

**Lego Therapy: Building Social Skills for Adolescents with an Autism
Spectrum Disorder.**

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Abstract

Keywords: Autism, Lego Therapy, Social Skills, Intervention, Adolescents.

Aim

This research aimed to explore the impact of school-based Lego Therapy groups for adolescents with a diagnosis of ASD in mainstream schools.

Method/Rationale

School staff were trained in the delivery of the social skills intervention to groups comprising one adolescent with ASD and two typically developing peers. A non-concurrent multiple baseline across participants design was employed to examine the impact of the intervention for six adolescent males with ASD.

Findings

Visual analysis, PAND effect sizes and Tau-U statistical analyses demonstrated the large positive impact of the intervention on duration of social engagement and frequency of social initiations, responses and positive social behaviours for five out of six participants. The final participant withdrew from the research. Parents and teachers saw some evidence of generalisation of skill to home and other aspects of school life but this was not consistent for all participants. Fidelity of implementation

was maintained, suggesting the approach is appropriate for delivery in school settings by school staff.

Conclusion

The results of this study suggest that Lego Therapy groups can be an effective school-based social skills intervention for adolescents with ASD.

Limitations

This research was limited by the small sample size. Future research should extend the evidence-base of Lego-based social skill groups, examining the impact of the intervention for a wider range of students with differing needs.

Introduction

Individuals with autism spectrum disorders (ASD) display qualitative impairments in communication, social interaction and have restricted patterns of interest (Lord & Spence, 2006). Challenges to the inclusion of children with ASD in mainstream schools include difficulties with social skills such as initiating interactions, maintaining reciprocity, sharing enjoyment, taking another person's perspective and inferring the interests of others (Bellini et al., 2007). Children with social skill deficits lack the behavioural repertoire necessary to interact with others according to social convention, with consequences in their academic and social development (Rao et al., 2008) as well as peer and familiar relationships (Krasny et al., 2003).

Social skill deficits may also contribute to secondary mood and anxiety problems in later development (Myles, 2003). A review of research into the prevalence of comorbid anxiety disorders in youth with ASD found that between 11 and 84% of children and young people with ASD experience impairing anxiety (White et al., 2009). Although the precise reasons for the increased prevalence of anxiety in individuals with ASD remain unclear, social skill deficits may be directly or indirectly linked (White & Roberson-Nay, 2009).

Social Skills Interventions

Despite the wealth of literature detailing the difficulties with social interaction and communication individuals with ASD experience, few children receive adequate social skills interventions (Hume et al., 2005). Kennedy and Shukla (1995) conclude that social interactions can be taught and learnt; social interaction in typical settings can be successfully instructed with substantial positive outcomes. As such,

researchers have argued that effective social skills programmes should be an integral component of educational programmes for children and young people with ASD (Bellini et al., 2007). Opportunities to learn social skills are regularly referred to in autism good practice guidelines and demonstrate the evidence necessary to be considered an established evidence-based practice (Reichow et al., 2008).

Researchers have endeavoured to categorise the different interventions available under the umbrella term of social skills. Rao et al. (2008) highlight the wide variety of techniques within social skill training programmes and their diverse theoretical foundations and consider the need to identify the specific features that elicit change. A wide range of teaching strategies have been highlighted in the literature as promising techniques (White et al., 2007).

Government legislation reflects a worldwide movement for inclusion, with many considering that inclusion of individuals with ASD in mainstream educational provisions should be the default position and is a fundamental right of all children (Jordan, 2011; UNESCO, 1994). As such, mainstream schools and provisions need to be providing adequate educational programmes and interventions to meet the unique and diverse needs of children and young people with ASD. Educational psychologists (EPs) are well placed to recommend interventions, with intervention planning highlighted as core EP practice (Cameron, 2006).

Lego Therapy: Theoretical Basis

Lego Therapy is a group based social skills intervention designed specifically for individuals with ASD (LeGoff, 2004). It is claimed that Lego Therapy is intrinsically motivating and naturally reinforcing because it draws on the child's interests to promote the development of social, communication and play skills which supports

Attwood's concept of constructive application (Attwood, 1998). The systemizing tendency in individuals with autism (Baron-Cohen, 2006) has also been considered as an explanation for the appeal of Lego Therapy as Lego is a highly structured, predictable and systematic toy (Owens et al., 2008).

In Lego Therapy, students work together to build Lego models in pairs or small groups, with the task divided into different roles. The division of labour with a common purpose allows children to practice joint attention, turn-taking, sharing, joint problem solving, listening and general social communication skills (Owens et al., 2008). By establishing clear job roles, Lego Therapy ensures the involvement of all students in the targeted outcome of building the Lego model.

This is combined with peer instruction and peer modelling; key features of social skills interventions (Koegel & Koegel, 1995). Peer mediated interventions have been highlighted as a potentially versatile and effective intervention approach for individuals with ASD across social, communicative and academic outcomes (Chan et al., 2009). In a review of the literature, Zhang and Wheeler (2011) conclude that peer mediated interventions were highly effective at promoting social interactions in young children with ASD.

LeGoff (2004) explored the effectiveness of Lego Therapy in improving social competence. Statistically significant gains in three measures of social competence were made after 12 weeks of therapy, with gains sustained after 24 weeks (LeGoff, 2004). Despite these promising results, the individual therapy sessions which continued alongside Lego Therapy make it difficult to attribute the change solely to the Lego intervention.

Longer-term outcomes of Lego Therapy were investigated by LeGoff and Sherman (2006). They investigated the broader range of social skills affected in a three-year period for a group of 60 children, compared to a control group who received traditional social skills interventions. Both groups had individual therapy sessions alongside the social skill intervention. Overall, the children in both the Lego and control group showed significant improvement on both the Vineland Adaptive Behaviour socialization domain (VABS-SD) and the GARS-SI, with the Lego group making significantly greater gains than the control group. However, the clinical setting and the ongoing individual therapy sessions make it difficult to generalise these findings.

Lego Therapy and the Social Use of Language Programme (SULP) were evaluated as social skills interventions for 6-11 year olds with high functioning autism and Asperger Syndrome (Owens et al., 2008). Therapy for both groups (Lego group n=16, SULP n=15) occurred weekly for one hour in an 18 week period in a clinic setting. Comparisons were made to a no intervention control group (n=16). Results showed that the Lego Therapy group improved more than the other groups on social interaction scores (GARS-SI). Again, the clinical setting makes generalisation to a school environment difficult.

Lego Therapy has also been combined with robot-mediated interventions with children with ASD and their siblings (Huskens et al., 2015). Using a non-concurrent multiple-baseline single-case design, the researchers did not find any statistically significant changes in the collaborative behaviours of the children with ASD. The use of robots, inclusion of siblings and short intervention sessions (only five sessions

of 30-minute duration) makes it difficult to draw conclusions regarding the effectiveness of Lego Therapy.

The experiences of mothers trained to implement Lego Therapy in the home setting has been explored by Peckett et al., (2016). The participants carried out hourly sessions with their child with an autism spectrum disorder and the child's sibling once a week for 6 weeks. In their qualitative study, themes emerged around improved family relationships, a positive impact on the child as an individual, and changed maternal, sibling and child perspectives. In a similar study, a qualitative analysis of a Lego social skills programme which included siblings and peers in a community setting suggested positive outcomes (MacCormack et al., 2015).

A scoping review explored quantitative and qualitative data on Lego Therapy from peer reviewed journals, conference proceedings and dissertations (Lindsay et al., 2017). The researchers reported that at 14 papers reported at least one improvement in social and communication skills, ASD-specific behaviours, belonging, family relationships, coping and reductions in playing alone. Common characteristics of the effective interventions included being group-based (with or without individual therapy), run by a clinician or educator in a clinic or a school, for a minimum of one hour per week for at least 3-18 hours total intervention time (Lindsay et al., 2017). The broad nature of these characteristics makes it difficult to decipher the true effectiveness of the intervention, with further research needed to define the characteristics required for effectiveness.

Rationale for this Study

This research examined the effectiveness of Lego social skills groups (an adaption of Lego Therapy) on the social skills of adolescents with ASD. There is an abundance

of research on the benefits of peer-mediated social skill interventions (for example, Chan et al., 2009; Odom & Strain, 1986; Wang et al., 2011; Zhang & Wheeler, 2011; Whalon et al., 2015), hence the focus within this study.

The study also examined whether changes in social skills are evident in broader contexts than the Lego Club setting. The generalization of social skills to non-clinical environments is often low (MacCormack et al. 2015). Weiss and Harris (2001) argue that skill acquisition is insufficient if it cannot be seen in the individual's behavioural repertoire. Furthermore, Smith and Gilles (2003) argue that social skills should be taught in the social context in which they may be needed to aid the generalisation of learnt skills. As this research moved the intervention from a clinical to a school setting, an examination of the generalisation of skills is facilitated.

In light of this research, the following research questions were examined:

RQ1. Are Lego Therapy groups effective at improving the social skills of students with an autism spectrum disorder?

RQ2. Are learnt skills generalised to situations outside of the Lego Club setting?

Methods

Design

A single-case non-concurrent multiple-baseline across participant design was employed. This allowed careful observation of behaviour change and a rigorous focus on individuals (Barlow et al., 2009; Harvey et al., 2004). Experimental control is established by evaluating behaviour across different participants with an increasing

baseline length for each participant and intervention delay for each successive participant in a staggered, time-lagged fashion (Barlow et al., 2009). Due to the limitations of conducting research in applied educational settings and the need for flexibility when working within a school system, a non-concurrent multiple baseline design allows data to not be collected simultaneously (Harvey et al., 2004). As such, the baseline period for each participant had staggered start dates.

Participants were randomly allocated varying baseline periods, with the total number of baseline sessions ranging from three to 13 sessions. Establishment of a priori baseline durations along with random allocation of participants to baseline length increased the design's potential to demonstrate experimental control and control threats to internal validity (Christ, 2007). Kratochwill et al. (2010) consider that a phase with fewer than three data points typically offers too little information to allow confident documentation of the pattern of the data.

3.2.2 Participants

Six students from an inner-city London secondary school were selected for the research. Participants were identified via referrals from the school Special Educational Needs Coordinator (SENCo). It is generally accepted that findings should be replicated with at least three participants to suggest a pattern of behaviour and demonstration of experimental effect (Riley-Tillman & Burns, 2009; Kratochwill et al., 2010).

To be eligible for the intervention, the students with ASD were required to meet the criteria outlined in Table 1. This was to ensure consistency and homogeneity among the participants, a key factor in single-case research designs (Barlow et al., 2009).

Table 1.

Participant Inclusion Criteria.

Inclusion Criteria	
I.	Attending mainstream education setting in years 7 to 9.
II.	Have a current diagnosis of high functioning autism, autism, autism spectrum disorder or Asperger's Syndrome.
III.	Diagnosis made by a clinical psychologist, psychiatrist or paediatrician.
IV.	Had a General Conceptual Ability (GCA) score of 70 or above on the British Ability Scales Third Edition (Elliot & Smith, 2012) or a Full Scale IQ (FSIQ) above 70 on the Wechsler Intelligence Scale for Children 4 th UK Edition (Wechsler, 2004) indicating that they did not have significant learning difficulties.
V.	Not currently receiving any other social skill interventions.

Table 2.

Participant Characteristics – Students with ASD.

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6
Age (years: months)	12:04	11:03	14:03	13:02	13:00	11:09
Gender	Male	Male	Male	Male	Male	Male
National Curriculum Year	8	7	9	9	9	7
Ethnicity	Middle Eastern	Mixed	White European	White European	Middle Eastern	White European
Home Language	Amharic	English	Polish	Russian	Arabic	Russian
SCQ* Score	2 (language barrier with parent)	28	35	Parent did not return form	16	26
Cognitive Ability Score	79 ¹	116 ²	84 ²	111 ¹	88 ¹	124 ¹

* Social Communication Questionnaire (Rutter, Bailey & Lord, 2003)

¹ British Ability Scales (Elliot & Smith, 2012) General Conceptual Ability Score

² Wechsler Intelligence Scale for Children (Wechsler, 2004) Full Scale IQ

In addition to the six participants with ASD, 12 typically developing peers were recruited via volunteer sampling. All peers were male and were not on the SEN register in the school. Two typically developing peers and one student with ASD formed each Lego Club group, with data collected only for the student with ASD.

Six learning support assistants (LSA) were recruited to implement the intervention via volunteer sampling, with each LSA running a separate Lego Club group. The professionals running each group remained consistent throughout the study. The LSAs ranged in age from 22-39 years and they all had an undergraduate degree. The researcher, a trainee educational psychologist, completed a one-hour training session (using a PowerPoint presentation) with the LSAs.

Procedure

Baseline Phase. Baselines were established prior to the introduction of the intervention, with the total number of baseline sessions ranging from two to 13 sessions. The introduction of the baseline phase was non-concurrent and staggered over a seven-week period. Baseline data was collected for participants during 15 minute free-play Lego sessions. In these sessions students were provided with assorted, mixed Lego to play with in their Lego Club groups (formed of one student with ASD and two typically developing peers). These sessions were video recorded for data analysis according to a social behaviour coding scheme (Appendix 1). At the start of the baseline phase, the parents and form tutors of the student participants were administered the Social Skills Improvement System (SSIS; Elliott, & Gresham, 2007) to obtain a standardised social skill score pre-intervention in home and school settings.

Intervention Phase. The intervention phase was introduced following completion of the baseline phase. The intervention phase consisted of 12 Lego Club sessions for each group, held twice a week for 45 minutes. Each session involved 15 minutes free-play where observational behavioural data was collected and analysed according to the social behaviour coding scheme. At the end of the intervention phase, the SSIS was re-administered to parents and teachers.

The intervention facilitators were asked to video record three of their Lego Club sessions to enable implementation fidelity checks. To help the Learning Support Assistants remember to record the sessions, reminders were sent for sessions three, six and nine. These sessions were chosen as they were evenly distributed across intervention phases. The video of the session was then given to the researcher who measured implementation fidelity using the implementation fidelity checklist shown in the Appendix.

Maintenance Phase. Following completion of the intervention phase, observational data was collected during three 15 minute free-play Lego sessions. This data was analysed using the social behaviour coding scheme. This formed the maintenance phase and allowed an examination of the students' social skills immediately after finishing the intervention programme.

Follow up Phase. This took place three months after the intervention phase, and comprised three 15 minute free-play Lego sessions to assess the maintenance of skills. These sessions were video-recorded and coded according to the behavioural coding scheme.

The Intervention: Lego Club

The Lego Club intervention was adapted from Lego Therapy as detailed in research papers (LeGoff, 2004; LeGoff & Sherman, 2006; Owens et al., 2008) and a recently published manual (LeGoff et al., 2014). Two adaptations were made to ensure suitability to a mainstream secondary school environment: sessions occurred twice weekly and the Lego Club groups involved typically developing peers.

Although the original research on Lego Therapy only included students with ASD, research has shown the benefits of including typically developing peers in social skills groups for students with ASD (e.g. Koegel & Koegel, 1995; Chan et al., 2009; Zhang & Wheeler, 2011). Furthermore, Grey et al, (2007) found cooperative learning groups with children with ASD and typically developing peers effective at increasing social engagement. As the needs, ages and profiles of the students varied, it was felt that it was inappropriate to group all the students together simply on the basis of their diagnosis. By including typically developing peers from the student with ASD's year group, the intervention was individualised to each student's profile and provided a naturalistic environment for learning social skills, a key feature of social skills interventions (Gresham et al., 2001).

Lego Club sessions occurred twice a week to ensure each participant received 12 intervention sessions with the Spring Term. Furthermore, this fits the notion of distributed practice, which has demonstrated benefits for retention of information

(Seabrook, Brown, & Solity, 2005). The number of sessions was negotiated with the school, and the decision to deliver the intervention twice each week was based on feasibility considerations, such as timetabling and availability of staffing.

Session Structure.

All Lego Club intervention sessions had the same basic structure within a 45-minute session:

1. 'Hello', recap of the previous session and rules, and giving out of job roles by the LSA.
2. 30 minutes of structured set building.
3. 15 minutes of free-play with assorted, mixed Lego pieces.
4. Clearing up.

At the core of the Lego Club programme is structured, collaborative set building. Students are given job roles (engineer, builder or supplier) to complete the building of a Lego model set with instructions. Each job had a specific role to play in the building process; the 'engineer' read the instructions and had to verbally communicate what piece is needed and where it should go, the 'supplier' was required to find the correct piece as instructed by the engineer and pass that piece over to the 'builder' who needed to follow the engineer's instructions as to where the piece should go. As the engineer was the only student who could see the Lego set instructions, students had to use their social communication skills to build the set correctly. The jobs were randomly allocated to students on a rotating basis, with students taking a different job role each session.

Following collaborative set building, students were allowed 15 minutes of free-play with assorted, mixed Lego. Although LeGoff et al. (2014) suggest free-play building

should be done collaboratively, this was not enforced in this research and students were allowed to use this time as they wished.

Rules, Rewards and Behaviour Management.

Underpinning the Lego Club sessions were the Lego Club rules and Lego Club points system (as detailed by LeGoff et al., 2014). Although LeGoff et al. (2014) recommended levels of Lego Club membership with associated certificates (for example, Lego Helper certificate for helping others during sessions), as all the students started the group at the same time this was not deemed necessary. Students were awarded Lego Club certificates upon completion of a Lego set.

During Lego Club sessions, students were encouraged to assist with behaviour management. The adult running the session was encouraged to facilitate the session rather than actively direct it, prompting the students to develop solutions to problems that may arise. The adult suggested the use of techniques such as role play if persistent issues occurred.

Measures

The inclusion criteria involved the administration of the British Ability Scales Third Edition (Elliot & Smith, 2012) and Social Communication Questionnaire (SCQ, Rutter et al., 2003). The Social Skills Improvement System (SSIS; Elliot & Gresham, 2007) was administered pre and post intervention to provide a standardised measure of social skills. Observational data was analysed with a social behaviour coding scale and intervention fidelity checklist.

An analysis of observational data was used to monitor the social skills displayed during baseline and intervention phases during which students engaged in 15-minute Lego free-play sessions. The sessions were video recorded to allow the coding of

social behaviours. Merrell (2001) suggests that naturalistic observations should be used as a primary measure for assessing social skills in children with ASD, with the categories of social interactions and social initiations most commonly investigated (Rotheram-Fuller et al., 2013).

Social behaviours were coded using a social behaviour coding schedule, adapted from Bauminger (2002) and Odom and Strain (1986). The coding scheme allowed the observation of the quality (positive or negative) and nature (initiating or responding) of social behaviours (Elliott et al., 1989). The duration of social interaction was also recorded and calculated as a percentage of time engaged with peers. Appendix 1 contains the coding schedule used.

As Barlow et al. (2009) recommends, inter-coder reliability data was established for a minimum of 15-25% of sessions. One psychology graduate working in Special Education was trained in the coding scheme and provided inter-coder reliability data. Minimum acceptable values of inter-coder agreement are at least .60 if measured by Cohen's kappa (Hartmann et al., 2004).

Fidelity of Implementation

Intervention fidelity was measured with an intervention fidelity checklist (see Appendix) for three sessions for each group, as completed by the interventionist. The intervention fidelity checklist was adapted from the dimensions of treatment fidelity suggested by Durlak and Dupre (2008) and the measures reported by Bishop et al. (2014). The fidelity checklist was based on observational data due to the increased objectivity (compared to self-report data) and indications that observational data are more likely to be linked to outcomes (Durlak & DuPre, 2008).

Data Analysis

Visual Analysis. Single-case experimental design studies have traditionally relied on visual analysis as the primary method of outcome evaluation (Kratochwill et al., 2014). Therefore data from this study was analysed using visual analysis of graphed data to assess the level of functional relation between the independent variable and dependent variable (Parsonson & Baer, 1978). Percentage of all non-overlapping data (PAND; Parker et al., 2007) was used to calculate the overlap between phases as an effect size estimate, as part of the visual analysis process.

Tau-U (Parker et al., 2011). Including statistical analysis of data generated from a single-case design is the recommended gold standard for single-case intervention designs (Kratochwill et al., 2010). Data generated from the social behaviour coding scheme was analysed using Tau-U, a family of indices that combine Phase AB non-overlap with Phase B trend (Parker et al., 2011). Tau-U overcomes some of the weaknesses existing in models of regression (for example, violation of data and scale-type assumptions) and simple models of non-overlap (for example, lack of statistical power and discrimination) (Parker et al., 2011).

Reliable Change Index (RCI; Jacobson & Truax, 1991). RCI was used to examine differences between SSIS (Elliot & Gresham, 2007) data at two time periods, pre-intervention and post-intervention. The RCI determines whether any change in scores from pre-intervention to post-intervention are statistically reliable; change scores above 1.96 are considered statistically significant (Jacobson & Truax, 1991).

Results

Participant 4 withdrew from the study after only six intervention sessions. The data prior to his withdrawal will be provided in this section but will not be included in any combined or weighted scores.

Observational Data

Video footage was analysed by the researcher (a trainee educational psychologist) using the social behaviour coding scheme. The data showed that the mean and median scores for duration of social interaction, frequency of social initiations, responses and positive social skills substantially increased for all participants (except 4) between the baseline to intervention phases. Participant 4 withdrew from the intervention after 6 sessions but data collected prior to his withdrawal suggests the intervention did not have a substantial impact on his social skills.

Cohen's (1960) Kappa was used to calculate inter-rater reliability, a crucial aspect of single-case experimental designs. Inter-coder reliability coefficients were calculated for the duration of social initiation and frequency of social responses observational data. Coefficients were not calculated for positive social behaviours as this variable was impacted by scores for social initiation and social responses. Percentage of agreement between coders has been definitively rejected as an adequate measure of inter-rater reliability (Hallgren, 2012). One psychology graduate provided the inter-coder reliability data. Cohen's (1960) Kappa was used to calculate inter-rater reliability.

The inter-coder reliability coefficients are presented in Table 4. Horner et al. (2005) recommend that the minimum standard for reliability is Kappa coefficients above

60%, a criterion satisfied in this research. Using the guidelines for interpretation by Landis and Koch (1977), there was substantial agreement for the duration of social interaction and frequency of social initiations with moderate agreement for the frequency of social responses.

Table 4.

Inter-coder reliability coefficients for observational data.

Variable	Cohen's Kappa	Interpretation of Kappa*	Number of Agreements	Number of Disagreements
Duration of social interaction	0.769	Substantial agreement	25	7
Social initiations	0.790	Substantial agreement	26	6
Responses	0.606	Moderate agreement	20	12

* According to Landis and Koch (1977).

Visual Inspection of Graphed Data and PAND Calculations

Visual inspection involves assessment of the level, trend and variability of data within the phase, in addition to an examination of the immediacy of effect, overlap and consistency of data in similar phases (Horner & Spaulding, 2010). A functional relationship is demonstrated when the data shows at least three demonstrations of experimental effect across at least three points in time (Horner & Spaulding, 2010). Judgements can then be made as to whether the graphic displays of data present

strong evidence, moderate evidence or no evidence of experimental effect (Kratochwill et al., 2014).

Graphic displays of the observational data are presented across all participants for each variable in Figures 1, 2, 3 and 4.

Figure 1. Graphic Display of the Duration of Social Interaction

across all Participants and Phases.

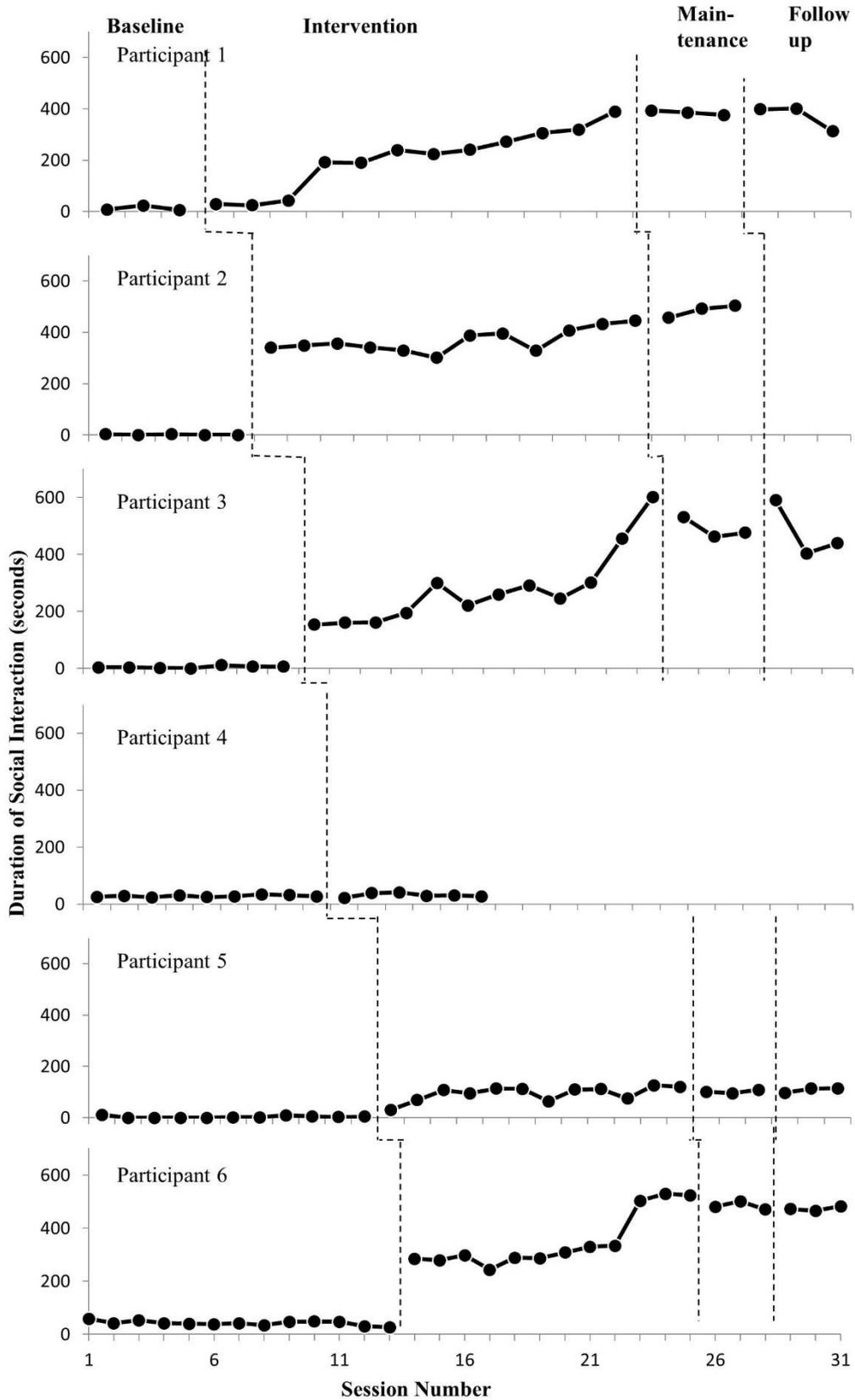


Figure 2. Graphic Display of the Frequency of Social Initiations across all Participants and Phases.

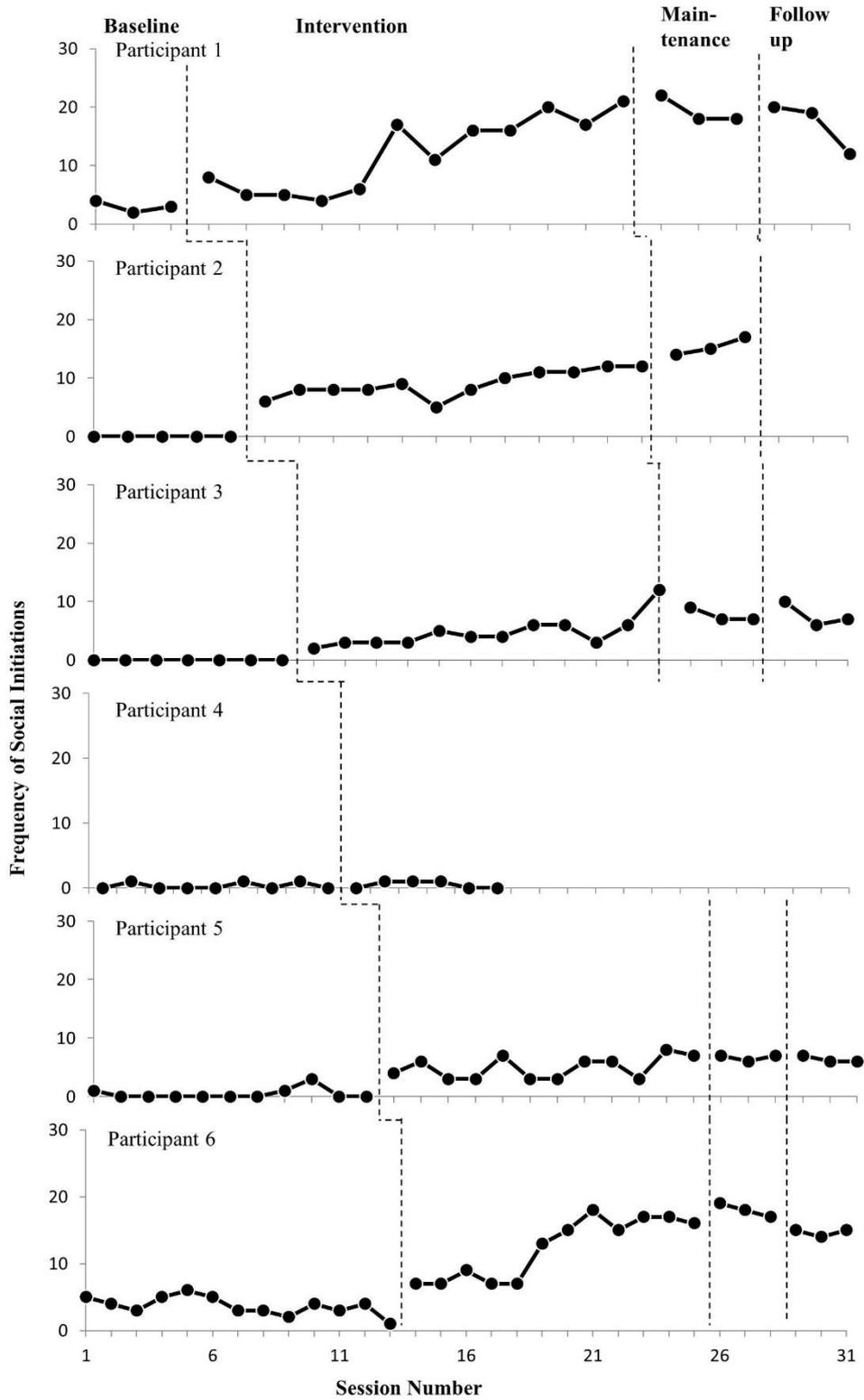


Figure 3. Graphic Display of the Frequency of Responses to Social Initiations across all Participants and Phases.

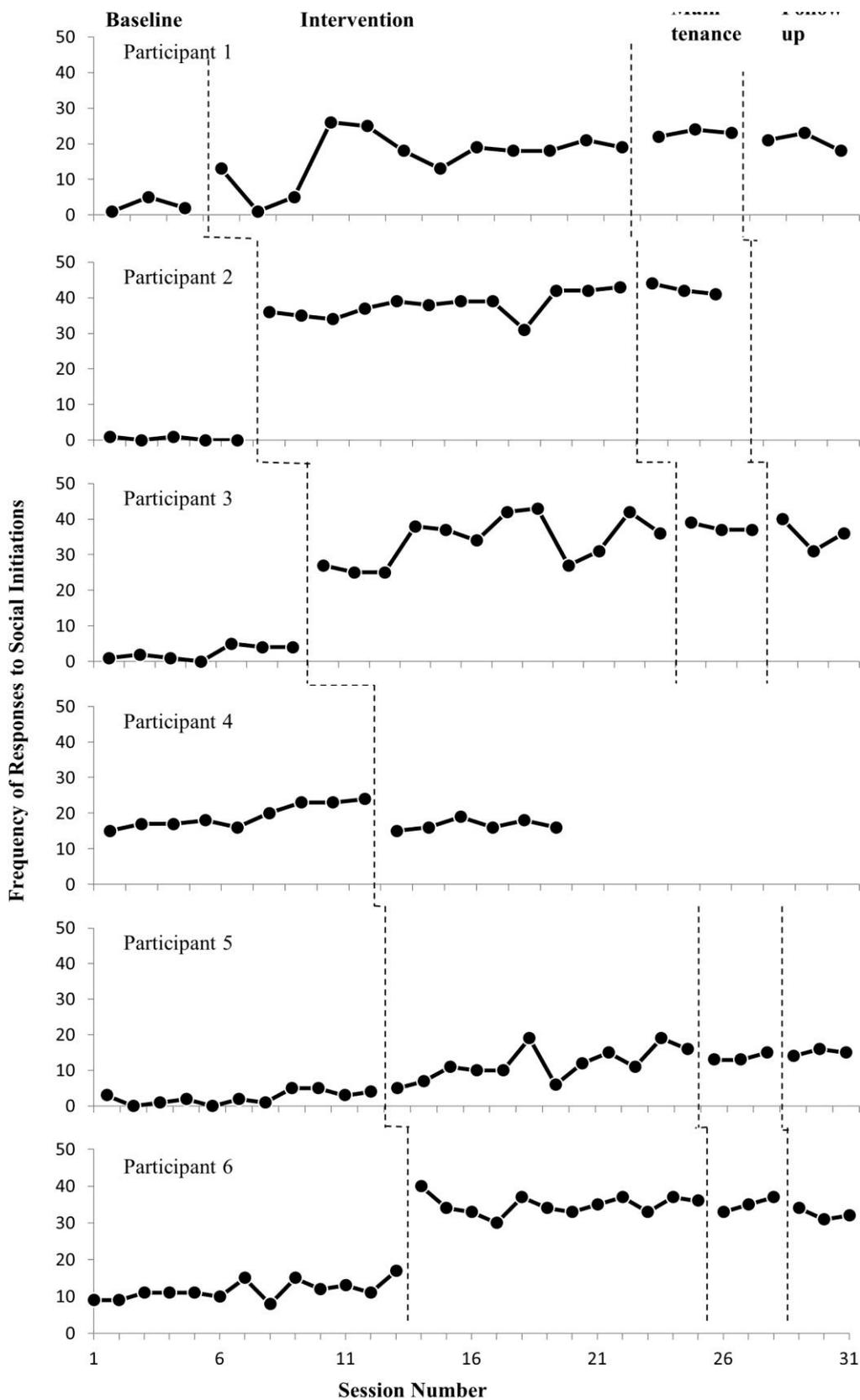
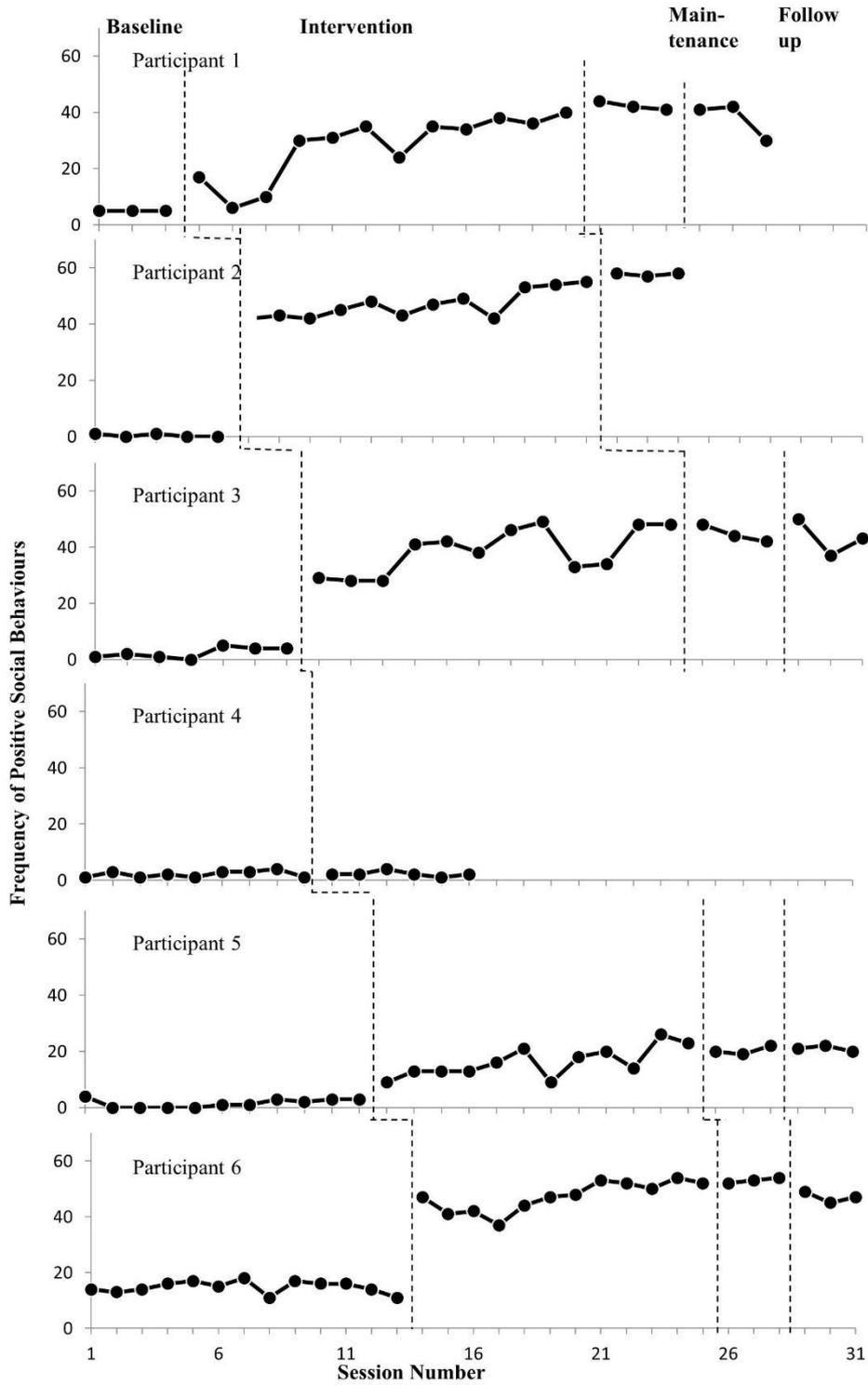


Figure 4. Graphic Display of the Frequency of Positive Social Behaviours across all Participants and Phases.



PAND Calculations

Percentage of all non-overlapping data (PAND; Parker et al., 2007) was used to calculate the overlap between phases as an effect size estimate. The mean PAND across all participants for the baseline to intervention phases for all variables is above 93%, suggesting a strong effect of the intervention. This suggests that Lego Therapy had a strong positive effect on duration of social interaction, frequency of social initiations, frequency of social responses and frequency of positive responses. The baseline to maintenance and follow up phases PAND scores of 100% suggests that the positive effects were maintained following completion of the intervention.

Table 3.8 shows that the PAND for baseline to intervention phases for the duration of social interactions for all participants was 100%, suggesting a very strong effect of intervention. The PAND of 100% for baseline to maintenance and follow up conditions suggests that the improvements were maintained post-intervention. Similarly, for frequency of social initiations, participants (excluding participant 4) had a PAND score of over 93% for baseline to intervention phases, with 100% effect in the baseline to maintenance and follow up comparisons. The frequency of responses (excluding participant 4) had PAND scores above 86% for baseline to intervention and baseline to maintenance and follow-up phases, suggesting another strong effect of the Lego intervention.

All participants (except participant 4) had 100% PAND scores for the baseline to intervention, maintenance and follow up phases. As such, the Lego intervention had a strong effect on social skills for participants 1, 2, 3, 5 and 6 during the intervention and skills were maintained during maintenance and follow up.

Table 5.

Percentage of Non-Overlapping Data for Each Participant

Variable		BAS ¹ – INT ²	MAIN ³ – FOL ⁴	Phase			
				BAS - MAIN	BAS- FOL	INT- MAIN	INT- FOL
Duration of social interactions							
	P1	100%	83.3%	100%	100%	93.3%	86.7%
	P2	100%	-	100%	-	100%	-
	P3	100%	66.6%	100%	100%	93.3%	66.0%
	P4	100%	-	-	-	-	-
	P5	100%	83.3%	100%	100%	80.0%	83.3%
	P6	100%	50%	100%	100%	80.0%	80.0%
Frequency of social initiations							
	P1	93.3%	66.7%	100%	100%	86.7%	66.7%
	P2	100%	-	100%	-	100%	-
	P3	100%	66.7%	100%	100%	93.3%	86.7%
	P4	80.0%	-	-	-	-	-
	P5	96.6%	50.0%	100%	100%	80.0%	80.0%
	P6	100%	100%	100%	100%	86.7%	80.0%
Frequency of responses							
	P1	86.7%	50.0%	100%	100%	86.7%	80.0%
	P2	100%	-	100%	-	100%	-
	P3	100%	66.7%	100%	100%	86.7%	83.33%
	P4	60.0%	-	-	-	-	-
	P5	96.6%	83.3%	100%	100%	80.0%	83.3%
	P6	100%	66.7%	100%	100%	80.0%	80.0%
Frequency of positive social responses							
	P1	100%	66.7%	100%	100%	100%	93.3%
	P2	100%	N/A	100%	N/A	100%	N/A
	P3	100%	66.7%	100%	100%	80.0%	86.7%
	P4	40%	N/A	N/A	N/A	N/A	N/A
	P5	100%	50%	100%	100%	80.0%	80.0%
	P6	100%	100%	100%	100%	80.0%	80.0%

¹ BAS = Baseline period² INT = Intervention period³ MAIN = Maintenance period⁴ FOL = Follow up period

Table 6.

Mean Percentage of Non-Overlapping Data for all Participants and Phases (exc. participant 4)

	Duration of Social Interaction	Frequency of Social Initiations	Frequency of Responses	Frequency of Positive Social Responses
Baseline to Intervention	100%	97.16%	93.62%	96.45%
Maintenance to Follow up	70.80%	71%	66.68%	70.85%
Baseline to Maintenance	100.00%	100%	100.00%	100.00%
Baseline to Follow up	100.00%	100%	100.00%	100.00%
Intervention to Maintenance	89.32%	89.34%	86.68%	88.00%
Intervention to Follow up	79.00%	78.35%	81.66%	85.00%

Tau-U Calculations

Tau-U (Parker et al., 2011) was calculated to provide effect size estimates and to overcome the limitations of PAND in high-end discriminations. For multiple-baseline designs, Tau-U is calculated separately for each phase contrast and the effect size for the full model is calculated by averaging all Tau-U scores together (Rakap, 2015). Tau-U was calculated using the online tool (<http://www.singlecaseresearch.org/calculators/tau-u>). Tau-U scores range from 0 to 1, with 0 - 0.65 representing weak or small effects, 0.66 - 0.92 representing medium to high effects and 0.93 to 1.0 representing large or strong effects (Rispoli et al., 2013).

As can be seen in Table 7, excluding participant 4, the Tau-U values for all variables for all participants were statistically significant at the $p < .05$ or $p < .01$ levels. The weighted averages across all participants for duration of social engagement and frequency of social initiations, responses and positive social skills showed large effects of the intervention which were significant at the $p < .01$ level.

Table 7.

Tau U Effect Size Estimates for Baseline to Intervention Phases.

	Duration of Social Engagement			Social Initiations			Responses			Positive Social Skills		
	TAU	<i>p</i> value	CI ¹ 90%	TAU	<i>p</i> value	CI ¹ 90%	TAU	<i>p</i> value	CI ¹ 90%	TAU	<i>p</i> value	CI ¹ 90%
Participant 1	1.000 Large	0.009*	0.367< >1.633	0.972 Large	0.012*	0.339< >1.605	0.833 Medium	0.030*	0.200< >1.466	1.000 Large	0.009*	0.367< >1.633
Participant 2	1.000 Large	0.002*	0.480< >1.520	1.000 Large	0.002*	0.480< >1.520	1.000 Large	0.002*	0.472< >1.528	1.000 Large	0.002*	0.480< >1.520
Participant 3	1.000 Large	0.000**	0.537< >1.463	1.000 Large	0.000**	0.537< >1.463	1.000 Large	0.000**	0.537< >1.463	1.000 Large	0.000**	0.537< >1.463
Participant 4	0.241 Small	0.444	-0.276< >0.758	0.167 Small	0.596	-0.35< >0.684	-0.982 ² Large	0.002*	-1.498< >-0.465	0.056 Small	0.860	-0.461< >0.573
Participant 5	1.000 Large	0.000**	0.595< >1.405	0.962 Large	0.000**	0.557< >1.367	0.985 Large	0.000**	0.580< >1.390	1.000 Large	0.000**	0.595< >1.405
Participant 6	1.000 Large	0.000**	0.612< >1.388	1.000 Large	0.000**	0.612< >1.388	0.782 ¹ Medium	0.001**	0.394< >1.170	1.000 Large	0.000**	0.612< >1.388
Weighted Average (exc. P4)	1.000 Large	0.000**	0.739< >1.261	0.987 Large	0.000**	0.781< >1.219	0.919 Large	0.000**	0.699< >1.139	1.000 Large	0.000**	0.7809<>1 .2191

¹ Confidence Interval² Corrected baseline due to significant baseline trend at the $p < .05$ level.

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

SSIS and Reliable Change Index

To examine generalisation of skill, the SSIS (Elliot & Gresham, 2007) was administered to the student's form tutor and parent pre- and post-intervention and analysed using the RCI (Jacobson & Truax, 1991). The RCI determines whether any change in scores post-intervention is statistically reliable, with change scores above 1.96 deemed statistically significant.

As can be seen in Table 8, the SSIS showed statistically reliable change, suggesting generalisation of social skills from the parent view for participants 1, 2 and 6. Parents saw a reliable reduction in problem behaviours for participants 1, 2 and 3. Teachers saw less improvement, with reliable change in social skills reported only for participant 3 and reduction in problem behaviours for participants 1 and 3. This may be because the SSIS was administered to form tutors who only see the students for a short period of time each day. Nevertheless, the data suggests that there was some generalisation of skill outside of Lego Club but this was inconsistent between raters and participants.

Table 8.
Reliable Change Index for SSIS pre- and post-intervention.

		Pre-Post Score Difference	Standard Error of the Difference (S_{diff})	Reliable Change Index (Pre-post score difference / S_{diff})	Statistically Reliable Change? (Reliable Change Index ≥ 1.96)
Participant 1					
Parent	Social Skills	12	2.74	4.38	Yes
	Problem Behaviours	-9	2.74	3.28	Yes
Teacher	Social Skills	5	2.83	1.77	No

	Problem Behaviours	-10	2.83	3.53	Yes
Participant 2					
Parent	Social skills	14	2.57	5.45	Yes
	Problem Behaviours	-14	2.57	5.45	Yes
Teacher	Social Skills	6	3.17	1.89	No
	Problem Behaviours	-5	3.17	1.58	No
Participant 3					
Parent	Social Skills	3	2.74	1.09	No
	Problem Behaviours	22	2.74	8.03	Yes
Teacher	Social Skills	13	2.83	4.59	Yes
	Problem Behaviour	-7	2.83	2.47	Yes
Participant 5					
Parent	Social Skills	0	2.74	0.00	No
	Problem Behaviours	0	2.74	0.00	No
Teacher	Social Skills	1	2.83	0.35	No
	Problem Behaviours	-3	2.83	1.06	No
Participant 6					
Parent	Social Skills	14	2.57	5.45	Yes
	Problem Behaviours	-2	2.57	0.78	No
Teacher	Social Skills	3	3.17	0.95	No
	Problem Behaviours	-5	3.17	1.58	No

Fidelity of Implementation

Implementation fidelity was assessed by the researcher through application of the fidelity checklist for three sessions for each group. The average percentage of intervention fidelity across the three sessions observed was 85% for participant 1,

87% for participant 2, 85% for participant 3, 50% for participant 4, 74% for participant 5 and 78% for participant 6. The score for participant 4's group was heavily impacted by the challenging behaviour displayed by group members and thus, the difficulties of the interventionist to adhere to the programme manual. Participant 4 displayed significant anger difficulties and engaged in challenging behaviours such as swearing. As the participant withdrew after 6 intervention sessions, the dosage score was impacted and his lack of engagement was evident in the observation. The high percentage scores for the other groups suggests that fidelity to the programme was adhered to, with good quality of delivery, participant engagement, no adaptations and the correct dosage (number of sessions).

Discussion

Social Skill Development

Visual and statistical analysis of the observational data collected showed statistically significant increases in the duration of social engagement, frequency of social initiations, frequency of responses and frequency of positive social behaviours between the baseline and intervention phases for all participants who completed the intervention programme.

Participant 4 withdrew from the research after six intervention sessions, with no statistically significant increase in social skill behaviour prior to withdrawal. Highly effective improvements in ratings of social skills were obtained across five participants at three different points in time, which provides the recommended demonstration of experimental effect for single-case research designs (Horner et al., 2005). This is consistent with the clinical trials of Lego Therapy (LeGoff, 2004; LeGoff & Sherman, 2006; Owens et al., 2008) and suggests that the intervention remains effective when delivered and implemented by school staff, in a school setting and with the inclusion of typically developing peers.

This research found a significant increase in the rate of social initiations in students with ASD. Social initiations have been highlighted as a central component of social behaviour; an individual requires the development of initiation and response skills in order to become socially competent (Kaczmarek, 2002). In comparison to their peers, children with autism make and accept fewer social initiations and spend more time playing alone (Koegel et al., 2001; Sigman & Ruskin, 1999). As children with ASD may face major difficulties initiating social behaviours (Nikopoulos & Keenan, 2003), an increase in social initiations is a significant advance. This is of particular importance as when the social initiation rate in children with autism increases, their social behaviour improves significantly (Strain et al., 1979).

This research found that learnt skills were maintained post-intervention. Persistent weaknesses of the literature on social skills training is its failure to demonstrate sufficient generalization and maintenance of learnt social skills (Gresham et al., 2001). The age group of participants in this study (adolescents in secondary education) may have impacted the maintenance success, with Bellini et al. (2007) finding the most successful maintenance of social skills in the secondary school age group. As skills were maintained post-intervention, this research supports LeGoff and Sherman's (2006) finding that skills learnt in Lego Therapy are maintained following completion of the programme.

Generalisation of Skill

The second research question asked whether any changes seen in the Lego Club setting were generalised outside of the intervention setting. Data from the Social Skills Improvement System (SSIS; Elliot & Gresham, 2007) administered pre- and post-intervention to parents and teachers showed variability in the generalisation of skills. The Reliable Change Index (RCI; Jacobson & Truax, 1991) demonstrated statistically reliable change for social skills from the parent viewpoint for participants 1, 2 and 6. The parents of participants 1, 2 and 3 saw a reduction in problem behaviours. Teachers only viewed there to be a statistically reliable change in social skills for participant 3, with teachers reporting a reliable decrease in problem behaviours for participant 1 and 3.

Therefore, there were three demonstrations of experimental effect for the generalisation of social skills to the home setting, fulfilling Horner et al.'s (2005) minimum criteria. It can therefore be concluded that social skills were generalised from the school to home setting, but conclusions cannot be drawn for the generalisation of social skills to other aspects of school.

Issues with the generalisation of social skills learnt through a programme or training have been long discussed in the literature on ASD. Despite evidence of the effectiveness of

teaching appropriate social functioning, there is concern about generalization and maintenance of learned skills (Smith & Gilles, 2003). Rao et al. (2008) consider the generalisation of skills from acquisition in the programme setting to application in the wider community a key challenge for social skill training. In this study, social skills were taught in the natural context of the school, fitting Smith and Gilles (2003) recommendation that social skills should be taught in the social context in which they may be needed. Gresham et al. (2001) emphasise the importance of contextualisation of social skill training, considering significant limitations to the ‘decontextualised’ approach of many programmes, a limitation overcome by the school setting in this research.

Participants in this study successfully generalised learnt skills to the home environment, a finding that is likely to have been impacted by the natural setting of the research. However, this research was unable to conclude that skills were generalised to other aspects of school life. Further investigation of skill generalisation from Lego Therapy is warranted.

Strengths and Limitations of this Study

A significant strength of this research is the real-world setting in which it was conducted. The research was conducted in a school setting, the setting for the majority of social skill interventions. Previous research on Lego Therapy has been clinic-based (LeGoff, 2004; LeGoff & Sherman, 2006; Owens et al., 2008) and consequently there are difficulties with generalisation to school settings. By conducting the research in the environment in which the intervention is likely to be carried out, this research has stronger ecological validity.

Further, exploring the effectiveness of the intervention at the individual level helps build our understanding of Lego Therapy and the mechanisms that may lead to change. Data was collected during every baseline and intervention session, as well as standardised measures pre- and post-intervention, creating an extensive picture of behaviour change. The

consistency in the environment in which the programme was implemented (the same school) and the similarity in participant characteristics (Table 2) fulfilled the recommendations for robust single-case designs (Barlow et al., 2009).

The inclusion of typically developing peers in a Lego Therapy group was an innovative contribution of this research. Including typically developing role models in social skill groups is well-supported in the literature and is congruent with inclusive schooling practices. In addition, school staff implemented the programme, whereas psychologists implemented Lego Therapy in previous research. The high scores for programme fidelity support the role of Learning Support Assistants as interventionists. These two adaptations make Lego Therapy more realistic for application in real-world school settings.

It is recognised that the small sample size and absence of a separate control group make generalisation to the wider population more challenging. It is unknown whether the results from this research would be relevant to other individuals, implementers or settings (Barlow et al., 2009). Further, the demographics and culture of the participant group may have impacted the results. Participants with similar characteristics were selected to aid group homogeneity but it is difficult to generalise the results to the wider population. In particular, all participants were male so further research is required on Lego Therapy's application to female students. The difficulties displayed by participant 4 suggest that the programme may not be appropriate for student's with significant social and emotional difficulties, but this needs further exploration before conclusions can be drawn.

The generalisation of skills to social situations outside of the Lego Club group was examined through administration of the Social Skills Improvement System (SSIS; Elliot & Gresham, 2007) to teachers and parents. Further information should be explored on the generalisation

of skill, with the views of other members of the school community (for example, lunch time staff) sought.

Percentage of non-overlapping data (PAND; Parker et al., 2007) was selected to provide an estimate of effect size based on an evaluation of available techniques. However, when applied to the data set (Table 5) the limitations of PAND to make high end distinctions was clear, with the ceiling limit often reached. Furthermore, the technique did not provide useful information when applied to phases of differing length. These limitations were overcome by supplementing the analysis with Tau-u statistics (Parker et al., 2011).

Finally, the research would have benefitted including an exploration of the views of the typically developing peers who formed the Lego Club groups. Informal qualitative feedback from the peers was extremely positive but this was not collected in a systematic manner.

Conclusions

In conclusion, Lego Therapy groups were effective at improving the social skills (as measured by duration of engagement, frequency of initiations, frequency of responses and positive social behaviours) for five out of six participants. These improvements were statistically significant using Tau-U analyses. Improvements were sustained over maintenance and follow-up phases, suggesting that the impact of Lego social skills groups is enduring and not limited to the delivery of the intervention.

The variability in the data collected to assess skill generalisation suggests that further research is required before conclusions can be reached. Currently, the generalisation of skills seems to be stronger to home settings, with parents more likely to report a positive change in social skills and a reduction in problem behaviour than teachers.

Future research should expand the evidence-base on this innovative programme. Whilst this research is suggesting the positive impact of Lego social skills groups, caution is still needed as this is the first school-based study of Lego Therapy and only six adolescents were involved. An examination of the impact of the programme for students in different settings, of different ages and gender and of varying levels of ability will help build a comprehensive picture of who is suitable for the intervention.

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Appendix 1: Social Behaviour Observational Coding Scheme

Participant:

Session number:

1. Duration of social interaction
2. Frequency of positive social behaviours.
3. Frequency of negative social behaviours.

For duration: Record the seconds of interaction per 15 minute freeplay session.

	Duration in seconds
Child initiated social interactions	
Peer initiated social interactions	

For frequency: Follow the interval sampling procedure below.

Minute	15 Second Intervals			
	15 secs	30 secs	45 secs	60 secs
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Code	Positive Social Behaviours
P1	Eye contact Looks into the eyes of another child.
P2	Affection Expresses affection towards another child verbally or nonverbally e.g. 'I like you'.
P3	Sharing objects Offers or gives something they are using to another child.
P4	Sharing experience Tells peers about an experience or asks them about their experiences.
P5	Smile or other non-verbal communication Smiling, shrugging, pointing etc.
P6	Giving help Offers or provides help to another child.
P7	Social communication Approaches another child with a social intention e.g. 'let's play'.
P8	Plays cooperatively with peer Engages in joint task or activity
P9	Turn takes Waits patiently for a turn.

Code	Negative Social Behaviours
N1	Physical or verbal aggressiveness Behaves in a malicious way towards peers e.g. yells, screams, makes fun of, pushes etc.
N2	Temper tantrum Expresses anger in an extreme way e.g. screams or shouts, hits objects etc.
N4	Controlling Dominates other children.
N5	Avoidance of social interaction Avoids social overtures made toward them by peers.

Appendix 2: Implementation Fidelity Checklist

Dimension	Measure	Y	N	Notes										
Adherence	1. Job roles given out													
	2. Students build according to job roles													
	3. Positive social behaviour praised													
	4. Students encouraged to problem solve													
	5. Adult facilitates rather than directs													
Quality of Delivery	1. General session management Quality of delivery: 1 (poorly) 2 (adequately) 3 (very well) 4 (exceptionally)													
	2. Facilitator enthusiasm Quality of delivery: 1 (poorly) 2 (adequately) 3 (very well) 4 (exceptionally)													
	3. Facilitator understanding of the programme Quality of delivery: 1 (poorly) 2 (adequately) 3 (very well) 4 (exceptionally)													
Participant Engagement	<table style="width: 100%; border: none;"> <tr> <td style="width: 20%; text-align: left;">Poor Engagement</td> <td style="width: 20%;"></td> <td style="width: 20%; text-align: right;">High Engagement</td> <td style="width: 20%;"></td> <td style="width: 20%;"></td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">4</td> <td style="text-align: center;">5</td> </tr> </table>				Poor Engagement		High Engagement			1	2	3	4	5
Poor Engagement		High Engagement												
1	2	3	4	5										

Adaptation	1. Adaptation made?	Y	N	
	Description of adaptation	Valence		
		Detrimental -2 , -1	No Impact 0	Improvement +1, +2
	Description of adaptation	Valence		
	Detrimental -2 , -1	No Impact 0	Improvement +1, +2	
Description of adaptation	Valence			
	Detrimental -2 , -1	No Impact 0	Improvement +1, +2	
Dosage	Total number of sessions as directed (12 intervention sessions)?	Y	N	Notes
	Duration of session as directed?			