DOI: 10.7860/JCDR/2023/65100.18789

Original Article

Physical Medicine and Rehabilitation Section

Comparison of Functional Communication Training, Sensory Integration Therapy, and Behaviour Intervention for Challenging Behaviours in Children with Autism: A Pilot Study

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ABSTRACT

Introduction: Challenging behaviours are frequently observed in children diagnosed with Autism Spectrum Disorder (ASD), potentially hindering their daily functioning. As the prevalence of autism continues to rise, the array of challenging behaviours, including repetitive patterns, stereotypes, and self-harm, emphasises the importance of developing effective interventions in occupational therapy. These interventions aim to manage these challenging behaviours and enhance the overall well-being and functionality of these children.

Aim: To compare the effectiveness of Functional Communication Training (FCT), Sensory Integration Therapy (SIT), and Behavioural Interventions (BI) on challenging behaviours in children with ASD.

Materials and Methods: An experimental study with pre-post test design was conducted in the Paediatric Unit of the Department of Occupational Therapy, SRM Institute of Science and Technology, Chennai, Tamil Nadu, India. The duration of the study was nine months, from September 2020 to May 2021. A total of six (N=6) children selected through convenience sampling. The SIT took place at the paediatric unit of the occupational therapy department at SRM Medical College Hospital and Research Centre, Kattankulathur, Chennai, Tamil Nadu, India. Due to Coronavirus Disaese-2019 (COVID-19) restrictions, FCT and BI were conducted simultaneously at the participants' homes. Outcomes were measured using Functional Behavioural Assessment (FBA) and the Repetitive Behaviour Scale-Revised (RBS-R). Within-group analysis involved utilising the Wilcoxon signed-rank test, while between-group analysis entailed the application of the Kruskal-Wallis and one way Analysis of Variance (ANOVA) test.

Results: The mean age of the study participants was 7.83±1.83 years. A significant reduction in challenging behaviours was seen in all six children in the three intervention groups when outcomes were measured using FBA ($p<0.05$). Among these interventions, BI proved to be the most effective in reducing the frequency of challenging behaviours in children with ASD, as evidenced by a mean post-test score of RBS-R (19.50±12.02 for BI, compared to 20±1.41 for SI and 23±11.31 for FCT, $p=0.047$).

Conclusion: The results of the study indicated that all three interventions - SIT, FCT, and BI successfully decreased the occurrence of challenging behaviours in children with ASD.

Keywords: Maladaptive behaviours, Reinforcement, Self-injurious behaviour, Sensory processing, Stereotypy

INTRODUCTION

Behaviours encompass a wide range of actions and expressions by individuals, reflecting how they interact and function in their daily lives. Challenging behaviours, on the other hand, refer to actions that disrupt a child's daily functioning. An estimated 6% to 40% of children with disabilities display self-abusive behaviours, including hand biting, head banging, and eye gouging [1].

Challenging behaviours, although not part of the core diagnostic criteria for ASD, are highly prevalent in early childhood and adolescence. Such behaviours include increased hyperactivity and self-injury, which frequently co-occur with ASD [2,3]. These behaviours are considered associated conditions that interfere with children's independent participation in everyday activities [4]. Approximately half of the individuals diagnosed with ASD commonly exhibit challenging behaviours, frequently functioning as a form of communication [5]. These behaviours can stem from various reasons, including language and communication deficits. Children with poor communication skills often resort to challenging behaviours to express discomfort, escape from unwanted situations, or seek reinforcement. Additionally, inconsistencies in the environment may interfere with the child's specific needs [6]. Sensory overstimulation or understimulation, can also trigger challenging behaviours [7].

Interventions were carefully selected to target the underlying causes of challenging behaviours directly. These include FCT, BI, and SIT. The overall focus of these interventions is to prevent challenging behaviours and promote positive ones. SIT employs a systematic approach, offering carefully regulated tactile, vestibular, and proprioceptive stimuli. On the other hand, FCT adopts behavioural techniques to replace undesirable behaviours with more proficient and appropriate communication skills [8]. Another effective intervention is BI, supported by substantial evidence for reducing challenging behaviours in children with ASD [9]. The central premise of BI is that underlying causes influence all behaviour in children. Given that these challenging behaviours manifest during the early years of life, early intervention and personalised support are essential to effectively address these issues.

Researchers who studied BI and SIT for challenging behaviours in children with ASD concluded that BI yields more significant results than SIT [10,11]. However, the study's crossover design had limitations regarding sequencing behavioural and sensory integration therapies and a limited scope for participant follow-up. Another study examined the effects of FCT using an iPad application on challenging behaviours in children with ASD [12]. The present study acknowledged its limitations concerning social validity and

methodological variations. Existing literature does not fully align with the theoretical foundation of sensory integration, as it primarily focuses on sensory stimulation rather than sensory integration strategies [8,10,12,13]. The evidence shows inconsistent potential success of BI over SIT. Furthermore, the available evidence either compares the efficacy of each intervention type or examines intergroup interventions, but no study has yet compared the effectiveness of all three interventions.

A pilot version of the present study was adopted due to the following reasons. The study focused on the diverse nature of challenging behaviours in children with autism. Providing interventions for a larger sample size would have posed a challenge as all the interventions were individualised per the child's challenging behaviour. Additionally, previously conducted studies have used a smaller sample size of 2 and 4 due to the diversity of these behaviours [12,13]. The COVID-19 pandemic limited the access to a larger population during the study. Therefore, the current study compared the effectiveness of FCT, SIT, and BI on challenging behaviours in children with ASD. The null hypothesis there was no significant difference in the effect of FCT, SIT, and BI on challenging behaviours in children with ASD and alternative hypothesis there was a significant difference in the effects of FCT, SIT, and BI on challenging behaviours in children with ASD.

MATERIALS AND METHODS

An experimental study with pre-post test design was conducted in the Paediatric Unit of the Department of Occupational Therapy, SRM Institute of Science and Technology, Chennai, Tamil Nadu, India. The duration of the study was nine months, from September 2020 to May 2021. The study was approved by the Institutional Ethical Committee (IEC) with the ethical clearance number: 2085/IEC/2020. The study opted for an experimental pre-post test design, with a total sample of six (N=6) children recruited through convenience sampling from the Chengalpattu district (Tamil Nadu, India).

Inclusion criteria: Children diagnosed with ASD by a developmental paediatrician or psychiatrist and both the genders. Patients aged between 6-12 years. Exhibited challenging behaviours analysed through observation on functional behavioural analysis and the patients showed limited speech and functional communication were included in the study.

Exclusion criteria: Children with co-morbidities alongside ASD and/or intellectual disability were excluded from the study.

Outcome Measures

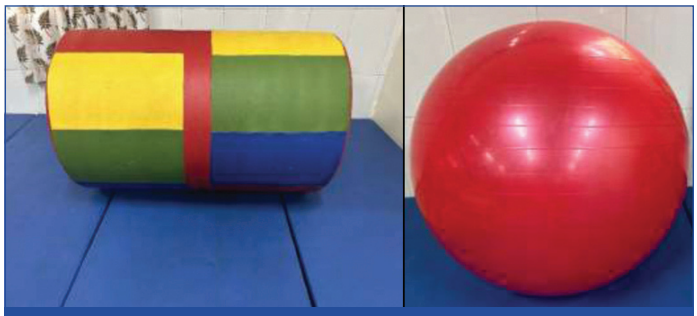
Functional Behavioural Assessment (FBA): The FBA is a systematic process that examines the factors influencing challenging behaviours to understand why they occur. It involves observing the Antecedent-Behaviour-Consequence (A-B-C) sequence to identify the function of each child's challenging behaviours. The main goal of FBA is to recognise the underlying factors that control the behaviours. During the assessment, the observer monitored each child's behaviour for 30 minutes, while parents and/or caregivers documented the child's functioning in the home environment. As FBA is an observational assessment, the frequency of challenging behaviours exhibited by the participants was recorded and documented [8,14]. Additionally, the observations of A-B-C sequences distinctly demonstrated the purpose behind the challenging actions of the participants, rendering experimental functional analyses unnecessary [12]. The antecedent is an event that sets the occasion for a behaviour or what occurs right before a behaviour. The behaviour is the action that someone does. The consequence is the immediately followed response after the exhibition of the challenging behaviour [12].

Repetitive Behaviour Scale-Revised (RBS-R): The RBS-R is an expanded version of the Repetitive Behaviour Scale (RBS) introduced by Bodfish JW et al., in 2000 [15]. It is a quantitative measure to assess repetitive behaviours in individuals with ASD. The RBS-R consists of 43 items of repetitive behaviours grouped into six dimensions: stereotyped, self-injurious, compulsive, ritualistic, sameness, and restricted behaviour subscales. The scale takes around 10-15 minutes for administration. Each behaviour is rated on a 4-point Likert scale for severity: 0=behaviour does not occur, 1=behaviour occurs and is a mild problem, 2=behaviour occurs and is a moderate problem, and 3=behaviour occurs and is a severe problem. The total score on this scale is 129, with a higher score indicating more challenging behaviours. Internal reliability ranges from 0.78 to 0.91 for different subscales, and overall reliability was 0.70 [15-17].

Study Procedure

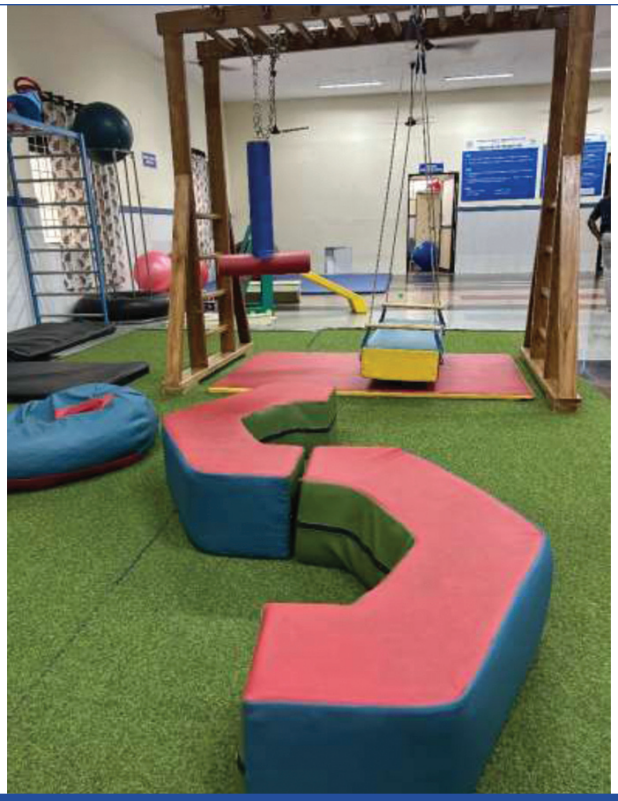
Initially, the plan was to include 15 children (5 in each group: SIT, FCT, BI) with ASD exhibiting challenging behaviour. However, due to the COVID-19 pandemic, the sample size had to be reduced to six children (2 in each group: SIT, FCT, BI). The parents received a comprehensive explanation of the study's purpose, and their written consent was acquired. Functional behaviour analysis was conducted to identify challenging behaviours, involving a preliminary 30-minute observation of the children. The outcome measure, RBS-R, was used to assess the challenging behaviours. Subsequently, the children were randomly assigned through simple random sampling to one of the three groups (SIT, FCT, and BI). This baseline served as the pretest for the study. The study took place at SRM College of Occupational Therapy, OP department, where SIT was conducted for four weeks (three days per week, 45 minutes per session). However, due to COVID-19 restrictions, FCT and BI were administered at the child's home, also lasting for four weeks (three days per week). Following the four-week intervention period, post-test scores were calculated for each participant. The intervention programme for each child was tailored to address their specific challenging behaviours.

Intervention protocol: Participants in group A (SIT) were assigned to receive SIT as their intervention [18-23]. The SIT sessions were conducted for 45 minutes. This intervention was provided in a structured and specialised paediatric occupational therapy set-up using sensory integration equipment [Table/Fig-1-3] and activities



[Table/Fig-1]: Sensory integration equipments (Left: Barrel, Right: Therapy Ball).

[Table/Fig-2]: Sensory integration equipments (Right: Balance board, Left: Ball pit).



[Table/Fig-3]: Sensory integration equipments (set-up for obstacle pathway).

that included a warm-up session, followed by engaging activities involving sensory-motor play (jumping on a trampoline, linear and rotational motion on swings, tactile and proprioceptive stimulation using a bean bag, tactile brush) and praxis (obstacle pathways using equipment like a barrel, stepping stones, walking beams, slides) and socialisation components (greeting, verbal and non verbal gestures, peer play).

Participants in group B received FCT as the mode of intervention [8,12,24,25]. FCT consisted of the implementation of the use of pictures to communicate. Both the therapist and the participant sat on the floor during the intervention. The therapist offered the participant a box of preferred toys and instructed him to select one. Initially, the participant chose the red car, and the remaining items were set aside until the session's conclusion. The child enjoyed 30 seconds of playtime with the red car, followed by a 10 second pause when the toy was momentarily taken away. During this interval, the therapist purposefully avoided direct eye contact while the child interacted with the toy. Subsequently, the child was presented with an image of the same red car. The child would regain access to the red car if he touched the correct picture. If the child exhibited challenging behaviours such as head banging, teeth grinding, or toy grabbing, the therapist responded with a verbal prompt: "If you want the toy, touch the picture." Responding to this prompt led to the return of the toy. A gestural prompt was introduced if the child did not respond, guiding him to "touch here." The session persisted until the child independently touched the picture or did so with prompts, earning praise for his responses.

Participants in group C received BI as their intervention. These interventions involved implementing reinforcement strategies, including positive, negative, and automatic reinforcement, as supported by research studies [10,26,27].

STATISTICAL ANALYSIS

Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 24.0. Descriptive analysis, such as frequencies, was utilised to describe the demographic data. The data did not follow a normal distribution, and the total sample size was six (N=6), so non parametric tests were employed for data analysis. The "within group analysis" was conducted using the Wilcoxon signed-rank test, while the "between group analysis" was carried out using the Kruskal-Wallis (one-way ANOVA) test. A significance level of $p<0.05$ was chosen, indicating that results with a p-value <0.05 were considered statistically significant.

RESULTS

A total of six participants were selected for the study, with a mean age of 7.83±1.83 years. The gender distribution within each group differed. The SIT group consisted of one male and one female, the FCT group consisted of two males, and the BI group consisted of one male and one female participant [Table/Fig-4]. The frequency of challenging behaviours exhibited by each participant is described in [Table/Fig-5]. All the interventions significantly improved the post-test scores in FBA: Participant one (p=0.019), Participant two (p<0.001), Participant three (p=0.047), Participant four (p=0.010), Participant five (p=0.008), and Participant six (p=0.046), as depicted in [Table/Fig-6].

Groups	Boys	Girls	Total (n)
SIT	1	1	2
FCT	2	0	2
BI	1	1	2
Total (N)		6	
Age (in years) (Mean±SD)		7.83±1.83	

[Table/Fig-4]: Demographic distribution of variables.
SIT: Sensory integration therapy; FCT: Functional communication training; BI: Behaviour intervention

Participants	Challenging behaviours frequency (no. of times/30 minutes)					
Scores	Pretest	Post test	Pretest	Post test	Pretest	Post test
Participant 1 frequency (Group A: SIT)	Self-biting		Twirling body		Hitting self on wall	
	10	8	15	10	9	7
Participant 2 frequency (Group A: SIT)	Rubbing feet		Protesting		Twisting fingers	
	9	6	2	2	8	7
Participant 1 frequency (Group B: FCT)	Biting others		Protesting		Head banging	
	7	2	8	3	5	3
Participant 2 frequency (Group B: FCT)	Protesting		Body rocking		Throwing objects	
	6	3	12	8	6	2
Participant 1 frequency (Group C: BI)	Self-biting		Inappropriate gazing at objects		Clapping hands	
	14	7	10	6	15	8
Participant 2 frequency (Group C: BI)	Self-harming		Hair pulling		Picking on skin	
	10	3	7	1	8	4

[Table/Fig-5]: Frequency distribution with Functional Behavioural Analysis (FBA).
SIT: Sensory integration therapy; FCT: Functional communication training; BI: Behaviour intervention

Groups	Pretest (Mean±SD)	Post test (Mean±SD)	p-value
Group A: SIT Participant 1	11.33±3.21	8.33±1.53	0.019
Group A: SIT Participant 2	6.33±3.79	5.00±2.65	<0.001
Group B: FCT Participant 1	6.66±1.53	3.33±1.54	0.047
Group B: FCT Participant 2	8±3.46	4.33±3.21	0.010
Group C: BI Participant 1	13±2.65	7±1.00	0.008
Group C: BI Participant 2	8.33±1.53	2.66±1.54	0.046

[Table/Fig-6]: Comparison of frequency in challenging behaviours on FBA in SIT, FCT, and BI.
Wilcoxon signed-rank test; SIT: Sensory integration therapy; FCT: Functional communication training; BI: Behaviour intervention

There was no statistically significant difference between the pre and post-test scores on the RBS-R in group A: SIT (p=0.180), while a statistically significant difference was seen between the pre and post-test scores in group B: FCT (p=0.041) and in group C: BI

(p=0.024), as depicted in [Table/Fig-7]. The Kruskal-Wallis test was used to compare the pretest scores for between-group analysis on the effect of SIT, FCT, and BI in reducing challenging behaviours. The results indicated no statistically significant difference between the pretest scores of RBS-R in all three groups (p=0.773), as shown in [Table/Fig-8]. A statistically significant difference between the post-test scores of RBS-R in all three groups was observed (p=0.047), as shown in [Table/Fig-9].

Groups	Test	Mean±SD	z-value	p-value
SIT	Pre	31.00±2.828	-1.342	0.180 NS
	Post	20.00±1.414		
FCT	Pre	27.50±14.849	2.035	0.041 S
	Post	23.00±11.314		
BI	Pre	40.00±15.556	2.252	0.024 S
	Post	19.50±12.021		

[Table/Fig-7]: Effectiveness of SIT, FCT, and BI on challenging behaviours in children with ASD on the RBS-R (intragroup comparison).
p≤0.05; Wilcoxon signed-rank test; SIT: Sensory integration therapy; FCT: Functional communication training; BI: Behaviour intervention

Groups	Mean±SD	z-value	p-value
SIT	31.00±2.828	0.515	0.773 NS
FCT	27.50±14.849		
BI	40.00±15.556		

[Table/Fig-8]: Intergroup comparison of pretest scores of RBS-R.
p ≤0.05, significant; Kruskal Wallis test; SIT: Sensory integration therapy; FCT: Functional communication training; BI: Behaviour intervention

Groups	Mean±SD	z-value	p-value
SIT	20.00±1.414	1.986	0.047 S
FCT	23.00±11.314		
BI	19.50±12.021		

[Table/Fig-9]: Intergroup comparison of post test scores on RBS-R.
p≤0.05,significant; Kruskal Wallis test; SIT: Sensory integration therapy; FCT: Functional communication training; BI: Behaviour intervention

DISCUSSION

The current study compared three groups (SIT, FCT, BI) aiming to reduce challenging behaviours in children with ASD. The FBA and RBS-R post-test analyses showed a reduction in the frequency of challenging behaviours in the present study. The results revealed that BI was more beneficial in reducing challenging behaviours than SIT and FCT in current study. Similar to previous studies [10,12,13,27] that compared SIT and BI, BI was more effective in reducing these behaviours than SIT.

The mean values of FBA in group A demonstrated a significant difference before and after intervention for participants 1 and 2. SIT is based on the premise that children, especially those with ASD, may exhibit challenging behaviours to cope or avoid situations due to difficulties integrating sensory cues from the external environment and their own body [10]. Processing information from the tactile, vestibular, and proprioceptive systems poses a challenge for children with ASD to respond adaptively. The results of the present study align with a study [23], which also found the effectiveness of SIT in reducing self-stimulatory and self-injurious behaviours in children with ASD. Although the frequency of these behaviours did not decrease immediately after the intervention, parents reported a substantial reduction in their occurrence throughout the day and improved engagement levels in the child. However, no evaluation has been conducted on the long-term effects of the intervention.

The mean values of FBA and RBS-R before and after intervention in group B showed a clinically and statistically significant difference. FCT improved communication skills for both participants as they learned to request toys by tapping or pointing at the picture, resulting in reduced challenging behaviours. By the end of 12 sessions, the number of prompts required for communication reduced to zero, indicating the positive impact of FCT on enhancing active communication and social skills. FCT operates on the premise that communication impairments may contribute to challenging behaviours in children with ASD. Thus, FCT is a useful communication aid to address these limitations and facilitate interaction [8,12]. The present study's findings align with a previous study [12] that used an iPad application incorporating natural reinforcement and systematic prompting to reduce challenging behaviours in two children with ASD. While initially challenging to establish consistency with the picture cards due to communication difficulties, the children's understanding of the picture card's function led to more active usage and a decrease in challenging behaviours. Using pictures as a communication medium suits the visual learning style often observed in children with ASD [28].

The mean values of FBA and RBS-R showed a clinically and statistically significant difference between participants in group C before and after intervention. Prior research [29-31] has placed significant emphasis on the effectiveness of BI, particularly in mitigating difficult behaviours within diverse clinical groups, including children with ASD. Furthermore, the "National Autism Centre" (2009, 2015) has also advocated for BI as the most substantial group of approaches that have shown positive outcomes in addressing these behaviours [31,32]. The rationale behind administering BI lies in the understanding that specific causes influence all behaviours. Such behaviours are developed and maintained through various reinforcements, including positive, negative, and automatic [27,33]. BIs proved to be the most effective in reducing challenging behaviours in the present study. The findings align with a previous study [26,33] demonstrating BI's effectiveness in addressing self-injurious behaviours in children with ASD. The behavioural strategies used in the present study, such as reinforcement-based approaches, extinction strategies, and alternating stimuli, were beneficial in reducing these behaviours.

Clinical implications: Occupational therapists are vital in managing challenging behaviours in children with ASD. The findings from the present study aimed to offer valuable guidance to occupational therapists, helping them choose evidence based interventions suitable for managing challenging behaviours in children with ASD.

Limitation(s)

The current study faced several limitations. Firstly, the authors had to modify the sample size due to COVID-19 restrictions, which restricted its generalisability. The different intervention settings (home for FCT and BI, and a paediatric clinic for SIT) may have influenced the study results. Administering individualised occupational therapy interventions based on each participant's challenging behaviours in the home setting due to COVID-19 restrictions could potentially impact external validity for generalisation. Furthermore, the study lacked follow-up assessments and focused solely on immediate post-intervention effects.

CONCLUSION(S)

Challenging behaviours are one of the most crucial factors that limit the independence of children with ASD in all settings. The study's results indicated a clinically significant difference post-intervention, revealing that BI was more beneficial than SIT and FCT. Further analysis revealed an overall decline in the frequency of challenging behaviours exhibited by children with ASD. Conducting the study on a larger sample size would allow for generalising the results. Increasing the number of therapy sessions and conducting a follow-up analysis could help estimate the long-term effects of the interventions.

Acknowledgement

The authors would like to sincerely thank the participants and their parents for their willingness to take part in the study.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: May 06, 2023
- Manual Googling: Oct 02, 2023
- iThenticate Software: Oct 05, 2023 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 8

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Apr 28, 2023**
Date of Peer Review: **Aug 25, 2023**
Date of Acceptance: **Oct 07, 2023**
Date of Publishing: **Dec 01, 2023**