills and allows the development of custom training sessions by adjusting the number of Pods, the time-out constraints, and the specific goals of the target workout: improved reaction time, mental agility, or endurance. Moreover, the BlazePod's app provides real-time feedback which includes performance logs.

Figure 2: BlazePod system (from https://blazepod.co.il).

2.3. Data Collection Instruments

Lego task – A free activity was given; no detailed guidance was given on whether to build individually/in pairs/as a group, and without instructions for constructing the model. The free and unstructured activity allows the researcher to observe the group's natural social interaction.

BlazePod intervention – This intervention included two phases: the first phase focused on training the participants to play independently with the BlazePod platform – random mode (1st and 2nd session). In the second phase the participants played with BlazePod as a group or in pairs, on tasks ranging from basic tasks – All at once mode (3rd and 4th session) medium – Focus mode (5th and 6th session) to more complicated tasks that require collaboration between the players – sequence mode (7th and 8th session).

Observations – Participant's Lego and BlazePod activities were videorecorded during all sessions.

Coding scheme – A coding scheme was developed to analyze the participants' activities throughout the research intervention.

2.4. Data Analysis

Data analysis involved qualitative analyses; these data focused on pre-and post-test Lego tasks and BlazePod activity. The analysis focused on identifying patterns of social interaction, such as verbal and non-verbal communication initiatives, collaboration, and coordination between participants.

2.5. Procedure

This study was conducted within the school setting. The intervention with the participants occurred once a week for ten weeks, at a fixed time during the week. The study process included ten sessions in five stages: (i) Stage one included parents' introduction and explanation, following which parents signed a consent form; (ii) Stage two focused on the pre-test Lego bricks task observation (approx. 30 minutes); (iii) Stage three included the main intervention: first, two sessions of introduction to the BlazePod platform and then six sessions playing with the BlazePod, each session lasting 30 minutes; (iv) Stage four, repeating the Lego bricks task and observation (post-test approx. 30 minutes); and (v) Stage five included analyzing the research data.

3. Results

The results were based on qualitative analyses of the Lego tasks (pre- and post- tasks) and BlazePod intervention. The following research questions were asked:

What were the social interaction characteristics (verbal and nonverbal initiative, cooperation, level of mediation) and interaction patterns (post-response, attentional bias), which the participants initiated during Lego task? (pre- and post- BlazePod intervention)

This question examined the change in participants' ability to initiate verbal and nonverbal interaction as a result of experiencing the game-based reaction-based interactions. In the pre-test the participants received no interaction initiative, and the data indicate a thorough social interactions disconnect. The results show that throughout the entire session (30 minutes), the level of verbal and nonverbal initiative was 0% for all four participants. No verbal initiative such as inquiries, requests, or comments were recorded between the participants. Similar results were found on

nonverbal initiatives such as eye contact, gestures, reaching out. Each participant was immersed in his or her own world, with no attempt to make eye contact or attract the other's attention. After the intervention (post-task), the data reveals nascent, very small, social interactions. Few participant verbal initiative events were recorded: Participant M. initiated almost 30 seconds of verbal initiative whenever required, and Participant P. also initiated about 16 seconds of initiative. No nonverbal communication and cooperation were recorded.

What were the social interaction characteristics (verbal and nonverbal initiative, collaboration, level of mediation) and interaction patterns (reaction after, attentional bias), which the participants initiated during BlazePod activity?

These results reflect the process that participants went through over eight sessions within the BlazePod intervention. These data examined the gradual change in the frequency and quality of initiative as the tasks became more complex (from introductory training tasks to more complicated tasks that required collaborative action between the players). A consistent upward trend in frequency and quality of verbal interactions initiative were observed, with findings indicating a clear positive correlation: as the number of sessions increased and the tasks became more complex (requiring interdependence), the frequency of verbal initiative interactions increased and their quality improved. These developments were demonstrated by progression from using single words to complete sentences, nonverbal interaction, and collaborations. For example, Participant M in the 2nd session presented verbal initiative at 10% without cooperation; at the 3rd session he initiated verbal and nonverbal communication 25% of the time, cooperated 5% of the time, and started guiding fellow participant 25% of the time; in the 6th session he was at 31% cooperation; and in the 7th session he increased to 50% cooperation when required. In the last session (8th) he reached a peak of 44% verbal and nonverbal initiative when required and a peak of 84% cooperation time.

In general, for all participants, basic communication such as "basic response": single words like *"here," "red," "blue,"* or short enthusiastic exclamations appeared simultaneously around the 5th session. Full verbal initiative was relatively rare (about 4–7%). In the peak sessions, (7th and 8th sessions) participants received a sequential task – they were first required to self-regulate (wait their turn) and then to engage in joint attention (look at a friend's Pod/listen to a friend's instructions/instruct themselves). As interdependence increased, participants upgraded communication. The group average of verbal initiative jumped to 21.77%, such as: *"M. go to the Blue" or "A. wait a second."*

The unique finding is the gap between joint attention and eye contact. The participants demonstrated high joint attention to the task and coordinated hand gestures through their group players, as well as long gaze, but a lack of direct eye contact between the participants was notable. This finding is consistent with the characteristics of the disability and shows that technology enables extensive social interaction even without the need for direct eye contact.

Figure 3 Participants playing with BlazePod (6th session).

4. Discussion

The discussion will focus on three central claims that emerge from the data results and correspond with the literature reviewed.

Game interaction supports social interaction – The BlazePod focuses on reaction-based game motoric interactions that present to the participants as a structured environment which reduces load and requires cooperation between the players to succeed in the game. This hidden requirement forced the participants to generate social interactions. This finding clearly reinforces the claim of Weiss et al. (2011), who showed in their research how collaborative technologies (the Diamond touch table) can force cooperation by defining game rules that require joint action. Moreover, the increase in initiative interactions supports the model of Crowell et al. (2019), who argued that technology provides a predictable and consistent environment that reduces sensory and social load. Unlike the Lego game, where the rules are vague and social interaction is not necessary and can even be threatening, the BlazePod provided clear feedback (via lights and sounds). This certainty allowed participants, as Kientz et al. (2014) predicted, to direct cognitive resources toward social interaction rather than anxiety, thereby creating a safe space for communication.

Executive functions and technology and it impact on social interactions – Past research on BlazePod by Bryan & Haynes (2024), found that the BlazePod improves coordination, selective attention, and working memory. The current research results confirm this claim. In the Sequence task (7th–8th sessions) the participants were first required to self-regulate (wait their turn) and to engage in joint attention (look at a friend's Pod/listen to a friend's instructions/instruct themselves). This finding also corresponds with Battocchi et al. (2009), who showed how cooperative games create 'joint attention' around an external object. In the current study, the external objects were the illuminated Pods, which served as an anchor for attention, allowing participants to interact without direct eye contact (one of the major difficulties in autism). People with autism often have difficulty with flashing lights, but in the BlazePod platform the flashing lights acted as strong and focused visual stimulus that helped them focus on the task, and through it, on their friend. As Bryan & Haynes (2024) noted, improving attention is critical: when the participant manages to ignore background noise and focus on the light, he is free to absorb the social activities.

What impact is there on collaboration in game interaction by moderate-low functioning autistic adolescents? – Current results demonstrate that being together in the room (Lego task)

does not create interaction between the participants. On the other hand, the participants were able to have social interaction even without direct eye contact. We may assume that the collaborative activities between the participants were influenced by the BlazePod special game platform, which has a hidden demand for collaboration between the players to succeed in the game. Similarly, Rosenberg et al. (2017), claim that interaction depends largely on the structure of the activity.

Maybe moderate-low functioning autistic adolescents identify and understand this hidden collaboration demand in the game and as the BlazePod is a reaction-based game they meet the challenge of these social interactions differently from the Lego construction challenge that requires no collaboration to succeed.

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References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Baird, G, Simonoff, E, Pickles, A, Chandler, S, Loucas, T, Meldrum, D, and Charman, T, (2006). *Prevalence of disorders of the autism spectrum in a population cohort of children in South Thames: The Special Needs and Autism* Project (SNAP), Lancet, 368, pp. 210–215.

Battocchi, A., Pianesi, M., Tomasini, D., Zancanaro, M., Esposito, G., Venuti, P., Ben-Sasson, A., Gal, E., & Weiss, P. L. (2009). Collaborative Puzzle Game: A tabletop interface for fostering collaborative skills in children with autism spectrum disorders. *Journal of Assistive Technologies*, 3(1), 4–13.

Bryan, M., & Haynes, J. (2024). *Exploring the Benefits of BlazePod Technology through an Occupational Therapy Lens.*(https://soar.usa.edu/cgi/viewcontent.cgi?params=/context/otdcapstonessummer2024/article/1038_/&path_info=Bryan_2024_Exploring_the_Benefits_of_BlazePod_Technology_through_an_Occupational_Thera py_Lens.pdf)

Brugha, TS, McManus, S, Bankart, J, Scott, F, Purdon, S, Smith, J, Bebbington, P, Jenkins, R, and Meltzer, H, (2011), Epidemiology of autism spectrum disorders in adults in the community in England, Arch. *Gen. Psychiatry*, 68, pp. 459–466.

Crowell, C., Sayis, B., Benitez, J. P., & Pares, N. (2019). Mixed reality environments to foster social interaction in children with autism. *IEEE Transactions on Visualization and Computer Graphics.*

Kientz, J. A., Goodwin, M. S., Hayes, G. R., & Abowd, G. D. (2014). Interactive technologies for autism. *Synthesis Lectures on Assistive, Rehabilitative, and Health-Preserving Technologies*, 2(2), 1–177.

Shattuck, P. T., Orsmond, G. I., Wagner, M., & Cooper, B. P. (2011). Participation in social activities among adolescents with an autism spectrum disorder. *PLoS One*, 6(11), e27176.

Rosenberg, L., Moran, A. & Bart, O. (2017). The associations among motor ability, social-communication skills, and participation in daily life activities in children with low-functioning autism spectrum disorder. *Journal of Occupational Therapy, Schools, and Early Intervention*, 10(2), 137–146.

Weiss, P. L., White, J. R., Bauminger, N., & Sadeh, A. L. (2011). *Usability of technology supported social competence training for children on the autism spectrum.* Proceedings of the 13th International ACM SIGACCESS Conference on Computers and Accessibility, 91–98.