The Effectiveness of the Lego® Bricks Play in Improving the Social Interaction of Children with Autism

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Abstract

One of the main characteristics of Autism Spectrum Disorder (ASD) is difficulty with social interaction, and research has shown that current social interventions may not be adequate to meet the needs of children with ASD in mainstream schools. Lego-based therapy is a peer-based social intervention which aims to improve social and communication skills for children with ASD. This intervention had been brought into Malaysia, but a limited evidence base has been developed. This study employed the structure and concept of Lego-based therapy in Lego® Bricks Play sessions. An AB Single-case research design was used to evaluate the effectiveness of the intervention in improving the social interaction of children with ASD. The study was run in the special needs education integration program in a public primary school. Two students with ASD were involved in this study. The intervention sessions were conducted three sessions per week

with three baselines and seven interventions sessions. The data of each session were collected during 15-minute free-play Lego sessions. The sessions were video recorded for data analysis according to a social behaviour coding scheme. Visual and statistical analyses such as Percentage of data points Exceeding the Median (PEM) and Tau-U calculation were used to analyse the data. Results indicated that both children with ASD increased their social initiations and responses, increased positive social behaviours, and decreased negative social behaviours. The study concludes that Lego® Bricks Play sessions effectively improve the social interactions of children with ASD.

Keywords: Autism Spectrum Disorder, Lego-based therapy, social interactions.

1. Introduction

According to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), Autism Spectrum Disorder (ASD) is a spectrum disorder that includes a wide range of needs and skills. It can vary from those who do not have learning difficulties to those who have learning difficulties, and some can even be diagnosed as a severe impairment. According to Goncalves and Castro (2015), individuals with ASD experience a lack of interest in social interaction, eye contact, atypical vocalisation, and failure to communicate verbally and non-verbally in their early years. Then slowly, it will affect the pragmatics encompassing skills, such as being unable to take appropriate conversational turns, not knowing how to maintain or

change in topic, and difficulty differentiating the tone and meaning of a conversation (American Speech-Language-Hearing Association, 2015). Such impairments may lead to devastating consequences for children with ASD as it affects them to develop friendships, gain social acceptance and even fail to achieve academic success. Therefore, it is crucial to address the students' pragmatic skills and social difficulties in their early years, primarily during school time to ensure students with ASD receive equal opportunity to develop and reach their full potential, both academically and socially.

2. Literature Review

Previous research suggests that the types and characteristics of the play activities can enhance and accelerate the social interactions among children with ASD. For example, children with ASD tend to have more social interactions with their peers when they are engaged in the activities that they are interested in, which generally is predictable, structured, and organised, as these types of activities help children with ASD to predict and know the expected behaviours (Hu, Zheng, & Lee, 2018). Besides, play activities that encourage social competence among children with ASD typically support the children to gain pragmatics skills. Through such plays, students are expected to learn the pragmatic language in social interactions, including using verbal language to comment and request, understanding the rules governing turn-taking in conversation, and contributions in conversations (Stanton-Chapman & Snell, 2011). While acquiring such skills, children with ASD have more significant

opportunities to develop social relationships and gain social experiences in school.

One of the play activities that fulfil the requirements mentioned above is Lego® Bricks Play. Lego® play intervention is designed by Daniel LeGoff with the purpose of empower and motivate children with ASD to embed social interactions through a naturalistic play of the Lego construction activities. The therapy is substantial in helping children with ASD in their pragmatic language development, communication, and social skills. This intervention is claimed to be more naturalistic than other social skills interventions due to its use of natural play settings and play materials that can be easily found in the home and school settings (LeGoff, 2004). The goal of Lego® therapy is to maximise children's intrinsic motivation so that they will build and improve in social interaction through the process of building Lego bricks. In a typical Lego® therapy session, the participants are expected to follow various social rules while building the Lego builds together, such as maintaining eye contact, joint attention, appropriate greetings and requests, turn-taking, listening to others, problem-solving and maintaining a conversation. Such unique experiences naturally draw participants with ASD into a social setting and thus develop social skills.

A typical Lego® Bricks Play intervention generally consists of 30 minutes to an hour weekly session, in which the group of two to three children is given different roles and tasks to build Lego models collaboratively. From the first session, rules will be set, and the duties of each role will be explained (LeGoff,

2004). The three roles are ‘Engineer’, ‘Supplier’ and ‘Builder’. ‘Engineer’ is the one who reads the instructions, ‘Supplier’ will gather the bricks based on the instructions given, and ‘Builder’ will build the model based on the bricks and instructions given. The roles and tasks given are to encourage children to learn and practice joint attention, turn-taking, sharing, problem-solving, active listening, and fostering communications through building the Lego bricks project (Levy & Dunsmuir, 2020). Sessions are facilitated by a facilitator who supports the children to take ownership of the playgroup, direct them to the words and phrases, and monitor the changes and reliability of the sessions.

Previous research has proven that Lego® therapy effectively improves social interaction, including increases in initiating social interaction, increases in the duration of dialogue exchanges, increased spatial vocabulary, decreases in negative behavior and improved the children’s interactions and perspectives with siblings and peers (LeGoff, 2004; MacCormack et al., 2015; Peckett et al., 2016; Brey, 2017; Lindsay et al., 2017).

Currently, children with special needs in Malaysia are primarily in segregated education rather than inclusive education. According to Data Pendidikan Khas 2020 (Ministry of Education, 2020), approximately 80% of students (74,447) with special needs were enrolled in the PPKI program. The idea of placing these students in PPKI is to minimise the risk of rejection by typically developing peers, social isolation, and other negative impacts if they were fully included in mainstream classrooms. However, some students, especially students with ASD, had

shown negative academic and behavioural feedback and low achievement in PPKI. Nevertheless, the situation was different for students with ASD who are attending both PPKI and therapy. One of the factors influencing this result is the social skills and social behaviours limitation among the students with ASD. Therefore, to resolve this issue, researchers suggested that Malaysia should follow other developing and developed countries to place therapists in schools or offer training and assistive devices to special needs teachers (Mahat, Rahayu, & Nursyahira, 2018).

To help students with ASD achieve their most tremendous potential and enhance their social competency in PPKI, teachers should not blindly focus on the curriculum but diversify teaching strategies such as playing methods, exploration, hands-on activities, and peer collaboration (Yusopa, M. Yassin, & M.Yassin, 2020). Lego® therapy or Lego® Bricks Play have fulfilled the criteria mentioned above. The fundamental criteria of running a Lego® therapy group are peer instruction and peer modelling. The members in the group highly rely upon each other to complete the Lego constructions, and the members will indirectly observe and learn from each other. There are numerous research runs in school settings that have proven its effectiveness. Lindsay et al. (2017) wrote a scoping review that concluded that all 14 papers reported at least one improvement in social and communication skills, restricted and repetitive behaviours, family and peer relationships, and reductions in playing along regardless of clinical research or school setting. In a case study, the students

who were involved acquired new communication skills and vocabulary. Besides, the students can perform better social interaction and present appropriate behaviour and emotion in the social environment in the school (Pang, 2010).

In this paper, the researcher implemented the concept, structure, and procedure of Lego® therapy and transformed it into Lego® Bricks Play Session, which will be done in the Integrated Special Education Program (PPKI) under a government primary school setting. This paper is aimed to analyse the effect of this Lego® Bricks Play session as an intervention in improving social interaction and its contributions to the changes in the social behaviours among students with ASD by observing the transformations and changes from the baseline phase to the intervention phase.

3. Methodology

The Lego® Bricks Play sessions were conducted in a public primary school with a special need's integration program in the Snoezelen Room. The Snoezelen Room is furnished with carpet, warm lighting, and air-conditioning, which will create a comfortable and safe environment for children with ASD to entirely focus and enjoy in the Lego Bricks Play sessions.

Two students with ASD were selected for the research. To be eligible to participate in this intervention, the students were required to meet the characteristics to ensure consistency and accountability of research: i. Attending PPKI program, ii. Diagnosed with Autism Spectrum Disorder or Asperger's

Syndrome, iii. Diagnosis is made by a clinical psychologist, psychiatrist, or paediatrician, and iv. Not receiving any other social skill interventions (Levy & Dunsmuir, 2020).

To fulfill the purpose of this research, the researcher implemented A-B Single-Subject Design. Baselines were established before the intervention was introduced. The baseline data was collected during three 15 minute free-play Lego sessions. In these sessions, the participants were provided with assorted, mixed Lego to play. According to a social behaviour coding scheme adapted from Levy & Dunsmuir (2020), these sessions were video recorded for data analysis. The researcher was aware of the importance of gathering at least three data points for the baselines, ensuring the measures were stable and the baseline was no longer than necessary.

The Intervention Phase began after the baseline phase. The intervention phase consisted of 7 one-hour Lego® Bricks Play sessions, held three times per week. The number of sessions was based on feasibility considerations such as timetabling and availability. All play sessions remained the same basic structure within an hour session. The observational data were collected and analysed according to the social behaviour behaviour coding scheme during the 15 minutes free-play. Primary data were collected by evaluating the students' social interaction with peers before the intervention, and during the intervention. The duration and frequency were recorded and calculated, and the results were gathered and compared, presented in the form of graphs, and transcribed in a written explanation.

A fidelity checklist was implemented to ensure the facilitator followed the established protocols and considered the variations. The fidelity checklist is adapted from Durlak and Dupre (2008). Meanwhile, the researcher had utilised Datavyu to collect behavioural data i) social initiation and ii) social responses from video as it helps to automate data analysis (Barto, Bird, Hamilton, & Fink, 2017). Social initiation was defined as any verbal or non-verbal social behaviour displayed to other group members without any prompts or preceding interaction. For instance, verbal social initiations included "Is it correct?", "I want that brick", or "Let us make a castle". Meanwhile, examples of nonverbal social initiations included tapping a member's arm to get attention, pointing to a brick, or showing flashcards to the members. On the other hand, the participants' social response was defined as any verbal or nonverbal social behaviour that responded or complied with a preceding initiation of others. Some examples included answering a question or giving a brick base on a request.

The frequency of each category was coded within a 15-seconds interval, such that more than one category could occur in one interval, such as passing instruction books to peers can be counted as positive social behaviours and social responses. After each session, the researcher coded the target behaviours using Datavyu and transferred the data into the codebook in Microsoft Excel.

Line graph as visual inspection were used to interpret and analyse the data. The sequence of time will be depicted on the x-

axis (horizontal axis). The duration of social interaction, frequency of social interactions, and frequency of social responses will be depicted on the y-axis (vertical axis). Besides, Percentage of Data Exceeding the Median (PEM) was implemented to test if the intervention is effective. PEM is measured by locating the median point in the baseline data, and a line will be drawn from the median into the intervention phase in the plotted line graph. Meanwhile, Tau-U is calculated separately for both phase A-B contrast, and the effect size for the complete model is calculated by averaging all Tau-U scores. In this research, the researcher used an online tool (http://www.singlecaseresearch.org/calculators/tau-u) to generate the Tau-U scores.

4. Findings

Figure 1.1 to Figure 1.5 shows line graphs of the baseline-intervention data set with trendline using the split middle method. As we can see from Figures 1.1, 1.2, 1.3, and 1.4, trend lines are either slightly moving upwards, downwards, or zero in the baseline phase, indicating that the baseline was stable and promising. Nevertheless, in the intervention phase, the trend lines in all graphs show an upwards trend and have an even steeper slope. Therefore, we can conclude that there is a great degree and positive changes for Duration of Social Interaction, Frequency of Social Initiations, Frequency of Responses, and Frequency of Positive Social Behaviours after implementing Lego Bricks Play sessions as intervention.

Meanwhile, in Figure 1.5, we can see for both Participants A and B, in the baseline phase, show a notable upward trend, indicating the increasing frequency of negative social behaviours. In contrast, in the intervention phase, both show a downward trend line, with a great degree of steeper, especially for Participant B. These trend lines proved the implementation of Lego Bricks Play not only increased the social interactions but also helped to minimize the negative social behaviours occurring among the participants.

Figure 1.1

Graphic Display of the Duration of Social Interaction across Participants A and B

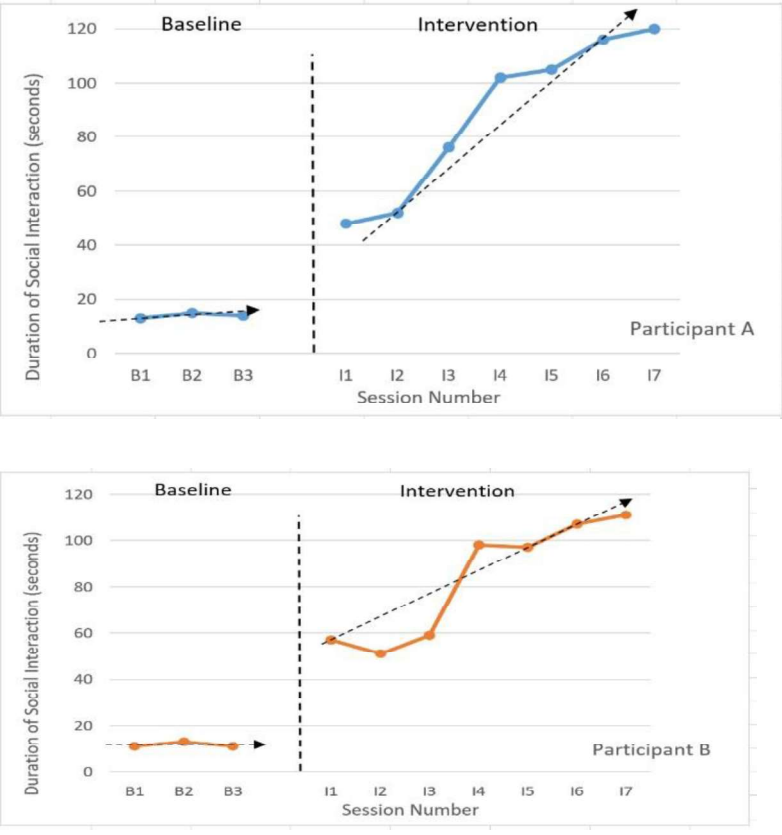
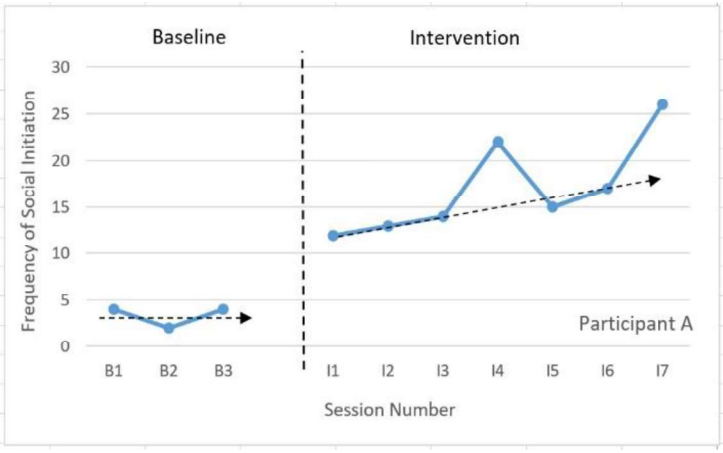


Figure 1.2

Graphic Display of the Frequency of Social Initiations across Participants A and B



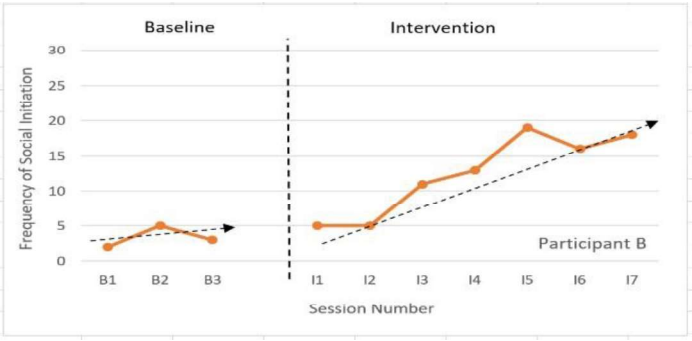


Figure 1.3

Graphic Display of the Frequency of Responses to Social Initiations across Participants A and B

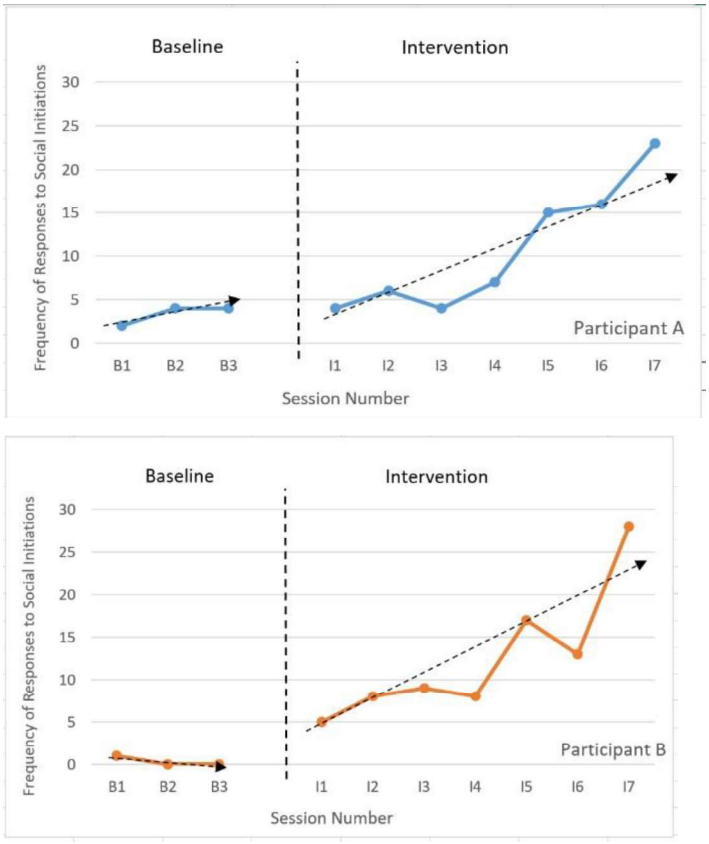
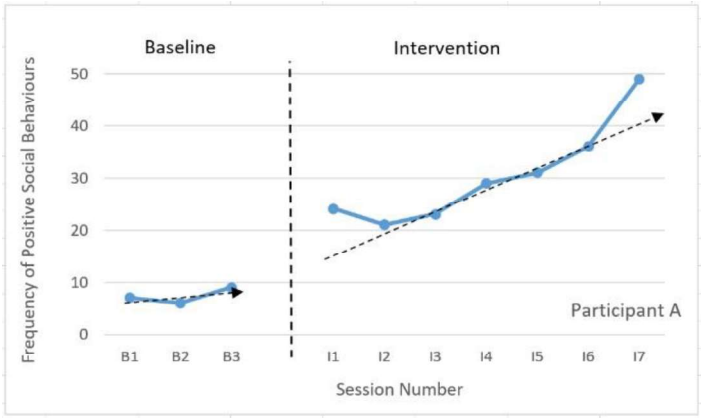


Figure 1.4

Graphic Display of the Frequency of Positive Social Behaviours across Participants A and B.



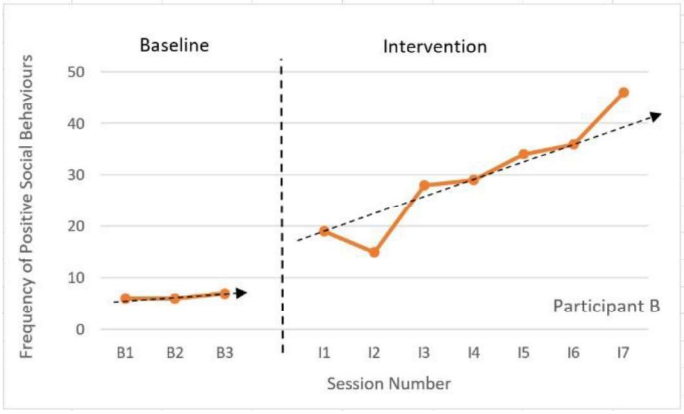
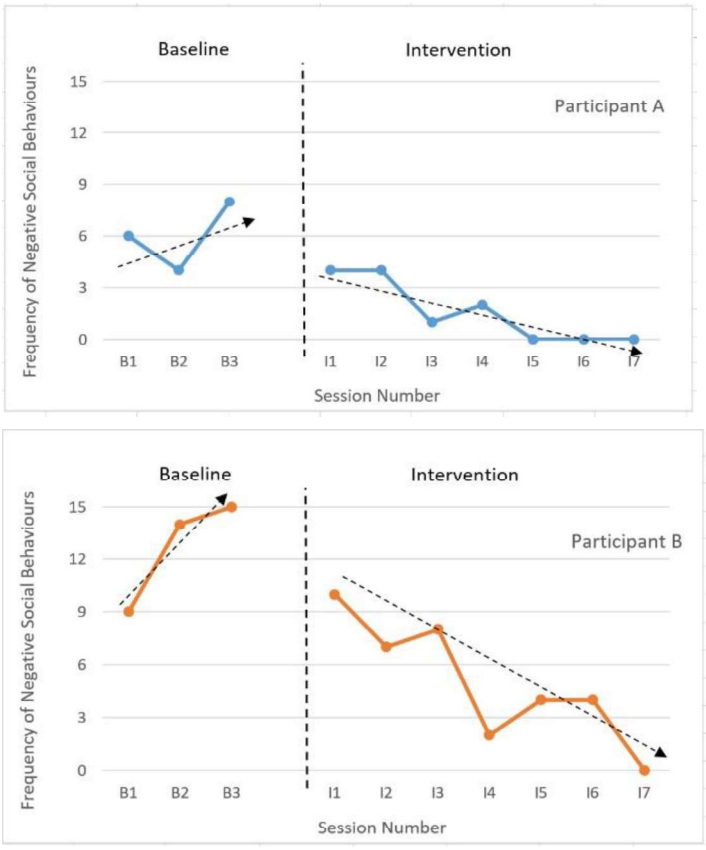


Figure 1.5

Graphic Display of the Frequency of Negative Social Behaviours across Participants A and B



To ensure there is a systematic change in this study, researcher implemented Conservative Dual Criterion (CDC) method. All 7 points in the intervention phase are above both the level line and trend line (Figure 1.6). Based on Table 1.1, 6 points must be above both lines to conclude that systematic change occurred. Since all 7 points are above the lines, the researcher concludes that there is a systematic change from baseline phase to intervention phase in the social interaction among the participants.

Table 1.1

Criteria for Concluding That the Treatment-Phase Change Is Systematic

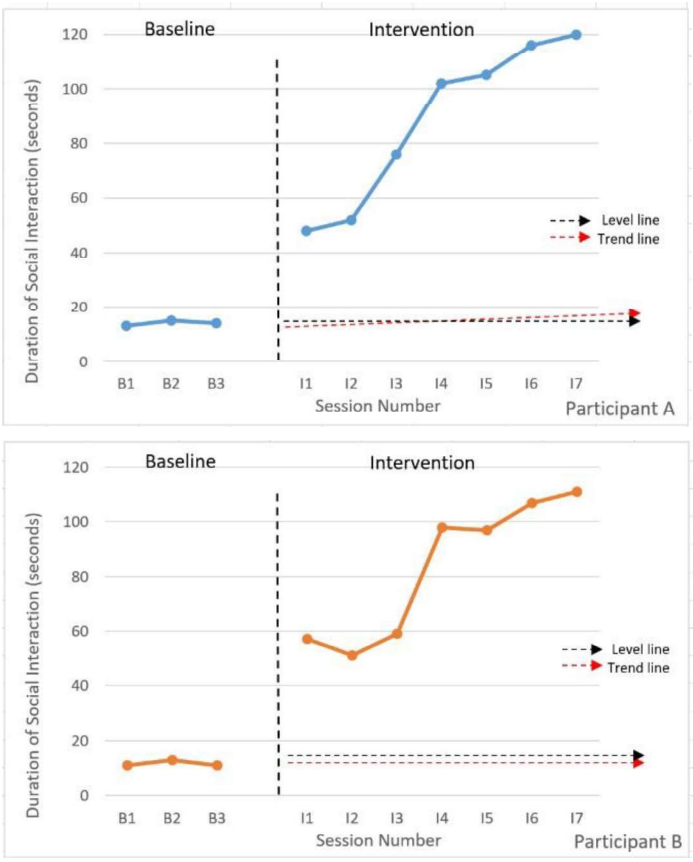
No. of points in the treatment phase.	No. of points in the predicted direction needed to conclude that there is a systematic change
5	5
6-7	6
8	7
9-10	8
11-12	9
13	10
14	11
15-17	12
18-19	13
20-21	14

22-23 15

Note: Adapted from (Fisher et al., 2003)

Figure 1.6

Graphic Display of the Duration of Social Interaction across Participants A and B with the CDC lines indicated



PEM is used to test the effect size in the presence of floor or ceiling baseline data points with scores ranging from 0 to 1. Table 1.2 shows the PEM scores for this study. The average PEM score for the baseline to intervention phase for all variables suggests a strong effect of the Lego® Bricks Play session. The

average PEM score is 1 for the duration of social interaction, frequency of social initiations, frequency of positive social behaviours, and frequency of negative social behaviours, which proves there is a strong positive effect for Lego Bricks Play sessions towards these variables. Meanwhile, the PEM score for frequency of social responses was .857, which shows moderate effectiveness.

Table 1.2

Percentage of data points Exceeding the Median (PEM)

	Duration of Social Interaction	Frequency of Social Initiations	Frequency of Responses	Frequency of Positive Social Behaviors	Frequency of Negative Social Behaviors
Participant A	1.00	1.00	.714	1.00	1.00
Participant B	1.00	1.00	1.00	1.00	1.00
Average PEM Score	1.00	1.00	.857	1.00	1.00

Tau-U scores range from 0 to 1. Scores that range from 0 to 0.65 represent small or weak effects, from 0.66 to 0.92 represent medium to high effects, and from 0.93 to 1.0 represent large or strong effects (Rispoli et al., 2013). Meanwhile, $p<.05$ or $p<.001$ levels are used to test the statistical significance of the results.

Based on the data shown in Table 4, Based on the data shown in Table 1.3, the Tau-U values for all variables for both Participant A and B were statistically significant at $p<.05$ or $p<.001$ levels. The weighted average scores for the duration of social interaction, frequency of social initiations, and frequency of positive social behaviours show large effects with significant levels at the $p<.001$ level. Meanwhile, the weighted average scores for social response frequency and negative social behaviours show medium effects with significant levels at the $p<.05$ levels.

Table 1.3

Tau-U Effect Size Estimates for Baseline to Intervention Phases

	Duration of Social Interactions			Social Initiations			Responses			Positive Social Behaviors			Negative Social Behaviors		
	TAU	*P* value	CI 90%	TAU	*P* value	CI 90%	TAU	*P* value	CI 90%	TAU	*P* value	CI 90%	TAU	*P* value	CI 90%
Participant A	1.000 Large	0.017*	0.313< >1	1.000 Large	0.017*	0.313< >1	0.810 Medium	0.053	0.122< >1	1.000 Large	0.017*	0.313< >1	-0.9048 Medium	0.030*	-1< >-0.217
Participant B	1.000 Large	0.017*	0.313< >1	0.905 Medium	0.030*	0.217< >1	1.000 Large	0.017*	0.313< >1	1.000 Large	0.017*	0.313< >1	-0.9048 Medium	0.030*	-1< >-0.217
Weighted Average	**1.000 Large**	**0.000****	**0.5140< >1**	**0.952 Large**	**0.001****	**0.4663< >1**	**0.905 Medium**	**0.002***	**0.4187< >1**	**1.000 Large**	**0.000****	**0.5140< >1**	**-0.9048 Medium**	**0.002***	**-1< >-0.4187**

[1]Confidence Interval

[2]Corrected baseline due to significant baseline trend at the p<.05 level.

*Significant at .05 level. **Significant at .001 level

5. Discussion

Visual and statistical analysis of the observational data collected showed statistically significant increases in the duration of social interaction, frequency of social initiations, frequency of responses, and frequency of positive social behaviours between the baseline and intervention phase for participant A and participant B. The result is consistent with the clinical studies of Lego® Therapy by LeGoff and other researchers. Besides, the researcher maintained standard responses in both baseline and intervention phases during the 15 minutes free-play section, and in neither condition, the researcher provided verbal praise or other reinforcement to the participants. Therefore, it is suggested that the intervention remains effective when delivered and implemented by a teacher in a school setting.

Besides, the trend lines for the graphs of the duration of social interaction, frequency of social initiation, social responses, and positive social behaviours show an upward trend and have an even steeper slope. Meanwhile, the trendline for the graph of negative social behaviours shows a downward trend and has a great degree of steeper. The pattern proved that the interventions were accelerating positive outcomes on all of the target aspects. The statement is supported by the result of the PEM score and Tau-U score. The average PEM scores are one, and the Tau-U weighted average scores are one and .952 at $p < .001$ level for the duration of social interaction, frequency of social initiation, and frequency of positive social behaviours, which prove the high effectiveness of the interventions towards these aspects. On the other hand, even the PEM score for frequency of negative social behaviours is 1, but the weighted average Tau-U score is .905 with significant levels at the $p<.05$ levels. Meanwhile, the frequency of social responses shows the same weighted average Tau-U score as the frequency of negative social behaviours but only score .857 in PEM. The score indicates that the intervention only has moderate effectiveness towards the frequency of social responses and negative social behaviours.

Overall, the data indicated that Lego® Bricks Play was effective at improving social interactions of children with ASD. Our observations in the baseline phase suggested that simply arranging children with ASD to stay with their peers in free play was not sufficient enough for social interactions and might even cause more negative social behaviours to occur. Therefore,

creating more structured activities that would encourage peers' involvement is necessary but remain a natural play setting. For instance, in Lego® Bricks Play sessions in this study, the participants were given roles and duties to fulfil during the controlled model building section. The concept is similar to the concept of Jigsaw classroom under constructivism education which is by assigning students to become experts in specific tasks and teach them to the others in their group. The collaboration helped the participants to learn to work together as a team, and as they were used to the setting, they grew their friendships and partnerships, which will then affect the social interactions among them.

Research indicated that children and adolescents with ASD tended to face more difficulties in responding to a conversation than social initiation, as social responses require one to have an awareness of the partner's speech and thoughts in order to stay on track with the conversation and interaction (McMahon, Vismara, & Solomon, 2013). The baseline result of this research was consistent with this finding. During the baseline phase, both participants showed consistent social initiation but decreased social responses. Moreover, the frequency of social responses was close to zero for participant B. The result indicates that the participant might initiate a topic or action but did not receive and give feedback. Gillespie-Lynch et al. (2012) suggested that social responses in the early years for individuals with ASD were more predictive of social and communicative skills in adulthood than social initiations. Therefore, to effectively empower children with

ASD for their quality of life, we should prompt them to initiate interaction and motivate and reinforce the duration of dialogue exchanges or interactions. In our study, the result showed that both frequencies of social initiation and social responses increased during the intervention phase. Additionally, the data indicated that both participants had more social responses than social initiations, indicating that the conversations and interactions lasted longer and continuous after each initiation. The result may be natural due to the participants' longer and more frequent conversations, which limited the need to initiate a new topic. The researcher noted that there were more back-and-forth conversations and fewer choppy conversations with no responses given at the end of the research. An alternative explanation for these results is that interacting and responding to unfamiliar peers at the beginning of play sessions can be stressful and undesirable as children with ASD prefer to play alone (McMahon, Vismara, & Solomon, 2013). Therefore, as the intervention was going on, the participants gained social interaction skills and greater familiarity with each other, which helped the participants to be more responsive towards each other.

Despite the positive changes in social interactions, the participants also have a steady increase of positive social behaviours with a gradual descending trend of negative social behaviours. Pang (2010) also concluded that students who participated in Lego therapy performed better social interaction and presented appropriate behaviour and emotion in the social environment in the school. Both participants joined the

intervention with a series of negative social behaviors, such as temper tantrums, controlling, echolalia, and leaving the play zone. However, over the sessions, the negative behaviours decrease, and positive behaviours increase. The most significant change is that participants voluntarily shared bricks and instruction books in the last few sessions. Besides, observations suggested that Participant B was easily distracted and frequently left the play area during the baseline phase. Moreover, echolalia was one of his most extensive negative behaviours during the baseline phase and the first few intervention sessions. However, after the interventions, Participant B was able to attend to the task given and sit through the playing area for the one-hour sessions. Besides, he stopped echolalia and used formal pragmatics and semantics language while communicating with his partner. The finding is consistent with Brey (2017) in which the researcher suggests Lego® therapy increased spatial vocabulary among the participants and thus improved their social communication skills.

There are several possible explanations for the decrease in negative behaviours. One may be naturally occurring reinforcers such as increased positive interactions, teamwork trained in the previous Lego model building session, and a common interest in building Lego bricks. This may also be because the structure setting of the Lego® Bricks Play sessions helps the participants to familiarise themselves with fundamental norms of social communication and conform to social rules that have been formerly imperceptible. Besides, another factor might be the visual support, such as group rules posters and flashcards. The

facilitator will introduce the rules that the participants must follow during the Lego® Bricks Play sessions and the roles and instructions with visual support during the intervention. Therefore, it is also possible that the participants may have decreased their negative behaviours as they could follow the instructions given, and the visual support reminded them of the expected behaviours to engage in the construction activities.

6. Conclusion

The present investigation replicated and extended previous research which demonstrated the effectiveness of Lego® therapy in increasing social interactions between students with ASD. This also further highlights the constructivist theory, which is that students learn and gain social interactions skills and needs through a naturalistic setting. More importantly, instead of a clinical setting, the study showed that it is also effective when implemented in school settings with participants that did not go through other intervention or therapy. This finding may bring practical implications in the current educational setting in Malaysia, in which social skills development was much neglected in the curriculum as the system was still focusing heavily on academic outcomes. If the social interactions can be increased through Lego Play sessions, schoolteachers can consider opening a Lego® Club for students to participate during the extra-curricular hours. Whilst this research suggests the positive impact of the Lego® Bricks Play session, caution is still needed as this is a new study done in Malaysia with only 2 participants involved. Future research on the effectiveness of Lego® Bricks Play

intervention should involve more participants from different age groups, gender, and family background. Besides, future research should address the participants' social interaction and social behaviours after the interventions terminate and outside the Lego session to ensure that the outcomes legitimately induce long-term and socially valid changes in social relationships outside of the Lego sessions.

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