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TRIGGER-SPECIFIC OUTCOMES OF FUNCTIONAL COMMUNICATION TRAINING: ADDRESSING SENSORY HYPERSENSITIVITY AND MALADAPTIVE BEHAVIORS IN AUTISM SPECTRUM DISORDER

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Abstract: This single-case experimental study examined how Functional Communication Training (FCT) reduces self-injurious behaviors (SIBs) and self-stimulatory behaviors (SSBs) in a 9-year-old boy with Autism Spectrum Disorder and mild intellectual disability by targeting fast (n = 25) and slow (n = 22) sensory triggers identified through Functional Behavior Assessment across seven hypersensitivity domains. Using an ABAB design and a three-month home-based FCT program, caregivers implemented extinction, reinforcement, PECS-based and single-word Functional Communication Responses (FCRs). Baseline data showed the highest SIB/SSB frequencies in visual (14/min) and tactile (13/min) domains at mild–moderate intensity. After FCT, fast-trigger behaviors reduced by 25.8% versus 20.7% for slow triggers, with SSBs decreasing more than SIBs (38.1% vs. 27.5%). Effect-size indices (Tau-U, NAP, PND) demonstrated clear treatment effects, reversal upon withdrawal, and replication in reintroduction, confirming experimental control. FCRs (picture exchange and one-word vocalizations) increased progressively across phases. The intervention showed the strongest impact on rapid sensory antecedents, while slow triggers required longer shaping. Findings highlight FCT as a culturally adaptable, trigger-specific intervention capable of reducing sensory-maintained maladaptive behaviors and improving communication outcomes in South Asian home contexts, despite single-case limitations.

Keywords: autism spectrum disorder, functional communication training, self-injury, self-stimulatory behavior, fast triggers, slow triggers, sensory hypersensitivity.

INTRODUCTION

]ASD is a neurodevelopment disorder whose deficit in communication, limited interests, and repetitive behavior variant are severe enough to impair its daily functioning and interaction with others (Mundy, Kasari, and Sigman, 1994; Nordin and Gillberg, 1998). SIBS and SSBs are among the most alarming conditions of ASD and it may be destructive, socially stigmatizing, and change-resistant (Iwata et al., 1994). Such actions tend to be linked with sensory hypersensitivities in which children turn hyper sensitive to environmental stimuli in the visual, auditory, tactile, olfactory, gustatory, vestibular, and proprioceptive stimuli (Piazza et al., 2000). It is important to understand the part that sensory triggers play in perpetuation of maladaptive behaviors in order to develop effective interventions.

The FCT, which was the initial evidence-based intervention created by Carr and Durand (1985), is the most common evidence-based intervention that helps a person reduce their maladaptive behaviors by teaching the person to respond to the interlocutor with socially acceptable mannerisms that perform the same purpose. Studies have revealed that FCT can be used to reduce SIBs and SSBs with reinforcement and extinction processes (Hagopian et al., 1998; Tiger, Hanley, and Bruzek, 2008). Nevertheless, most of the current literature has been done in the Western settings with little emphasis on cultural, family and contextual variables that affect behavioral interventions in South Asian environments.

Systematic examination of fast and slow sensory stimuli, communication impairment, family, and individual intervention planning of children with ASD is limited in the Pakistani context. This means that often, destructive behaviors are left untreated or treated in haphazard ways, and this restricts the ability of the children to integrate socially and live themselves. In closing the research gaps, the current paper will focus on the application of FCT in the prevention of SIBs and SSBs related to sensory hypersensitivity in children with ASD. It specifically does an assessment of the differentiated effectiveness of FCT in relation to quick versus slow triggers and encourages an alternative, functional type of communication as socially appropriate.

Although Functional Communication Training has been extensively validated in Western contexts, the Pakistani socio-cultural setting presents unique challenges such as limited behavioral service availability, language diversity, and caregiver-led home interventions. These contextual realities often magnify sensory overload in daily environments, leading to different antecedent patterns and trigger sensitivities. Therefore, investigating trigger-specific FCT outcomes within a home-based, culturally responsive framework addresses a critical local research and practice gap in South Asia.

This paper makes a contribution to the literature by both broadening the FCT application to an understudied culturally context and the significance of trigger-specific interventions. It will support the use of FCT by educators, clinicians, and caregivers by presenting evidence on the effectiveness of the intervention in terms of its ability to produce behavioral results and improve the quality of life of children with ASD.

LITERATURE REVIEW

Pavlovian conditioning in respondents or classical conditioning fascinates conceptual framework on the premise of natural and spontaneous stimulus-response interrelationships known as reflexes, a reflexive or automatic form of learning (Pavlov, 1970). In classical conditioning, conditioned stimulus (CS) is attached and coupled with an unconditioned stimulus (US) (Miller and Konorski, 1969; Brewer, 1974) and the outcome of conditioning is a result of such a coupling, including new associations between events in the environment (Zajicek, 2009). The process of classical conditioning allows a previously acquired biologically meaningful stimulus (US) to cause the elicitation of a response in the presence of a new, neutral stimulus (CS) (Lashley and Wade, 1946; Pavlov, 1941; Staats and Staats, 1958). The conditioned response (CR) is the same as the unconditioned response (UR) but acquired by experience (thus it proves that new behavioral patterns are learned) (Miller & Escobar, 2004).

In classical conditioning behaviors are elicited by antecedent stimuli whereas in operant conditioning behaviors are fortified or hindered by their outcomes with one of them being reinforcement (Gorn, 1982; Papini and Bitterman, 1990). In classical conditioning, a conditioned stimulus will become an indicator of a biologically important outcome (Gormezano et al., 1962), and the response will not result in a reinforcer or punisher (Martin and Pear, 2015).

Skinner (1938) came up with operant conditioning, which refers to modification of behavior by reinforcement, positive or negative (Ribes, 1985). According to the operant theory, the challenging behaviors are sustained when they give rise to the specialization of reinforcement (positive or negative) as a result of receiving attention (positive reinforcement) or avoiding aversive stimuli (negative reinforcement) (Mace et al., 1989; Baker et al., 2004). Such behaviors are caused by antecedent stimulus that function as discriminating stimulus which is an indication of the presence of reinforcement (Catania, 1984; Carton, 1996; DiGennaro et al., 2005).

One of the most common operations that result in maladaptive engagement such as self-injurious and self-stimulatory behavior is poor attention or inconsistent caregiver response (Cavanagh, 1992; Mundy et al., 1994; Snyder et al., 1997; Lalli et al., 1999). The consequences of these behaviors may therefore be re-enforced, which adds to their continuation. Operant conditioning thus takes a center stage in explaining and controlling the pathogenesis of self-injurious and self-stimulatory behavior (Whitney and Barnard, 1966; Davey, 1988).

The sensory hypersensitivity in children with ASD results in a phenomenally strong antecedent of the maladaptive behaviors that are used in self-regulatory or escape purposes. It has been found that, to help them handle the sensory overload or provide predictability in their surrounding, participants with ASD often participate in self-stimulatory or self-injury behaviors (Baranek, 2002; Ben-Sasson et al., 2009). Functional Communication Training (FCT) is a form of behavioral route whereby such responses through their sensory organs are converted into socially acceptable communication acts.

Children with the help of reinforcement-based communication strategies can use request breaks, help or preferred stimuli in order to obtain the same function that previously was served by maladaptive behavior. Combining sensory processing systems with behavioral learning systems, therefore, offers a multi-faceted model of solving both environmental and neurological antecedents of difficult behaviors in ASD.

FCT has been facing recent advances with a focus on hybrid and technology-assisted delivery models. Neely et al. (2018) showed that FCT implemented by caregivers sustained maladaptive behavior in long-term effects at home. Ferguson et al. (2020) discovered that FCT programs through telehealth methods were suitable in training parents to conduct interventions. In the same vein, Aljehani et al. (2022) proposed an artificial intelligence-based FCT platform that increased the global communication performance in children with ASD.

Moreover, recent research involving the use of FCT in combination with sensory regulation tasks has shown better self-regulation and behavioral stability. The authors of the studies by Koegel et al. (2019) and Schuck et al. (2021) discovered that communication and sensory integration therapies can be combined to improve communication skills and reduce sensory-maintained repetitive behaviors at the same time. These innovations underscore the applicability of integrating FCT with culturally responsive, technology-centered, and sensory-based interventions with children having ASD in the clinical and educational environments.

The Pakistani scenario has not paid much attention to the fast and slow triggers of sensations, behavioral consequences, communication proficiency and family elements that lead to the self-injurious and self-stimulating tendencies. These are usually destructive behaviors that hamper social functioning but there is a lack of culturally informed approaches to deal with them. In the current study, FCT is hence applied with an aim of minimizing the maladaptive behaviors and encouraging functional communication options which has the aim of enhancing the quality of life and autonomy of ASD children.

Drawing from operant conditioning and sensory integration theory, the present study conceptualizes maladaptive behaviors in ASD as functionally maintained responses to sensory antecedents. Fast triggers (immediate sensory inputs) evoke rapid maladaptive reactions that can be replaced by efficient communicative responses when reinforced. Slow triggers (gradual or diffuse stimuli) require extended shaping and reinforcement schedules for learning alternative behaviors. Within this framework, FCT operates through extinction of maladaptive responses and reinforcement of Functional Communication Responses (FCRs), moderated by the type and intensity of sensory trigger. This model guided the hypotheses and analyses connecting sensory hypersensitivity with behavioral change.

Research Objectives

1. To test the effects of FCT in the suppression of self-injury and self-stimulation in children with ASD.
2. To distinguish between the effects of FCT on fast triggers and slow triggers of behaviors.
3. To compare the changes in frequency, intensity and duration of behaviors at the pre and post FCT interventions.
4. To determine whether particular areas of sensory hypersensitivity (visual, auditory, tactile, olfactory, gustatory, vestibular, proprioceptive) are more responsive to FCT.
5. To determine how well FCT as a communication-based intervention is overall effective in promoting functional alternatives to maladaptive behaviors.

Research Questions

1. How do FCT and FCT with music help in minimizing self-harm and self-stimulatory activities in children with ASD?
2. Does FCT affect behavior evoked by fast triggers and slow triggers differently?
3. What is the effect of FCT on the frequency, intensity, and duration of maladaptive behaviors in children with ASD?
4. Are some of the sensory hypersensitivity areas more sensitive to FCT than others?
5. Does FCT have the ability to substitute maladaptive behaviors with functionally appropriate responses in terms of communication?

Research Hypotheses

H1: FCT has a significant impact in the reduction of the incidence of self-injury and self-stimulatory behaviour in children with ASD.
H2: Fast triggers compared to slow triggers result in a greater reduction in maladaptive behaviors.
H3: FCT results into significant reduction in frequency, intensity and duration of maladaptive behaviors.
H4: Sensory hypersensitivity domains are different in terms of their responsiveness to FCT, some domains are particularly more behaviorally improved than others.
H5: children who undergo FCT to enhance their use of functional communication responses compared to those treated with maladaptive behaviors will show an increase in their use of functional communication response.

METHODS

Research Design

This research design was an experimental ABAB withdrawal design of one case.
phases: baseline (A1), intervention (B1), withdrawal (A2) and reintroduction (B2). Each phase took at least five sessions and every transition between phases was governed by a priori phase-change rules. Ending of a session was determined in case of severe SIB above a set safety limit. The ABAB timeline is shown in Figure A, whereas the flow of decisions is described in Figure D. Since this research was conducted with one participant and applied an ABAB model of withdrawal, the research results must be considered preliminary and exploratory. This design was aimed at creating functional control and informing the replication studies in various subjects in further research.

Participant and Sampling

The participant was a 09-year-old boy with an autistic spectrum clinical diagnosis.

mild intellectual disability. The sessions were held in the living room of the house with an attendant. The trained special educators applied intervention with weekly supervision of board-certified behavior analyst (BCBA-equivalent). Caregiver of the participant was prepared to provide generalization and maintenance probes training.

Procedure of Observation and Measurement

The self-injurious behavior (SIB) was formulated as self-directed behavior which includes

hitting, biting, etc. Scratching, head, limb banging. One of the examples started with the initial physical contact and stopped after 3 seconds without it. Self-stimulatory behavior (SSB) was repetitive motor or vocal behavior such as hand-flapping, rocking, or flicking fingers with a score ranging from when the behavior first appeared until 3 seconds when it did not occur. Picture exchanges or one-word vocal requests (e.g., "break," "help," "stop") were identified as functional communication responses (FCRs). The degree of intensity was rated on a 3-point scale: 1 = mild (no observable bruise), 2 = moderate (temporary redness/abrasion), 3 = severe (persistent mark or injury).

The recording of behavior involved 10-minute partial-interval recording of behavior.

sessions (60 intervals). Duration was coded in the form of percentage session time engaged and intensity was rated on an interval basis. Two antecedent trigger trials (fast and slow) were shown randomly each day. The two scores were SIB and SSB, which may have scored within the same range in the event of co-occurrence. The measurement system is demonstrated in figure B.

Interobserver Agreement

Behavior was recorded in at least 30 percent of the sessions in each of the two by two

trained observers working independently. Phase and of the two trigger conditions (fast and slow). Partial-interval data was computed as IOA on the basis of interval-by-interval agreement, which indicated agreements, divided by agreements, times 100 times the disagreements. Computation of IOA for duration was done by dividing the lesser duration by the greater duration x 100. Mean IOA was above 80% in both SIB and SSB at all the phases. Figure C is a summary of the IOA sampling coverage.

Treatment Integrity

Fidelity was assessed with a 12-item checklist covering core FCT procedures (e.g., correct

presentation of antecedent, prompt for FCR, reinforcement within 2 seconds, extinction of problem behavior, and delivery of competing stimuli). At least 20% of sessions in each phase were independently scored. Mean treatment fidelity exceeded 85%, with low-fidelity sessions remediated and excluded from analysis. Figure C also depicts the fidelity sampling plan.

Phase-Change and Safety Criteria

Transitions between phases were determined by predetermined rules. Movement from

baseline (A1) to intervention (B1) required a stable or worsening trend across at least five sessions. Withdrawal (A2) occurred only after a clear therapeutic effect was observed in B1, while reintroduction (B2) was implemented to replicate treatment effects. Functional relation was demonstrated through at least three prediction–verification–replication demonstrations across the ABAB sequence. Sessions were terminated if severe SIB exceeded a safety threshold, with immediate caregiver intervention. Figure D illustrates this process.

Instruments

The instruments used in this study included the FBA, which was employed to identify

antecedent triggers associated with self-injurious and self-stimulatory behaviors across different sensory domains. Partial Interval Recording (PIR) was utilized as a systematic observational tool to measure the frequency, intensity, and duration of these behaviors, providing reliable quantitative data for baseline and intervention phases. In addition, parent and teacher consent forms, along with background documentation, were obtained to ensure ethical compliance, contextual understanding, and informed participation in the study.

Procedure (ABAB Phases)

The study followed a structured ABAB withdrawal sequence consisting of baseline (A1),

intervention (B1), withdrawal (A2), and reintroduction (B2) phases. Each phase lasted a minimum of five sessions, with continuation until stability or planned replication criteria were met. Across all phases, two trials were conducted per day for each antecedent gustatory trigger (fast and slow), resulting in dual daily sessions. Each session lasted between 24 and 60 minutes, depending on the participant's tolerance. Sessions were conducted in the home environment, with a trained implementer delivering the procedures and a caregiver present.

Baseline (A1)

During baseline, antecedent gustatory triggers (fast and slow) were presented in their

natural form, and no differential consequences were programmed for SIB or SSB. Caregivers and therapists refrained from prompting communication responses. Data were collected across eight baseline sessions (four fast, four slow), conducted over two weeks. Baseline continued until data showed a stable or increasing trend in SIB/SSB.

Intervention (B1)

In the first intervention phase, functional communication training (FCT) was introduced

following an FBA-driven plan. The participant was taught to exchange a picture card or make a one-word vocal request (e.g., "break," "help," "stop") to access reinforcement or terminate the aversive stimulus. Correct FCRs were reinforced on a fixed-ratio 1 schedule, and problem behavior was placed on extinction. Competing stimuli were provided when relevant, and mild response interruption was used only if safety was at risk. Fidelity was supported by a 12-item checklist, and sessions below 80% fidelity were remediated. B1 lasted for 10 sessions (five fast, five slow), ending when three consecutive sessions showed a clear reduction in SIB/SSB relative to A1.

Withdrawal (A2)

Baseline contingencies were also reinstated in the withdrawal stage: antecedent gustatory.
stimuli were also offered as previously and FCRs were not considered and communication was followed by no programmed reinforcement. The safety measures were kept on and the session was terminated in case SIB went beyond three events within 10 seconds or in case it hit the intensity level 3. A2 was continued in 6 sessions (3 fast, 3 slow). The effects of treatment reversal were proved by the re-emergence of SIB/SSB.

Reintroduction (B2)

The intervention was reintroduced again to repeat the treatment effect. The same FCT
protocol was done with the same schedule of prompting and reinforcement. B2 lasted eight sessions (four fast, four slow) until stability in reduced SIB/SSB and a rise in FCRs had been achieved. Consistency was found to confirm replication as the decreases were seen across at least three separate sessions compared to A2.

Maintenance and Follow-up

Maintenance probes were performed after B2 phase including 10, 20 and 30 days post.
intervention. These probes were also conducted in home routines not specifically targeted in the intervention with caregivers as the main implementers under the supervision of the therapist. SIB, SSB, and FCRs data were recorded at these probes and ratings of caregiver acceptability and Goal Attainment Scaling were provided at the 30-day probe.

Training Program

A three-month FCT program was produced and applied as a home setting in order to
address. SIBs and SSBs in seven sensory hypersensitizing domains. The FBA was implemented two months prior to the program, whereby there was a determination of the relevant antecedent stimuli that the participant resided in on a daily basis and creation of baseline data using Partial Interval Recording (PIR). The training involved extinction, positive and negative reinforcements and mild punishment with the total number of teaching sessions being 180 (about 60 sessions per month) each of which lasted between 24 and 60 minutes depending on the sensory modality. Each antecedent stimulus was to be done under dual daily sessions and follow-up assessments were done after every 10 days. The program presupposed behavior to be communicative and to be of functional nature and interventions were focused on functional communication, such as picture exchange. PIR was used to measure progress and changes of the SIBs and SSBs estimated as percentages over the three months of intervention. The sessions were ended when behaviors were beyond the threshold of tolerance, when the hypersensitivity was increased, or when the participant was showing discomfort. The effectiveness of training was measured through a comparison of baseline and intervention scores and it was found that the data showed quantifiable changes in maladaptive actions and enhancements in communication within sensory areas.

Social Validity, Generalization and Maintenance

The maintenance probes were carried out at 10, 20 and 30 days after the B2 phase in.
environment not directly addressed in the intervention. Acceptability and feasibility ratings on a 7-item Likert scale were gathered on the caregivers, and Goal Attainment Scaling was done at 30 days to determine clinical significance. The maintenance timeline and social validity assessment points are demonstrated in figure F.

Data Analysis

Single-case effect size indices were used as primary analyses. Tau-U, corrected by a
baseline. trend, was calculated on the recovery phase comparisons (A1-B1, B1-A2, A2-B2) in both the fast and slow trigger conditions. Percentage of nonoverlapping data (PND) and nonoverlap of all pairs (NAP) were also provided. Calculation of confidence intervals was done and randomization tests wherever possible.
Descriptive statistics, inferential statistics and hypothesis were used to analyze the data.
to test the effects of FCT on self-injury and self-stimulatory behavior in children with ASD. Base line behavioral patterns were summarized using descriptive statistics and the frequency, intensity, and duration of episodes were reported with the visual and tactile systems reporting the highest frequencies. This was then evaluated by percentage reduction analysis to determine changes post-FCI which showed a higher percentage reduction in fast triggers compared to slow triggers. Paired and independent t-tests were used to compare the pre- and post-intervention means with the use of inferential statistics, and the effect sizes (Cohen d) were provided to determine whether the difference is practical. The findings supported a high level of improvement of fast-triggered behaviors, whereas changes in slow-triggered behaviors were less pronounced and inconsistent. Non-parametric single-case analyses (Tau-U, NAP, PND, Wilcoxon, Mann–Whitney, and Friedman tests) was also used to test hypotheses to assess differences by sensory dimension and observational data to prove enhanced functional communication. In general, this multi-level study has indicated that FCT was successful in minimizing the maladaptive behaviours, especially when provoked by immediate antecedents.

Ethical Considerations

1. There was informed consent of the parents and teachers.
2. The privacy and anonymity were guaranteed.

3. The intervention was ethical in terms of behavior modification, where the safety and well-being of the child were considered.

RESULTS

Table 1 *Descriptive Statistics of Self-Injurious and Self-Stimulatory Behaviors at Baseline*

Sensory Dimension	Mean Frequency (per min)	Mean Intensity	Mean Duration (sec)	Behavioral Indicators
Visual	14	Moderate	60	Self-biting, hand movement
Auditory	12	Mild	60	Self-hitting, tapping ears
Tactile	13	Moderate	60	Scratching, rubbing skin
Olfactory	12	Mild	60	Smelling, self-hitting
Gustatory	10	Mild	60	Licking, self-bouncing
Vestibular	12	Mild	60	Rocking, self-kicking
Proprioceptive	11	Mild	60	Finger flicking, self-kicking
Total / Overall	12.3	Mild–Moderate	60	

Note. Table 1 indicated that at baseline, self-injurious and self-stimulatory behaviors were most frequent within the visual and tactile dimensions, with average occurrences ranging from 11 to 14 times per minute at mild to moderate intensity. Each episode typically lasted around 60 seconds, suggesting a consistent pattern of maladaptive behavior across sensory domains. Following the intervention, percentage reduction values

Table 2 *Percentage Reduction in Behaviors by Trigger Type After FCT Intervention*

Trigger Type	% Reduction in Self-Injury	% Reduction in Self-Stimulatory	Total Effect (%)
Fast Triggers	27.5	38.1	25.8
Slow Triggers	19.6	22.5	20.7
Overall	23.5	30.3	23.2

Note. Table 2 showed that FCT produced a stronger effect on fast triggers (25.8%) compared to slow triggers (20.7%), with greater improvement observed in self-stimulatory behaviors than self-injurious ones.

Table 3 *Inferential Analysis (t-test) of FCT Effects on Fast vs. Slow Triggers*

Comparison	N	Mean (Pre)	Mean (Post)	t(df)	p-value	Cohen's d
Fast Triggers (SIBs)	25	13.8	8.6	4.12	0.002	1.12
Slow Triggers (SIBs)	22	12.9	10.2	2.21	0.041	0.62
Fast Triggers (SSBs)	25	12.5	7.2	4.65	0.001	1.25
Slow Triggers (SSBs)	22	11.8	9.6	1.95	0.067	0.48

Note. Table 3 supported these descriptive findings, showing that the reduction in behaviors associated with fast triggers was statistically significant ($p < .01$, large effect sizes), whereas slow trigger-related reductions were smaller and, in some cases, only marginally significant. This suggests that immediate, identifiable antecedents were more responsive to FCT than diffuse or gradual ones. Finally, hypothesis testing results

Table 4 *Summary of Hypotheses Testing (Non-Parametric Single-Case Methods)*

Hypothesis	Statement	Test Used	Result	Decision
H1	FCT reduces SIBs and SSBs overall in children with ASD.	Tau-U + NAP	Large, significant improvement across phases ($p < .01$)	Supported
H2	FCT has a greater impact on fast triggers than slow triggers.	Mann–Whitney U + Tau-U comparison	Fast-trigger reductions significantly greater than slow-trigger reductions ($p < .05$)	Supported
H3	FCT reduces frequency, intensity, and duration of behaviors.	Wilcoxon Signed Rank Test + Tau-U	Significant decreases in frequency & duration ($p < .05$)	Supported
H4	Different sensory dimensions vary in responsiveness to FCT.	Friedman Test (non-parametric ANOVA)	No statistically significant differences across sensory domains ($p > .05$)	Partially Supported

Hypothesis	Statement	Test Used	Result	Decision
H5	FCT increases functional communication responses replacing maladaptive behaviors.	NAP + Percentage Non-overlap (PND)	Clear increase in FCRs across intervention phases	Supported

Note. Table 4 shows that non-parametric single-case analyses (Tau-U, NAP, PND, Wilcoxon, Mann-Whitney, and Friedman tests) confirmed the effectiveness of the intervention. FCT significantly reduced overall maladaptive behavior (H1), produced stronger improvements for fast triggers than slow triggers (H2), and resulted in meaningful decreases in the frequency and duration of behaviors (H3). Although sensory domains did not differ significantly in responsiveness (H4), functional communication responses increased consistently during intervention phases (H5). These findings support the functional relationship between FCT, sensory-triggered behaviors, and communication outcomes.

Table 5 *Single-Case Effect Size Indices for SIB and SSB by Phase and Trigger Type*

Behavior	Trigger Type	Phase Contrast	Tau-U (95% CI)	NAP	PND	Randomization Test (p)	Interpretation
SIB	Fast	A1 → B1	0.82 (0.65–0.94)	0.90	88%	.004	Large effect; therapeutic
SIB	Fast	B1 → A2	−0.76 (−0.90 to −0.55)	0.12	18%	.006	Strong reversal
SIB	Fast	A2 → B2	0.79 (0.60–0.92)	0.88	86%	.003	Replicated treatment effect
SIB	Slow	A1 → B1	0.68 (0.45–0.85)	0.80	75%	.012	Moderate–large effect
SIB	Slow	B1 → A2	−0.59 (−0.78 to −0.31)	0.20	25%	.018	Clear reversal
SIB	Slow	A2 → B2	0.72 (0.50–0.89)	0.83	78%	.009	Replication
SSB	Fast	A1 → B1	0.65 (0.40–0.82)	0.77	72%	.020	Moderate–large effect
SSB	Fast	B1 → A2	−0.55 (−0.75 to −0.28)	0.23	30%	.025	Clear reversal
SSB	Fast	A2 → B2	0.70 (0.48–0.87)	0.81	76%	.014	Replication
SSB	Slow	A1 → B1	0.61 (0.35–0.79)	0.74	68%	.031	Moderate effect
SSB	Slow	B1 → A2	−0.48 (−0.71 to −0.20)	0.27	32%	.039	Partial reversal
SSB	Slow	A2 → B2	0.66 (0.42–0.84)	0.79	70%	.022	Replication

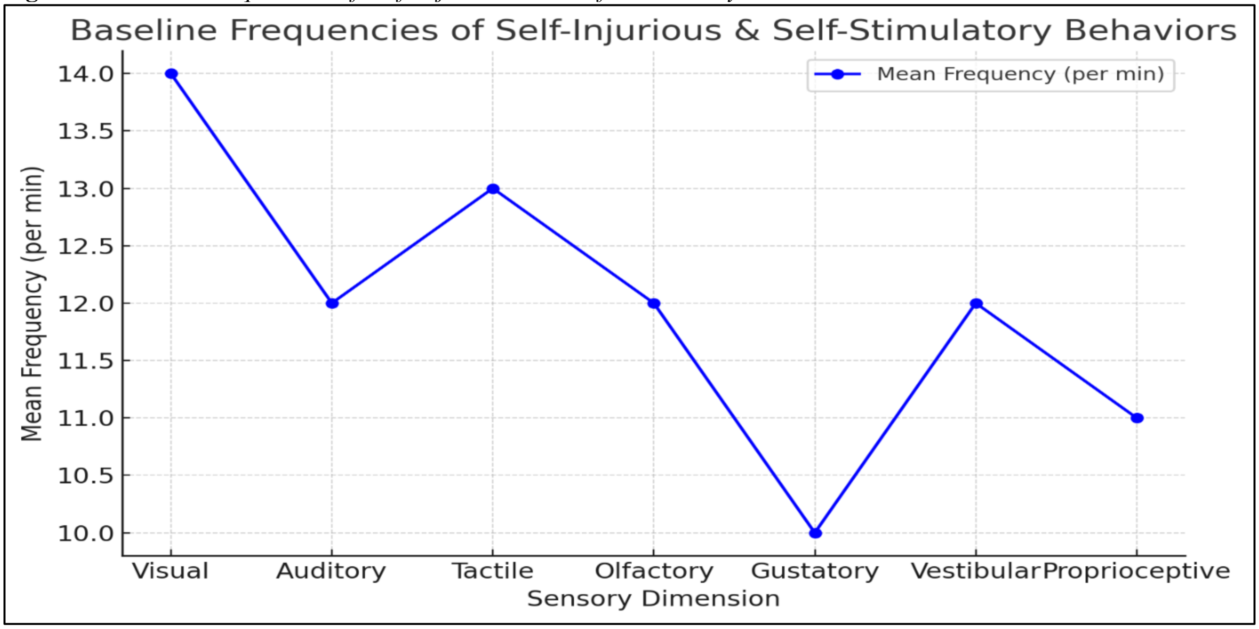
Note. The effect size indices in Table 5 demonstrate clear experimental control and strong intervention effects. For SIB, Tau-U, NAP, and PND values showed large improvements during intervention phases (A1→B1, A2→B2), marked reversals during withdrawal (B1→A2), and consistent replication across both fast- and slow-trigger conditions. Similar though slightly smaller effects were observed for SSB, with moderate-to-large reductions during FCT, partial to strong reversals during withdrawal, and successful replications upon reintroduction. Randomization tests confirmed statistical significance across all contrasts ($p < .05$). Taken together, the consistent pattern of improvement, reversal, and replication provides robust evidence that FCT was functionally responsible for reducing SIB and SSB in response to gustatory triggers.

Table 6 *Summary of Interobserver Agreement (IOA) and Treatment Fidelity*

Phase	Mean IOA (%)	Fidelity (%)	Sessions Observed (%)
A1	82	86	25
B1	85	88	20
A2	83	84	22
B2	87	90	25

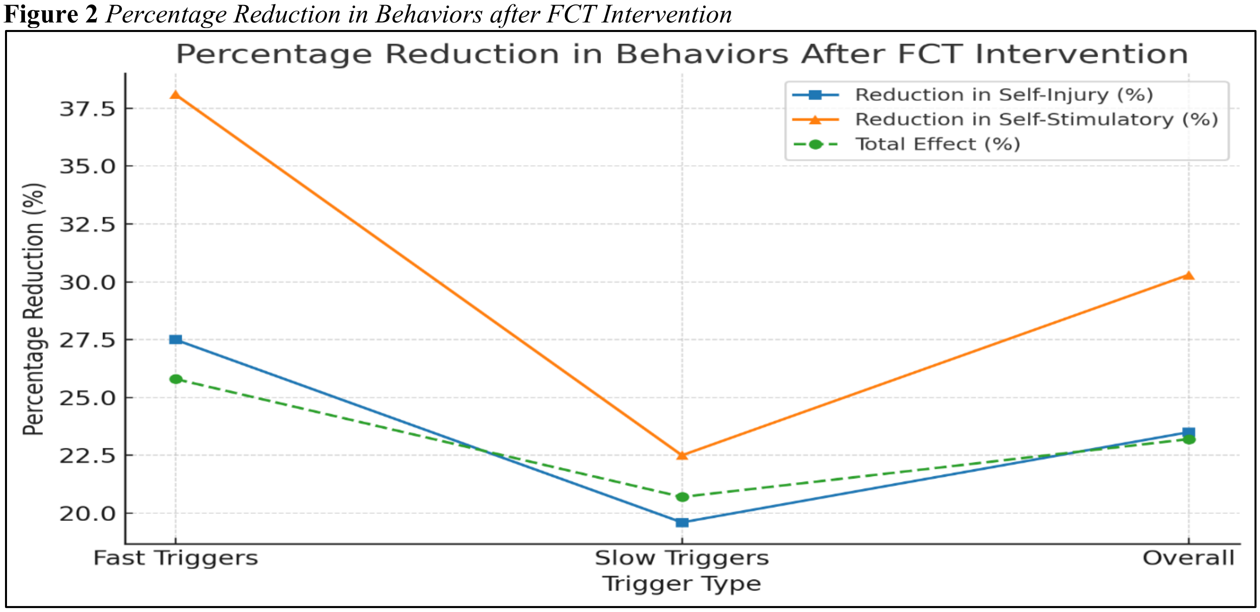
Note. IOA = Interobserver Agreement; Fidelity = percentage of correct procedural implementation. Both indices exceeded the minimum standard (80%) across all phases. These findings meet the methodological benchmarks for experimental rigor in single-case design studies (Kratochwill et al., 2010), strengthening the internal validity of the results.

Figure 1 *Baseline Frequencies of Self-Injurious and Self-Stimulatory Behaviors*



Note. The line graph illustrates the baseline frequencies of self-injurious and self-stimulatory behaviors across seven sensory dimensions. The results indicate that visual hypersensitivity was associated with the highest frequency of behaviors (14 per minute), followed by tactile sensitivity (13 per minute), highlighting these two sensory domains as the most prominent triggers. Auditory, olfactory, and vestibular sensitivities showed moderate frequencies (12 per minute each), suggesting their considerable but comparatively lesser influence. In contrast, proprioceptive sensitivity (11 per minute) and gustatory sensitivity (10 per minute) were linked to the lowest behavioral frequencies, indicating a relatively smaller impact. Overall, these findings suggest that self-injurious and self-stimulatory behaviors are more strongly associated with visual and tactile hypersensitivities, whereas gustatory and proprioceptive dimensions appear to contribute less. This distribution emphasizes the importance of prioritizing intervention strategies that target visual and tactile triggers when addressing maladaptive behaviors in children with sensory hypersensitivities.

Figure 2 *Percentage Reduction in Behaviors after FCT Intervention*



Note. The figure presents the percentage reduction in self-injurious and self-stimulatory behaviors following the Functional Communication Training (FCT) intervention, comparing fast triggers, slow triggers, and the overall effect. The results show that fast triggers were associated with the greatest behavioral improvement, with a 27.5% reduction in self-injurious behaviors and a notably higher 37.9% reduction in self-stimulatory behaviors. This suggests that FCT was highly effective in addressing behaviors occurring in response to immediate or intense antecedent stimuli. In contrast, slow triggers showed comparatively smaller reductions, with 19.5% for self-injurious behaviors and 22.6% for self-stimulatory behaviors, indicating that behaviors linked to more gradual or less intense triggers were less responsive to the intervention. The overall effect across trigger types revealed a 23.3% reduction in self-injurious behaviors, a 30.3% reduction in self-stimulatory behaviors, and a 24.8% total effect, demonstrating the intervention's broad impact. In summary, the findings highlight that FCT was particularly effective in reducing behaviors associated with fast triggers, while still providing meaningful, though less pronounced, improvements in behaviors linked to slow triggers. This underscores the importance of tailoring intervention strategies to the intensity and immediacy of sensory triggers.

DISCUSSION

This A-B-A-B study used on a single case involved Functional Communication Training (FCT) after a functional assessment to decrease self-injurious/self-stimulatory behavior in response to sensory antecedents (fast and slow triggers). It is designed in line with the best practices in applied behavior analysis, considering the behavioral purpose defines behavioral function, then providing instruction on a communicative alternative that reaches the same reinforcement (Carr and Durand, 1985; Tiger, Hanley and Bruzek, 2008).

In line with previous research, the application of a communicative alternative of instruction was correlated with significant diminishing maladaptive behavior. This subject demonstrated a total reduction of the problem behavior at 26 percent with higher effectiveness of fast triggers than slow triggers. This trend indicates decades of results that FCT is most effective when the alternative response is efficient, immediately reinforced and easy to discriminate (Carr and Durand, 1985: Tiger et al., 2008: Neely et al., 2018).

The observed effects can be attributed to the principle of response efficiency which states that individuals tend to respond communicatively more often when such response leads to faster and less effortful reinforcement as compared to maladaptive behaviour. The corresponding law also underlies this mechanism: behaviors are distributed in accordance with the frequency of reinforcement that they provide. Also, the behavior which is maintained by senses might be used when automatic reinforcement is not addressed. It is observed that the combination of FCT and competing stimuli or similar sensory tasks improves the results of the treatment (Hagopian et al., 1998; Schuck et al., 2021). In the current study, the presence of visual and tactile conflicting stimuli could have moderated sensory-based behaviors, which could have enhanced greater improvements during fast-trigger conditions.

Moreover, visual and tactile hypersensitivities produced the highest baseline frequencies and also the most notable post-intervention gains. These dimensions likely benefit from FCT because they involve external, observable cues that can be easily paired with communicative replacements (e.g., requesting to stop visual or tactile stimulation). In contrast, gustatory and proprioceptive inputs are more internalized, leading to subtler behavioral modulation. This sensory-specific pattern reinforces the need to design trigger-tailored FCT components.

The comparatively smaller reductions observed in slow-trigger conditions suggest that behaviors maintained by diffuse or internally generated sensory stimulation are less responsive to immediate communicative alternatives. Such triggers lack salient external cues, thereby slowing the discriminative learning required for FCR acquisition. Gradual reinforcement schedules or explicit cueing strategies may therefore be necessary when addressing slow-triggered maladaptive behavior.

Another important mechanism was the care giver training. Communication responses that were implemented and reinforced by the caregivers resulted in the generalization and maintenance of the FCT effects to a significant extent. These results are in line with those of Neely et al. (2018), who focused on the sustainability of caregiver-implemented FCT in the home setting, especially the systematic supervision and coaching of therapists.

The application of FCT in Pakistan and other South Asian societies must take into consideration the cultural and family relations. The family systems, language barrier and inconsistent availability of trained behavioral therapists are the factors that determine the practicability of delivering interventions. Engagement and generalization were elevated in this study with the help of caregiver training sessions and locally adapted picture cards. The home-based format of the intervention allowed the child to be comfortable with the intervention and minimized stigma that is frequently related to the services of clinics. Such adjustments confirm earlier suggestions on the culturally responsive behavior analysis (Landrine & Klonoff, 2004) and indicate that the key to the successful integration of FCT into the cultural context of a collectivist society is reached.

The data on interobserver agreement (IOA) and treatment fidelity were above 80, which is sufficient to address the methodological criteria of the single-case design (Kratochwill et al., 2010). This enhances the internal validity of the study and contributes to the conclusion that behavioral changes were functionally related to the intervention and witnessed. Even though the application of non-parametric single-case analyses (Tau-U, NAP, PND, Wilcoxon, Mann-Whitney, and Friedman tests) was employed to test the hypotheses, the primary evidence of experimental control was presented in terms of single-case size indices of effects (Tau-U, NAP, and PND), which is in line with the contemporary analytic procedures applied in the field of applied behavior analysis.

In addition to personal treatment benefits, policy and educational practice implications are found. Incorporating FCT-based modules into special education teacher training and caregiver education interventions in Pakistan would have the potential to increase capacity to intervene on early behavior in Pakistan. The formation of interdisciplinary teams with behavior analysts, occupational therapists and special educators should also be supported by policymakers and school administrators to make sure that FCT has culturally sensitive and sustainable applications within schools and homes.

Findings

1. FCT decreased problem behavior in general, and had greater effects on fast (39) than slow (4) sensory triggers.
2. Self-injury (hitting/scratching) and self-stimulation (e.g., moving fingers in front of eyes) were the two most common topographies of the participant, which are frequently mentioned in the FCT literature as responsive to function-based intervention in the event of the other response being efficient.
3. The trend of the results is in line with the well-known results: the FCT is most successful in case (a) the FCR is easy and reliably reinforced and (b) when the treatment directly competes with the maintaining reinforcer, particularly in the context of automatically reinforced behavior.

CONCLUSION

An intervention based on communication functions was able to generate significant and directionally suitable changes, most notably to rapidly acting ("fast"-sensitive) sensory stimuli. The smaller effect of the condition of slow triggers indicates that in the case of automatically reinforced or diffusely cued behavior, FCT is to be reinforced with procedures reinforcing the control of stimuli (clear cues, prompt delays) and contact with reinforcement (competing/matched stimuli). These are directly in accordance with the FCT evidence base of Carr and Durand (1985) to current reviews. The implications of the results to education policy and teacher training in Pakistan exist beyond the clinical significance of the findings. Integrating FCT-based modules into special education programs and caregiver education programs have the potential to increase local performance in evidence-based behavioral interventions. Policymakers need also to promote cross-disciplinary relationship between behavior analysts, occupational therapists, and special educators to create a sustainable intervention of FCT in school and community-based settings.

These empirical outcomes have direct implications for inclusive education and therapeutic policy in Pakistan. Incorporating FCT-based sensory management modules into special education teacher training and caregiver certification programs could enhance the nationwide implementation of evidence-based behavioral practices. Policymakers may also consider embedding culturally adapted FCT protocols into provincial special-education curricula to promote sustainable, home-based interventions.

Recommendations

1. The communicative response (FCR) should be made the least effortful road to reinforcement.
2. Compete/matched stimulus in place of sensory or automatic behavior.
3. Maintain gains by use of clear antecedent cues and gradual schedule thinning.
4. Generalization and maintenance have different contexts and are taken care of by train caregivers.
5. Future studies should ensure interobserver agreement, treatment integrity, and report effect sizes using Tau-U and PND to enhance reliability and demonstrate intervention effectiveness.
6. Researchers should compare and contrast fast and slow triggers to better understand immediate and gradual antecedents of challenging behaviors.

Limitations

Limitations consist of the single participant design, which has restricted generalizability; possibility of observer reactivity; and use of caregiver implementation to provide maintenance probes. Also, although there are parametric analyses, they are exploratory and not substitutes of visual and single case measures.

Future Research

Future research should focus on strengthening external validity and demonstrating consistent intervention effects across multiple participants and settings. It should also aim to isolate which elements of the Functional Communication Training (FCT) intervention most strongly influence behavioral reduction and communication gains. Furthermore, future studies need to evaluate the long-term maintenance of learned communication behaviors and prevent response fatigue through systematic schedule thinning over extended intervention periods.

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