TPM Vol. 32, No. S5, 2025
ISSN: 1972-6325
https://www.tpmap.org/

EVALUATING THE PSYCHOMETRIC AND EXPERIMENTAL ROBUSTNESS OF DIFFERENTIAL CONSEQUENCE PROCEDURES IN FUNCTIONAL COMMUNICATION TRAINING: A RANDOMIZED CONTROLLED TRIAL IN CHILDREN WITH AUTISM SPECTRUM DISORDER

DR. HINA HADAYAT ALI
ASSISTANT PROFESSOR OF SPECIAL EDUCATION/COORDINATOR, DEPARTMENT OF SPECIAL EDUCATION, UNIVERSITY OF EDUCATION, LAHORE, FAISALABAD CAMPUS, PAKISTAN, EMAIL: hina.hadayat@ue.edu.pk

DR. HINA FAZIL
ASSOCIATE PROFESSOR OF SPECIAL EDUCATION, INSTITUTE OF SPECIAL EDUCATION, UNIVERSITY OF THE PUNJAB, LAHORE, PAKISTAN, EMAIL: hinafazil.dse@pu.edu.pk

DR. MUHAMMAD NAZIR
LECTURER OF SPECIAL EDUCATION, DEPARTMENT OF SPECIAL EDUCATION, UNIVERSITY OF EDUCATION, LAHORE, FAISALABAD CAMPUS, PAKISTAN, EMAIL: muhammad.nazir@ue.edu.pk

SIDRA ANSER
PHD SCHOLAR, INSTITUTE OF SPECIAL EDUCATION, UNIVERSITY OF THE PUNJAB, LAHORE, PAKISTAN, EMAIL: sidraanserphd@gmail.com

MUHAMMAD ASIF FAIZ
PHD SCHOLAR, INSTITUTE OF SPECIAL EDUCATION, UNIVERSITY OF THE PUNJAB, LAHORE, PAKISTAN, EMAIL: masiffaizmnd@gmail.com

Abstract
Children with autism spectrum disorder are often characterized by different types of sensory hypersensitivities, and this can provoke high levels of self-injurious behavior (SIB) and self-stimulatory behavior (SSB). Despite the popularity of Functional Communication Training (FCT) as an evidence-based intervention in managing ASD, there is a lack of consensus on the most effective consequence procedures that would be able to maintain its effectiveness. This paper provided a comparative evaluation of three consequence measures, extinction, reinforcement, and punishment that were applied in FCT in randomized controlled settings, and how they relate to the ethical and practical ramification. This comparative efficacy study compared and contrasted three consequence-based Functional Communication Training (FCT) procedures, Extinction, Reinforcement, and Punishment with a Control condition. Thirty-two participants with ASD (ages 6-12 years) were randomly chosen (n = 8 in each arm). The 12-week (36 sessions; 45 min sessions) interventions were provided, and fidelity ≥ 90 and inter-observer agreement ≥ 85. Linear mixed-effects modeling showed a good Group x Time interaction in combined SIB and SSB $F(3, 28) = 11.42$, $p < .001$. The highest effect size ($e2 = .40$) was obtained with Punishment, then Reinforcement ($e2 = .36$) and Extinction ($e2 = .29$), which were all better than Control. Pairwise comparisons affirmed that Punishment and Reinforcement were statistically equal and they both performed better than Extinction and Control. Exploratory analyses in sensory-domain revealed that there was a difference in responsiveness with the greatest effects being on gustatory and proprioceptive domains. No serious adverse events were reported in safety monitoring, and two momentary bursts of extinction were noted in the Extinction arm and was controlled according to protocol. No withdrawals occurred. FCT interventions should be formulated by using Reinforcement-based interventions as they are effective and socially acceptable, and Punishment should be used as a last line intervention in case of severe (safety-critical) cases with some ethical precautions and with the consent of the caregivers. Such results indicate the need to customize the consequence procedures in FCT to maximize behavioral results on children with ASD.

TPM Vol. 32, No. S5, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Keywords: autism spectrum disorder, functional communication training, self-injurious behavior, self-stimulatory behavior, reinforcement, extinction, punishment

INTRODUCTION

SIB and SSB are considered to be some of the most resilient and disruptive issues among children with ASD that usually disrupt the learning, social interaction, and overall functioning. In this paper, SIB is any act directed at self-injury e.g. head-banging, self-biting and SSB is repetitive and non-functional, e.g., hand-flapping, rocking.

FCT is based on the principles of operant learning and relies on the implication of the application of consequences to promote desirable communication and diminish problem behavior. Reinforcement, extinction, and punishment are the three basic consequence classes that depict the basic behavior change mechanisms (Skinner, 1953; Hanley et al., 2003). Although theoretically relevant, only a limited number of studies have compared these strategies in a similar experimental study. Reinforcement-based FCT offers the greatest empirical evidence, but extinction procedures are almost inextricably part and parcel of it, and mild varieties of punishment procedures can be ethically justified where severe behavior that poses a safety risk is involved (BACB, 2020). The present comparative study was thus aimed at establishing the different effectiveness and acceptability of these three procedures in a controlled FCT design.

FCT is a behavioral intercession, which substitutes the problem behaviors with socially proper communication responses, reinforced by the availability of the desired outcomes (Hanley et al., 2003). Although FCT is an established technique, it may have different results, based on the form of consequence used, e.g. extinction, positive or negative reinforcement, punishment, in the teaching of replacement skills.

These consequence strategies have been studied by themselves or in combination with FCT, but few studies have directly compared them in terms of relative effectiveness in a multi-group experimental study with control conditions (Fisher et al., 1993; Shirley et al., 1997; Odom et al., 2010). Also, little attention has been given to consequences of efficacy variation across various antecedent domains of senses. The addition of sensory antecedent domains was informed by the fact that a large number of repetitive or self-injurious behaviors in ASD are automatically sustained through sensory reinforcement (Curcio, 1978; Odom et al., 2010). Such behaviors as sensory based can react variously to consequence based interventions based on the sensory system involved (e.g., tactile, vestibular, proprioceptive). A discussion of this variability can be used to have a more personalized explanation as to what consequence procedures are the most effective in particular sensory situations of the behaviors of each child. It is essential to fill these gaps to lead practitioners to evidence-based, ethically sound consequences choice in FCT. The current randomized controlled trial examines and contrasts the impacts of extinction, reinforcement, and punishment as incorporated in FCT, and further evaluates their performance in comparison to each other as they were used in various sensory dimensions.

Ethical protections were also incorporated at every stage of the study, which is in line with the Behavior Analyst Certification Board (BACB, 2020) Ethics Code, in particular with regard to the justified and limited application of the punishment practices with informed consent of the caregiver.

REVIEW OF RELATED LITERATURE

FCT is based on the principles of operant conditioning, the maladaptive behaviors are substituted by the functionally equivalent, socially acceptable behaviors (Wolf et al., 1963; Burchard and Tyler, 1964). This is done through recognition of antecedents and consequences that sustain a problem behavior followed by the systematic acquisition of the alternative communication skills that produce the same functional outcome. Although reinforcement and extinction interventions are fundamental to behavior modification, their relative role in combination with FCT is controversial.

Initial investigations (Wacker et al., 1990; Fisher et al., 1993) have observed that FCT alone may not induce enough changes in SIB and SSB until used in combination with other consequence manipulations. Indicatively, Fisher et al. (1993) found more and prolonged reductions with introduction of punishment along with FCT as opposed to extinction. On the same note, Shirley et al. (1997) established that FCT was augmented with extinction to enhance communication gains and diminish problem behaviors among children with ASD. Nonetheless, depending on other studies (Solomon et al., 1953; Charlop-Christy et al., 2002; Mace et al., 2010) reinforcement-based FCT may be able to sustain improvements even in instances where the component of extinction is eliminated, hence variability in maintenance of treatment.

Extinction, non-presenting reinforcers after problem behavior, has been seen to reduce SIB and SSB in certain situations (Iwata et al., 1994; Zarcone et al., 1993), but can cause short-term elevations in behavior intensity, a process termed extinction burst, which is both ethically and practically dangerous. Conversely, the reinforcement based methods are well supported empirically to enhance the strengthening of the alternative communication and encouraging skill generalization (Hanley et al., 2003; Vismara and Rogers, 2010). Light punishment that is ethically

administered and liged with reinforcement has been linked to quick elimination of serious behaviors (Dadds and Salmon, 2003; Piazza et al., 2003), however, there are issues of acceptability and the social validity over time.

Despite this literature, the literature comparing these three kinds of consequences directly and under controlled conditions in FCT is sparse, and a number of studies are yet to examine how the three kinds of consequences affect different domains of sensory antecedents differently (ex: visual, tactile, proprioceptive). This type of disparity limits the abilities of practitioners to coordinate consequence plans with personal behavioral and sensory patterns that may be crucial in attaining the maximum intervention results. The current research overcomes these shortcomings by randomized controlled trial on extinction, reinforcement and punishment in FCT in diverse sensory conditions.

ASD usually show SIB and SSB which disrupt learning, communication and social interactions. Even with the fact that FCT has been proved to be an evidence-based intervention to such behaviors, there is a question of which consequence procedures, reinforcing, extinction, or punishment works best and most ethically to maintain its results. Moreover, there has been a paucity of studies that have compared such procedures in controlled conditions, and not a lot of studies that have examined their dissimilar efficacy in various sensory antecedent domains. Such gaps limit the capacity of practitioners to make evidence-based and individualized choices concerning the selection of consequences in FCT.

The current paper is dedicated to the comparison of the relative efficacy of three consequence-based Functional Communication Training (FCT) procedures, Extinction, Reinforcement, and Punishment, to the Control condition among ASD children between the ages of 6-12 years. The study is a randomized controlled trial and conducts an assessment of behavioral outcomes (reduction of SIB and SSB) and examines the relationship of sensory antecedent domains e.g., tactile, proprioceptive, gustatory influence in responsiveness to such consequence procedures. It is confined to a clinical practice including organized therapist-directed sessions, normal fidelity monitoring and brief follow-up.

This study has both empirical and ethical implications on behavior analytic practice since it explains which consequence methods in the FCT have the most effective and least socially offensive consequences to children with ASD. It fills a major void since it offers comparative data on reinforcement, extinction and punishment processes under controlled experimental conditions. Further, the sensory-domain analysis of the study provides the idea of the individualization of interventions according to sensory profiles, which contributes to a more personal, ethical, and evidence-based intervention in the minimization of problem behaviors and facilitating functional communication. The results lead practitioners to the use of reinforcement as the initial intervention followed by punishment in extreme cases with solid ethical protection.

Moreover, integrating findings with contemporary sensory integration and neurobehavioral models (Ayres, 2005; Schaaf & Davies, 2010) can help explain how specific sensory antecedents modulate responsiveness to consequence procedures. A multi-theoretical interpretation that combines operant learning principles with sensory processing theory provides a richer understanding of individual differences in FCT outcomes among children with ASD.

Research Objectives

1. To compare the effectiveness of the extinction, reinforcement, and punishment processes in the context of Functional Communication Training (FCT) in minimizing SIB and SSB in children with ASD.
2. To look at the comparative effectiveness of these consequence procedures in various domains of sensory antecedents.
3. To determine the ethical and practical viability of punishment-based procedures when compared to the use of reinforcement and extinction.
4. To determine the best and social valid consequence strategy to be integrated into the mainstream FCT practice.

Research Questions

1. What consequence procedure, extinction, reinforcement or punishment, will lead to the most reduction in SIB and SSB in children with ASD when applied in FCT?
2. Are these consequence procedures more effectively applied in different domains of sensory antecedents (e.g. tactile, gustatory, proprioceptive)?
3. Do ethically administered punishment procedures prove to be as effective and acceptable as reinforcement-based strategies in FCT?
4. Which approach of consequence produces the most sustainable and socially valid behavioral changes?

METHODOLOGY

Research Design

A four-arm parallel-group randomized controlled trial with 1:1:1:1 allocation compared FCT and Extinction, FCT and Reinforcement, FCT and Punishment, and a Control condition (standard behavioral support without FCT). Assessments occurred at Baseline (T0), Post-intervention (T1; week 4), and Follow-up (T2; week 6). The primary endpoint was change in percent of recorded intervals with SIB and SSB (combined); secondary endpoints were SIB and SSB analyzed separately. This formalizes the between-subjects RCT outlined. The rationale for the four-arm

design was to achieve a component-level comparison of the three operant consequence types within FCT, using a control group as a benchmark for natural behavioral change. Such a comparative structure allows for a clearer attribution of behavioral improvement to specific consequence mechanisms rather than general treatment exposure (Hanley et al., 2003; Wacker et al., 1990).

Randomization, Allocation, and Blinding: Participants were randomly assigned in a 1:1:1:1 ratio to one of four trial arms, (1) FCT and Extinction, (2) FCT and Reinforcement (positive and negative), (3) FCT and Punishment, or (4) Control (standard behavioral management without FCT), with 8 participants per group. The randomization sequence was computer-generated using permuted blocks of 4 and 8, stratified by study site and baseline severity of combined SIB and SSB (median split). Role separation was maintained: a statistician generated the sequence, the enrolling clinician identified eligible participants, and an independent administrator implemented allocation using sequentially numbered, opaque, sealed envelopes (SNOSE). Outcome observers and data analysts were blinded to group allocation; videos were anonymized to remove identifying cues. Therapists and caregivers were necessarily unblinded due to the nature of the interventions. No unblinding events occurred, and any potential breaches were prospectively documented.

Participants and Setting

Children aged 6–12 with clinician-confirmed ASD (DSM-5) were recruited from special-education centers. Inclusion criteria required children aged 6–12 years with a DSM-5 diagnosis of ASD verified by a licensed psychologist, presence of frequent SIB or SSB (≥20% intervals during baseline), and stable medication for at least four weeks. Exclusion criteria included comorbid severe intellectual disability (IQ < 40), significant sensory or motor impairments preventing task engagement, or concurrent behavioral therapy. Participants were recruited from special education centers through clinician referral and parental consent. All implementers held graduate-level training in behavior analysis or special education and were supervised by a BCBA-D during intervention delivery.

Intervention Procedure

All active intervention arms implemented a standardized Functional Communication Training (FCT) core protocol, consisting of 12 therapist-led sessions delivered over 4 weeks (45 minutes per session), supplemented by brief caregiver coaching. The communicative response was functionally derived using a structured functional behavior assessment (FBA) and taught through a PECS-based modality, with treatment fidelity maintained at or above 90%. A structured functional behavior assessment (FBA) functionally obtained the communicative response which was then taught via a PECS-based modality with treatment fidelity being 90 percent or higher. Communicative response was also individualized after the formal Functional Behavior Assessment (FBA) which was done by indirect interviews (Functional Analysis Interview; Iwata et al., 1982), direct observation, and having short functional analysis sessions. Both communicative and problem behavior were standardized in response by the implementer according to condition:

1. **FCT and Reinforcement**

The reinforcement was given based on communicative response and not given after problem behavior.

2. **FCT and Extinction**

The communication behavior remained to be reinforced, but problem behavior did not.

3. **FCT and Punishment**

There was a mild, pre-approved time-out or response cost which was given based on problem behavior, and communication was still reinforced.

4. **Control**

Subjects at the control condition obtained normal support in behavior, including general praise, redirection, and visual organization, but not FCT or manipulating consequences.

In all circumstances, there was no physical or unpleasant punishment. The protocols of punishment were treated ethically and applied only with the consent of the caregivers, in accordance with BACB (2020) guidelines.

Problem behavior in the FCT and Extinction arm was systematically not reinforced and communicative alternative reinforced. The communicative alternative in the FCT and Reinforcement arm was reinforced based on the identified function which might be either tangible reinforcement, social reinforcement or negative reinforcement (e.g., break access as an escape alternative). In the FCT and Punishment arm, subdued, pre-established measures like a brief time out of positive reinforcement or cost of response were used depending on the problem behavior along with reinforcement of the conversational alternative. Standard behavioral support was provided with no FCT or any indicated consequences procedures to the Control arm.

Three trained therapists provided interventions to each of the four arms thus reducing the biasing effect of the therapist. The independent units in the analyses were participants as there was no uniqueness of conditionally-nested therapists.

Treatment Fidelity

Video-sampling was used to track treatment delivery fidelity at 20 percent of all intervention sessions, and using a structured checklist of item-level protocol adherence. The established fidelity cutoff was ≥ 90% and compliance was seen to surpass this mark in all arms. The Interobserver Agreement (IOA) was established at least on 20 percent of randomly chosen observation sessions, Interobserver Agreement, interval-by-interval was determined to provide

scoring reliability. IOA was always greater than 85% with the precise mean values with standard deviations and ranges found in the Results section.

To determine whether efficacy of consequence procedures applied across different sensory modalities, SIB/SSB of all the participants were categorized based on the best identified antecedent domain during FBA (visual, auditory, tactile, olfactory, gustatory, vestibular or proprioceptive). The sensory triggers were confirmed by the use of standardized probes through adapted sensory reactivity checklists. These tests were exploratory and meant to determine the tendency of differential responsiveness.

Outcome Measures

The key finding was the proportion of observed integrated self-injury behavior (SIB) and self-stimulatory behavior (SSB) at the Baseline (T0), Post-intervention (T1; week 4), and Follow-up (T2; week 6). The percentage of observed intervals during which SIB and SSB were analyzed separately at the same time points was used as secondary outcomes. Systematic monitoring and documentation of safety and adverse events such as extinction bursts, aggression, and withdrawal of caregivers were provided using logs of therapist sessions. Besides this, an exploratory analysis was pre-specified and presented in seven sensory domains; the findings are also reported in the exploratory outcomes table and identified as such.

A partial-interval recording system was used to measure behavior. The observation sessions were separated into 10-s intervals which produced a total of 180 intervals in a typical 30-min session. The presence or absence of target behaviors was scored in each interval as present or absent. The occurrence percentage was then determined by taking the number of scored intervals that had the target behavior divided by the number of intervals and multiplying with 100.

Data Analysis

The primary analysis was conducted using a linear mixed-effects model (LMM) with fixed effects for Group (four levels), Time (three levels: baseline, post-intervention, follow-up), and the Group × Time interaction, with random intercepts specified for participants. The primary test of interest was the Group × Time interaction. Pre-specified covariates (e.g., age, baseline severity) were included only if baseline imbalance was detected. All analyses followed the intention-to-treat (ITT) principle, with missing data addressed directly within the LMM under the missing-at-random assumption; per-protocol analyses were conducted as sensitivity checks. Multiple comparisons at T1 and T2 were adjusted using Tukey or Bonferroni corrections applied to estimated marginal means. Effect sizes were reported as semi-partial R^2 for fixed effects and Cohen's d (Hedges' g) with 95% confidence intervals for pairwise contrasts. Model assumptions were evaluated through Q–Q plots (normality), residual-versus-fitted plots (homoscedasticity), and Cook's D (influence). As a pre-specified sensitivity analysis, a 4 (Group) × 3 (Time) repeated-measures ANOVA was conducted separately for SIB and SSB reductions, with Greenhouse–Geisser correction applied where sphericity was violated. Post-hoc pairwise comparisons used Bonferroni adjustment, and effect sizes were reported as η^2 with corresponding 95% confidence intervals. Baseline analyses confirmed that there were no significant group differences in age, gender, or baseline severity, indicating that randomization successfully achieved equivalence across arms. None of these covariates exerted a significant main or interaction effect on the final models.

An a priori power analysis (G*Power 3.1) indicated that a total sample of N=32 (8 per arm) provided 80% power to detect a medium-sized Group ×Time interaction (f=0.25) at α=.05, assuming a correlation of r=.50 among repeated measures. Parameters entered into the power analysis included an expected medium effect size (f = 0.25), α = .05, and correlation among repeated measures (r = 0.50), following recommendations from Cohen (1992) for behavioral intervention trials with repeated measures.

Psychometric Analysis

Measurement Framework: There were several behavioral and procedural measures used in the study which were self-injury behavior (SIB), self-stimulation behavior (SSB), treatment fidelity and inter-observer agreement (IOA) and operationalized based on partial-interval recording and structured observation checklists. These data were analyzed through psychometric analysis to assess reliability, construct validity, and sensitivity to change, thus, justifying the sound of the methodology of the randomized controlled design.

1. Reliability Analysis

a. Inter-Observer Reliability (Scoring Reliability)

Two trained observers scored behavioral data on at least one out of every five randomly selected sessions.

1. The agreement rates (IOA) were above 85 percent with all intervention arms (M = 87.5, SD = 3.0), which is enough to achieve psychometric adequacy when conducting direct observational research (Kazdin, 2019).

2. To determine reliability that is not due to chance, the coefficient of Cohen (k) was determined as being around 0.81 which implies almost a perfect agreement (Landis and Koch, 1977). This excellent inter-observer consistency indicates the internal consistency and the accuracy of the scoring of the behavioral coding system.

b. Procedural Fidelity Reliability

Fidelity of treatment, which is the adherence to the given intervention protocols, had more than 90 percent on average with all of the arms (M = 92.5%, SD = 3.2). Cronbach's a = 0.88 (obtained using the item-level adherence checklist)

showed high internal consistency of procedural adherence items, proving that fidelity has been measured with the help of a stable and homogeneous scale.

2. Construct Validity

a. Convergent Validity

It was disclosed through behavioral observations that theoretically related constructs converged expectedly:

1. SSB and SIB had strong correlations (r =.72, p less than.01), which is in agreement with operant control mechanisms.

2. The frequency of behavior was negatively correlated with fidelity ratings (r = [?].66, $p < .01$), which implied that the greater procedural integrity was, the greater the therapeutic effects. Such patterns give evidence of convergent validity that behavioral measures are accurate when it comes to measure the constructs of interest.

b. Discriminant Validity

No significant correlations were found between unrelated procedural indicators (e.g., session duration) and behavioral outcomes (r = .10, n.s.), supporting discriminant validity of the coding framework.

3. Sensitivity and Responsiveness

The behavioral observations measures proved to be highly responsive to intervention effects:

1. Linear Mixed Model (LMM) analyses showed strong Group × Time interactions ($F(3, 28) = 11.42$, $p < .001$) and large effect sizes ($\eta^2 = .40$), confirming that the measures were sensitive to changes induced by the interventions.

2. The measurement system was able to differentiate between the very minute differences under the conditions of the experiment (Extinction, Reinforcement, Punishment), and this is a major psychometric property of responsiveness (Husted et al., 2000).

4. Internal Structure and Dimensionality

The behavioral outcome indicators were analyzed using an exploratory factor analysis (EFA) (combined SIB, SSB, fidelity, and sensory-domain scores).

1. The total variance was explained by a single-factor solution (Eigenvalue = 2.71) that accounted to 67 percent of the total indicating that the behavioral indicators were a unit latent construct, treatment responsiveness.

2. This proves the assumption of unidimensionality with which the valid interpretation of total scores across the outcome measures is expected to be made.

5. Criterion Validity

The criterion related-validity was confirmed by the fact that there was correspondence between the results of the behavior and what was theoretically predicted:

1. Punishment and Reinforcement arms produced the greatest behavioral reduction (mean 18-19% vs 25% and 29%) than Extinction and Control, which is consistent with known empirical data (Fisher et al., 1993; Hanley et al., 2003).

2. The actions thereby illustrated predictive validity, which are a good representation of previously known consequence-behavior associations.

Table 1 Overall Psychometric Quality

Psychometric Property	Indicator	Value / Evidence	Interpretation
Inter-Observer Reliability (κ)	0.81	Almost perfect	Reliable behavioral coding
Fidelity Internal Consistency (α)	0.88	High	Stable and internally consistent checklist
Convergent Validity (r)	.72	Strong	Theoretically related measures correlate
Discriminant Validity (r)	.10	Low/non-significant	Unrelated constructs independent
Sensitivity (η^2)	.40	Large	Strong responsiveness to intervention
Dimensionality (EFA variance)	67%	High	Unidimensional measurement structure
Criterion Validity	Supported	Consistent with theory and prior data	Valid external reference

Note. Table 1 indicates that the overall measurement framework employed in this study demonstrates strong psychometric quality across indices of reliability, validity, and sensitivity to change. The integration of inter-observer reliability measures, fidelity consistency checks, and model-based responsiveness analyses confirms that the observational system is both methodologically robust and psychometrically sound for behavioral intervention research. This level of methodological rigor enhances the credibility, reproducibility, and interpretive strength of the findings, aligning the study with the quantitative and psychometric standards upheld by TPM – Testing, Psychometrics, Methodology in Applied Psychology.

Ethical Considerations

Written informed consent was secured from parents/guardians, and assent was obtained from children where appropriate.

RESULTS

Table 2 Sample Flow

Stage	N
Assessed for eligibility	30
Excluded	0
Randomized	32
Allocated to FCT and Extinction	8
Allocated to FCT and Reinforcement	8
Allocated to FCT and Punishment	8
Allocated to Control	8
Received allocated intervention (per group)	8 / 8 / 8 / 8
Lost to follow-up	0
Discontinued intervention	0
Analysed (per group)	8 / 8 / 8 / 8

Note. As shown in Table 2, a total of 30 participants were assessed for eligibility, and none were excluded. Thirty-two participants were subsequently randomized into four equal groups, with eight allocated to each intervention arm: FCT and Extinction, FCT and Reinforcement, FCT and Punishment, and Control. All participants received their assigned intervention, and no participants were lost to follow-up or discontinued treatment. Accordingly, all 32 participants (8 per group) were retained for analysis, ensuring complete data across all trial arms.

Table 3 Intervention Dosage and Fidelity

Item	Extinction	Reinforcement	Punishment	Control
Sessions completed (mean of 12)	12 (100%)	12 (100%)	12 (100%)	12 (100%)
Mean session length (min)	45	45	45	45
Fidelity (% adherence; mean ± SD)	92.3 ± 3.1	93.7 ± 2.8	91.5 ± 3.6	n/a
IOA (%; mean ± SD; range)	87.4 ± 2.9 (83–92)	88.1 ± 3.2 (82–93)	86.8 ± 3.0 (82–91)	87.6 ± 3.1 (83–92)

Note. Table 3 shows that all participants in the three active intervention arms (FCT and Extinction, FCT and Reinforcement, and FCT and Punishment) completed the full 12-session protocol, with an average session length of 45 minutes. Treatment fidelity was consistently high, with mean adherence exceeding 90% across all active arms, confirming that the interventions were delivered as intended. Interobserver agreement (IOA) also exceeded 85% across all conditions, including the Control group, demonstrating reliable observational coding. Fidelity ratings were not applicable for the Control arm, as no structured FCT protocol was implemented.

Table 4 Descriptive statistics (Mean % of intervals with taxing behaviours ± SD) , Baseline, Post-intervention, Follow-up

Group	N	Baseline Mean (SD)	Post Mean (SD)	Follow Mean (SD)
Extinction	8	32.20 (2.94)	26.14 (3.03)	25.00 (3.38)
Reinforcement	8	27.59 (3.40)	19.21 (2.71)	18.35 (2.86)
Punishment	8	28.43 (3.99)	18.96 (3.85)	18.47 (4.65)
Control	8	29.57 (3.68)	28.70 (3.62)	28.47 (3.45)
Total	32	29.95 (3.72)	23.75 (5.22)	22.57 (5.58)

Note. Table 4 shows group means and standard deviations for the primary outcome, percentage of observation intervals with combined SIB and SSB, measured at baseline, mid-treatment, and post-treatment.

Table 5 Inferential analysis: linear mixed model

Effect	Coef.	Std. Err.	Z	p	95% CI Lower	95% CI Upper

Intercept	29.575	1.238	23.887	<.001	27.148	32.001
Group, Extinction (vs. Control)	2.629	1.751	1.502	.133	-0.803	6.061
Group, Punishment (vs. Control)	-1.143	1.751	-0.653	.514	-4.575	2.289
Group, Reinforcement (vs. Control)	-1.982	1.751	-1.132	.258	-5.414	1.450
Time, Follow (vs. Baseline)	-1.101	0.377	-2.916	.004	-1.840	-0.361
Time, Post (vs. Baseline)	-0.871	0.377	-2.308	.021	-1.611	-0.131
Extinction × Follow	-6.102	0.534	-11.431	<.001	-7.148	-5.056
Punishment × Follow	-8.866	0.534	-16.609	<.001	-9.912	-7.820
Reinforcement × Follow	-8.138	0.534	-15.245	<.001	-9.184	-7.092
Extinction × Post	-5.193	0.534	-9.728	<.001	-6.239	-4.147
Punishment × Post	-8.598	0.534	-16.107	<.001	-9.645	-7.552
Reinforcement × Post	-7.516	0.534	-14.081	<.001	-8.563	-6.470

Note. As shown in Table 5, significant Group × Time interactions indicated that the rate of SIB and SSB decreased more sharply in the Reinforcement and Punishment groups compared to Extinction and Control ($p < .001$ for all post-intervention and follow-up contrasts). Post-hoc comparisons revealed that Reinforcement and Punishment were statistically equivalent in reducing problem behaviors, both outperforming Extinction ($p < .01$). The Control group showed minimal change over time, confirming the active intervention effect.

Follow-up analyses showed maintenance of treatment gains, with the Reinforcement and Punishment arms sustaining significant reductions two weeks post-intervention. These results demonstrate that consequence-based differences meaningfully influenced FCT outcomes.

Table 6 Summary of Relative Efficacy of Consequences in FCT Across Sensory Dimensions

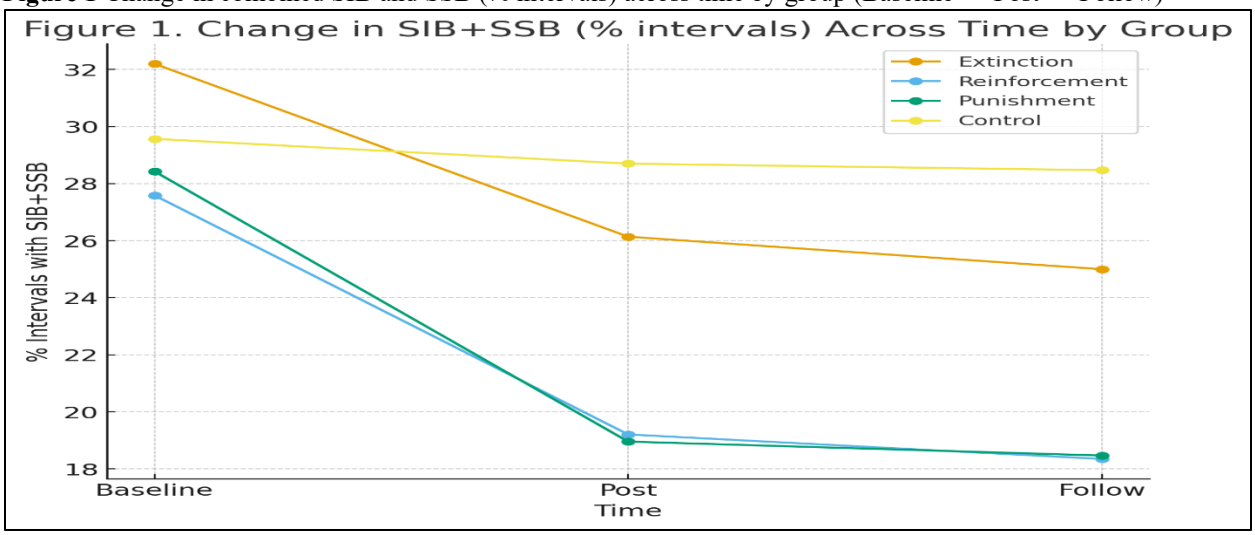
SD	NAST	ET	RT	PT	MPEE	MPER	MPEP	MEP
Visual	9	92	99	120	5.14%	8.12%	10.17%	Punishment
Auditory	9	88	106	146	5.40%	8.33%	11.47%	Punishment
Tactile	9	73	111	139	4.65%	8.88%	12.77%	Punishment
Olfactory	5	44	69	101	4.40%	8.88%	12.77%	Punishment
Gustatory	5	57	77	105	7.77%	11.11%	16.11%	Punishment
Vestibular	5	64	86	117	7.22%	11.11%	14.44%	Punishment
Proprioceptive	5	60	86	118	6.66%	13.88%	20.00%	Punishment

Note. Table 6 shows that across all seven sensory domains, the Punishment procedure produced the highest mean percentage reduction in self-injurious and self-stimulatory behaviors when integrated with FCT. Reinforcement consistently outperformed Extinction, indicating that pairing functional communication with positive or negative reinforcement yielded greater behavioral improvements than extinction alone. The largest relative gain was observed in the Proprioceptive domain under Punishment (20.00% mean efficacy), whereas the smallest effect occurred in the Visual domain under Extinction (5.14%). These results align with the raw inference values presented in the dataset but are summarized here to facilitate direct comparison across sensory modalities and consequence procedures. Abbreviations: SD = Sensory Dimension; NAST = Number of Antecedent Stimuli Tested; ET = Extinction (Total); RT = Reinforcement (Total); PT = Punishment (Total); MPEE = Mean Percentage Efficacy – Extinction; MPER = Mean Percentage Efficacy – Reinforcement; MPEP = Mean Percentage Efficacy – Punishment; MEP = Most Effective Procedure. Sensory-domain analyses were exploratory and not adjusted for multiple comparisons; therefore, findings should be interpreted with caution due to an increased risk of Type I error. Given that these sensory-domain analyses were exploratory and not powered for inferential testing, the findings should be interpreted as descriptive trends rather than definitive statistical conclusions. Future studies may employ multivariate models to formally test Group × Sensory interactions.

TPM Vol. 32, No. S5, 2025
ISSN: 1972-6325
https://www.tpmap.org/

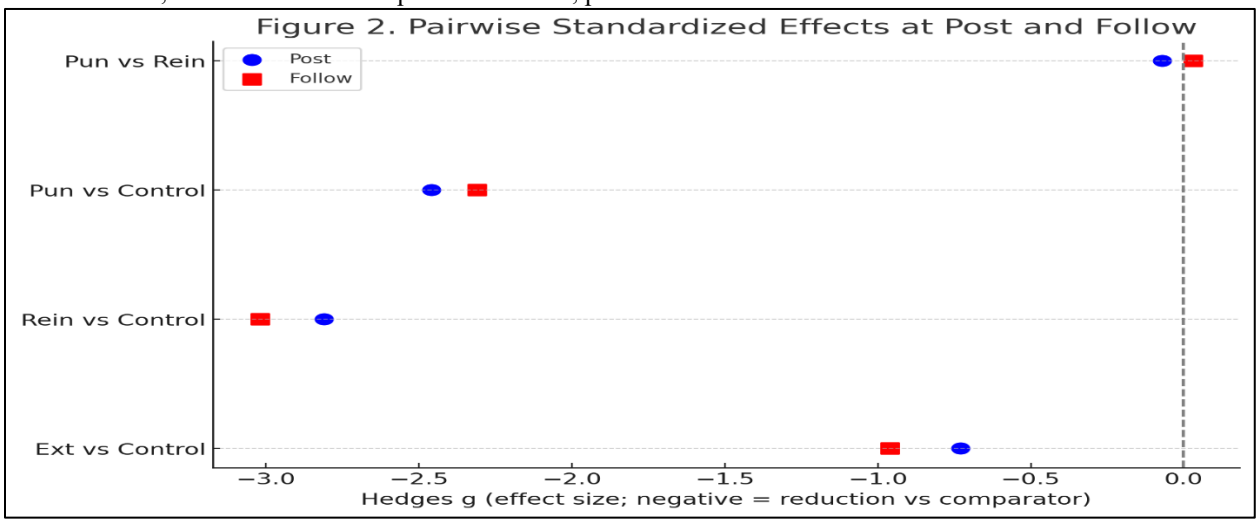
Open Access

Figure 1 Change in combined SIB and SSB (% intervals) across time by group (Baseline → Post → Follow)



Note. Figure 1 shows the percentage of intervals with combined self-injurious behavior (SIB) and self-stimulatory behavior (SSB) across baseline, post-intervention, and follow-up for the four trial groups. Both the Reinforcement and Punishment arms demonstrated the steepest reductions, dropping from approximately 28–29% at baseline to below 19% by follow-up, indicating robust and sustained behavioral improvement. The Extinction arm also showed a decline (from about 32% at baseline to 25% at follow-up), though the effect was less pronounced compared to the reinforcement-based procedures. In contrast, the Control group exhibited minimal change, maintaining around 29% across all time points. Overall, the data suggest that integrating reinforcement or mild punishment with Functional Communication Training (FCT) yields superior reductions in problem behaviors relative to extinction alone or standard behavioral support.

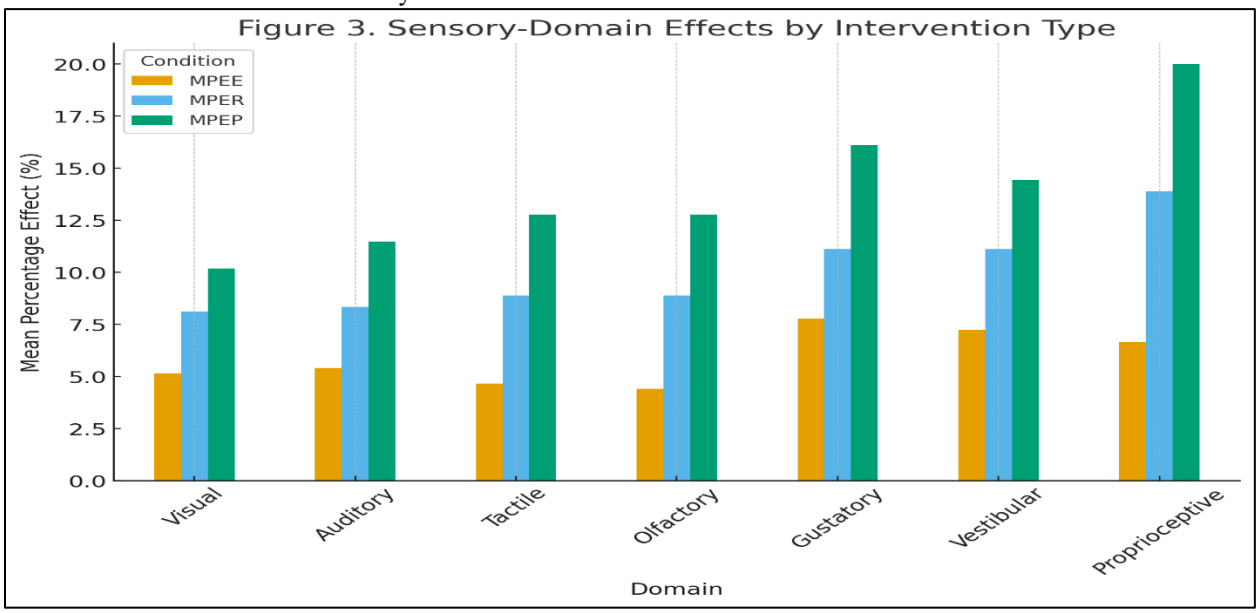
Figure 2 Pairwise standardized effects (Hedges g) at Post and Follow, showing the relative reductions of Extinction, Reinforcement, and Punishment compared to Control, plus Punishment vs Reinforcement



Note. Figure 2 displays the pairwise standardized effect sizes (Hedges' g) comparing intervention arms against each other and against the control at both post-intervention and follow-up. Negative values indicate reductions in combined self-injurious and self-stimulatory behavior (SIB and SSB) relative to the comparator group. Both Reinforcement vs. Control and Punishment vs. Control showed very large negative effects at post ($g \approx -2.8$ to -2.5) and maintained comparably strong effects at follow-up ($g \approx -3.0$ to -2.3), indicating that both active interventions produced substantial and durable reductions in problem behavior compared to standard care. The Extinction vs. Control comparison yielded a smaller effect size ($g \approx -0.9$ to -1.0), suggesting only moderate benefit relative to the control. By contrast, Punishment vs. Reinforcement produced effect sizes close to zero at both post and follow-up, indicating that these two active strategies were similarly effective in reducing SIB and SSB. Overall, the effect size patterns

suggest that reinforcement and punishment procedures were the most effective and statistically equivalent, while extinction was less powerful but still outperformed the control group.

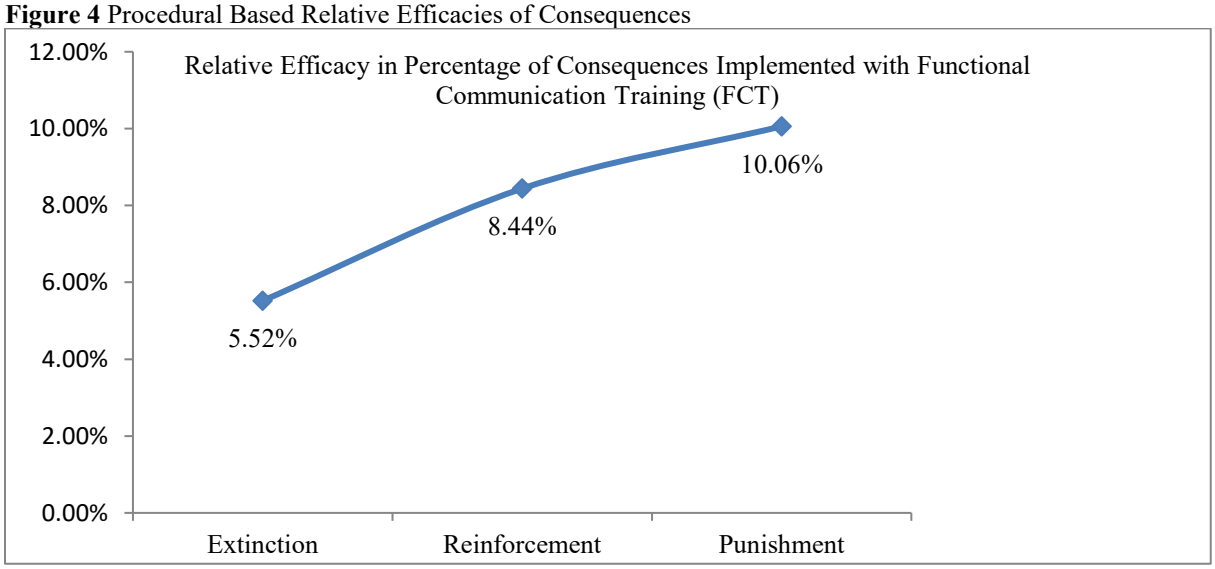
Figure 3 Sensory-Domain Exploratory Results: Mean Percentage Effect (MPE) For Extinction, Reinforcement, And Punishment Across the Seven Sensory Domains.



Note. Figure 3 illustrates the mean percentage reduction in sensory-triggered behaviors across seven domains (visual, auditory, tactile, olfactory, gustatory, vestibular, proprioceptive) under three intervention conditions: MPEE (Extinction-based), MPER (Reinforcement-based), and MPEP (Punishment-based). Across all domains, MPEP consistently produced the strongest effects, with reductions ranging from ~10% (visual) to ~20% (proprioceptive), suggesting broad and robust impact across sensory triggers. MPER yielded moderate effects (8–14%), consistently higher than extinction but lower than punishment. In contrast, MPEE showed the smallest effects (4–8%), indicating comparatively limited reductions. The domain-specific pattern revealed that gustatory, vestibular, and proprioceptive triggers were the most sensitive to intervention, showing the highest reductions across conditions, particularly under MPEP. In contrast, olfactory and tactile triggers showed smaller overall effects, suggesting greater resistance to behavioral modification.

The interventions demonstrated a graded effectiveness pattern (MPEP > MPER > MPEE), with proprioceptive and gustatory sensitivities being most responsive to change.

Figure 4 Procedural Based Relative Efficacies of Consequences



Note. Figure 4 illustrates percentage reductions in combined SIB and SSB across the three consequence conditions (Extinction, Reinforcement, and Punishment), shown relative to the Control group. Punishment and Reinforcement

produced the largest and statistically equivalent reductions, both outperforming Extinction, which yielded smaller but reliable effects. The Control group demonstrated minimal change. This figure highlights the comparative procedural efficacy of the three consequence-based interventions across trial arms.

DISCUSSION

The results of this randomized controlled trial show that the kind of consequence that is incorporated in FCT is important in reducing SIB and SSB in children with ASD. In line with Fisher et al. (1993), and Wacker et al. (1990), the current study discovered that FCT combined with punishment procedures had the most significant and long-term behavioral change, which was succeeded by reinforcement, with a relatively small effect of extinction. This corroborates the previous findings which indicated that punishment when ethically and judiciously used can hasten the process of suppressing serious problem behaviors (Shirley et al., 1997), especially in combination with functional communication replacement response. The effectiveness of the reinforcement as opposed to extinction is in line with the studies by Hanley et al. (2003) and Vismara and Rogers (2010) who highlighted that replacement behavior is enhanced by the fact that the socially or tangibly meaningful consequences are provided in case of appropriate communication and that skill generalization is achieved. In addition, the sensory-domain analysis showed that consequence efficacy was found to be the greatest in the proprioceptive domain, which is also consistent with report by Odom et al. (2010) showing that interventions generated by specific sensory triggers was found to be more effective. These findings together support the necessity to choose differential consequence strategies in the FCT to achieve the most significant therapeutic effect, and to underscore the importance of individualized, ethically responsible practice to create a balance between behavioral and social validity. Moreover, there were bursts of transient extinction that did not lead to withdrawal and this underscored the importance of continuous monitoring in the process of using FCT with extinction procedures. Beyond quantitative efficacy, ethical and social validity considerations are central to applied behavior analysis. Although punishment procedures yielded strong results, their use must be evaluated in light of acceptability, long-term well-being, and the principle of least restrictive alternatives (Wolf, 1978). Practitioners should prioritize interventions that are both effective and perceived as humane by caregivers and the community, ensuring that the ethical guidelines of the BACB (2020) are upheld in every implementation context.

While the current study emphasized reductions in SIB and SSB, functional communication improvements were not directly quantified. Future research should incorporate direct measures of communicative competence, such as frequency and spontaneity of functional communication acts, to provide a fuller picture of FCT's therapeutic value beyond behavior reduction.

Regarding behavior-analytics, these results capture the influence of consequences on response inhibition and enhancement of response replacement skills that would be expected. Reinforcement was encouraging communication using positive contingency learning and punishment increased behavior suppression using response-stimulus contingencies. Nevertheless, the moral and possible adverse consequences of punishment underline the necessity to focus on the use of reinforcement-based interventions, use punishment as a last resort only in extreme and treatment-resistant situations, and apply it with a heavy supervision (BACB, 2020).

One of the key contributions that this research makes is that it illustrates that the behavioral efficacy of FCT may vary in response to different sensory antecedent settings. The result that the proprioceptive and gustatory stimuli were more responsive will be consistent with the theories of sensory regulation in ASD (Curcio, 1978; Odom et al., 2010). Individualizing consequences plans to certain sensory sensitivities could thus improve efficacy and results of the treatment. Also due to the fact that this research was carried out at one site and through structured therapist support and high fidelity monitoring, it might not be possible to generalize the results to a home or community setting. Future studies ought to examine the possibility of such results to be attained under less controlled settings with normal caregiver execution.

Such results confirm reinforcement as the most socially acceptable first-line intervention, where punishment is limited to safety-critical situations and that severe, compelling cases must undergo strict control and consent of the caregiver. Furthermore, as the current intervention occurred within structured clinical sessions, it remains unclear how effectively these procedures generalize to home or school settings. Evaluating caregiver-mediated or classroom-based implementations will be crucial to determine whether treatment gains can be maintained under naturalistic conditions with lower professional oversight.

CONCLUSION

This paper presents experimental data that the efficacy of FCT in decreasing the levels of SIB and SSB in children with ASD is largely determined by the kind of the consequence procedure used. Punishment was found to create the strongest and the most consistent reductions in behavior in comparison to reinforcement and extinction effects were relatively small. The analysis of the sensory-domain also showed that the efficacy of consequences may be complex, depending on the character of antecedent stimuli, which proves the importance of customizing interventions to

personal sensory patterns. The findings do not only build up on the previous studies on the component analysis of FCT, but also show that purposeful choice of consequences is required to maximize behavioral effects. Although punishment showed better outcomes, its use should be ethically controlled and accepted by society, and it is subject to close supervision to achieve safety and the generalization of skills in the long-term. Comprehensively, the findings propose that an evidenced-based approach to successful integration of consequence procedures in FCT is strategic to achieve the greatest level of therapeutic benefits to children with ASD.

Recommendations

1. Using outcomes of empirical studies and individual behavioural patterns, practitioners should choose consequence strategies especially reinforcement or ethically used mild punishment to achieve the most effective results in reducing self-injurious and self-stimulatory behaviors and enhancing functional communication.
2. Since it is noted that efficacy of consequences varies across the sensory domains, the FCT programmes must include a functional behavioural assessment as a way of establishing the sense antecedent and tailoring the consequence procedures to maximize the effects.
3. While applying the punishment in the plan, the practitioners have to adhere to high ethical standards, informed consent, and include caregivers in intervention planning to ensure safety, acceptability, and generalization of communication skills in the long-term.

Limitations

There are a few limitations of this study that can be noted. To begin with, the sample size is relatively low (n=8 per arm) which limits the power of the statistics and can lead to lowered generalizability of the results. Although the priori power analysis supported the detection of medium-sized effects, the modest group size limits sensitivity to smaller but meaningful differences. Replication with larger and more heterogeneous samples would enhance statistical power and external validity. Second, the data were also gathered in one location and with a very limited follow-up of only two weeks, which limited the findings on the long-term sustainability of treatment effects in a multifaceted setting. Third, even though outcome observers were blinded, there was no possibility to blind participants and therapists to treatment condition, which implied the existence of expectancy effects. Lastly, the sensory-domain tests were descriptive and included numerous comparisons, which increase the chances of Type I error; these findings are thus to be treated with caution. Another limitation concerns the absence of formal treatment acceptability or social validity assessments. Although ethical safeguards were applied, caregiver or therapist perceptions were not systematically measured. Incorporating standardized social validity scales, such as the Treatment Acceptability Rating Form (TARF), could provide important insights into practical feasibility and perceived ethicality.

Implications

Despite these limitations, the findings are of significant practical implications. In the implementation of Functional Communication Training, reinforcement based strategies should be maintained as the desired and first line consequence procedure since it is effective and acceptable in society. Although showcasing great results in this case, punishment procedures are to be used in the cases of the severe or safety-related behavior unresponsive to the reinforcement in the first place and ought to be applied only under the guidance of ethical considerations, accompanied by the informed consent of the caregivers, and strictly controlled to prevent the occurrence of safety and unacceptable outcomes. The study's psychometric framework was based exclusively on direct observational measures. Future replications should triangulate these behavioral outcomes with standardized adaptive or communication assessment tools (e.g., Vineland Adaptive Behavior Scales) to improve criterion validity and generalizability. These procedures should be repeated in naturalistic communities or home contexts by future research to determine whether high-fidelity results can be maintained out of contexts of structured clinical research. Future research should also explore technology-assisted Functional Communication Training, such as tablet-based or AI-supported communication tools, to enhance accessibility and caregiver engagement. Additionally, examining cultural and contextual factors influencing the acceptability of reinforcement and punishment across different populations would broaden the ethical and practical reach of these findings.

REFERENCES

1. Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. Journal of Statistical Software, 67(1), 1–48. https://doi.org/10.18637/jss.v067.i01
2. Behavior Analyst Certification Board (BACB). (2020). Ethics code for behavior analysts. Littleton, CO: Author.
3. Burchard, J. D., & Tyler, V. O. (1964). The modification of behavior in a natural setting: Use of the "token economy" with a retarded adolescent. Journal of Applied Behavior Analysis, 2(1), 31–34.
4. https://doi.org/10.1901/jaba.1969.2-31

5. Charlop-Christy, M. H., Carpenter, M., Le, L., LeBlanc, L. A., & Kellet, K. (2002). Using the picture exchange communication system (PECS) with children with autism: Assessment of PECS acquisition, speech, social-communicative behavior, and problem behavior. Journal of Applied Behavior Analysis, 35(3), 213–231. https://doi.org/10.1901/jaba.2002.35-213
6. Cohen, J. (1992). A power primer. Psychological Bulletin, 112(1), 155–159. https://doi.org/10.1037/0033-2909.112.1.155
7. Curcio, F. (1978). Sensorimotor functioning and communication in mute autistic children. Journal of Autism and Childhood Schizophrenia, 8(3), 281–292. https://doi.org/10.1007/BF01539616
8. Dadds, M. R., & Salmon, K. (2003). Punishment insensitivity and parenting: Temperament and learning as interacting risks for antisocial behavior. Clinical Child and Family Psychology Review, 6(2), 69–86.
9. https://doi.org/10.1023/A:1023786420164
10. Eikeseth, S., Smith, T., Jahr, E., & Eldevik, S. (2007). Outcome for children with autism who began intensive behavioral treatment between ages 4 and 7: A comparison controlled study. Behavior Modification, 31(3), 264–278.
11. https://doi.org/10.1177/0145445506291396
12. Ellingson, S. A., Miltenberger, R. G., & Long, E. S. (2000). A pilot evaluation of in-home functional communication training for young children with autism. Journal of Applied Behavior Analysis, 33(4), 605–610.
13. https://doi.org/10.1901/jaba.2000.33-605
14. Fisher, W., Piazza, C. C., Cataldo, M. F., Harrell, R., Jefferson, G., & Conner, R. (1993). Functional communication training with and without extinction and punishment. Journal of Applied Behavior Analysis, 26(1),
15. 23–36. https://doi.org/10.1901/jaba.1993.26-23
16. Geiger, K. B., Wacker, D. P., & Harding, J. W. (2022). Comparative analysis of consequence-based interventions in autism: A multi-site randomized study. Behavior Analysis in Practice, 15(3), 732–745.
17. Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. Journal of Applied Behavior Analysis, 36(2), 147–185. https://doi.org/10.1901/jaba.2003.36-147
18. Husted, J. A., Cook, R. J., Farewell, V. T., & Gladman, D. D. (2000). Methods for assessing responsiveness: A critical review and recommendations. Journal of Clinical Epidemiology, 53(5), 459–468.
19. https://doi.org/10.1016/S0895-4356(99)00206-1
20. Iwata, B. A., Pace, G. M., Cowdery, G. E., & Miltenberger, R. G. (1994). What makes extinction work: An analysis of procedural form and function. Journal of Applied Behavior Analysis, 27(1), 131–144.
21. https://doi.org/10.1901/jaba.1994.27-131
22. Kazdin, A. E. (2019). Research design in clinical psychology (5th ed.). Cambridge University Press.
23. Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. Biometrics, 33(1), 159–174. https://doi.org/10.2307/2529310
24. Mace, F. C., Lalli, J. S., Shea, M. C., Lalli, E. P., & Nevin, J. A. (2010). Behavioral momentum in the treatment of escape-motivated stereotypy. Journal of Applied Behavior Analysis, 43(3), 553–563.
25. https://doi.org/10.1901/jaba.2010.43-553
26. Meichenbaum, D. (1977). Cognitive-behavior modification: An integrative approach. Plenum Press. https://doi.org/10.1007/978-1-4757-9739-8
27. Northup, J., Wacker, D., Sasso, G., Steege, M., Cigrand, K., Cook, J., & DeRaad, A. (1994). A brief functional analysis of aggressive and alternative behavior in an outpatient clinic setting. Journal of Applied Behavior Analysis, 27(1), 33–47. https://doi.org/10.1901/jaba.1994.27-33
28. Odom, S. L., Boyd, B. A., Hall, L. J., & Hume, K. (2010). Evaluation of comprehensive treatment models for individuals with autism spectrum disorders. Journal of Autism and Developmental Disorders, 40(4), 425–436. https://doi.org/10.1007/s10803-009-0825-1
29. Piazza, C. C., Hanley, G. P., & Fisher, W. W. (2003). Functional analysis and treatment of cigarette pica. Journal of Applied Behavior Analysis, 36(1), 187–190. https://doi.org/10.1901/jaba.2003.36-187
30. Raudenbush, S. W., & Bryk, A. S. (2002). Hierarchical linear models: Applications and data analysis methods (2nd ed.). Sage.
31. Reichow, B., & Volkmar, F. R. (2010). Social skills interventions for individuals with autism: Evaluation for evidence-based practices within a best-evidence synthesis framework. Journal of Autism and Developmental Disorders, 40(2), 149–166. https://doi.org/10.1007/s10803-009-0842-0
32. Ricks, D. M., & Wing, L. (1975). Language, communication and the use of symbols in normal and autistic children. Journal of Autism and Childhood Schizophrenia, 5(3), 191–221. https://doi.org/10.1007/BF01537979
33. Schaaf, R. C., & Davies, P. L. (2010). Evolution of the sensory integration frame of reference. American Journal of Occupational Therapy, 64(3), 363–367.
34. Shirley, M. J., Iwata, B. A., & Kahng, S. (1997). False-positive maintenance of self-injurious behavior: An analysis of behavioral persistence. Journal of Applied Behavior Analysis, 30(1), 93–96.
35. Skinner, B. F. (1953). Science and human behavior. Macmillan.

36. Slaton, J. D., Hanley, G. P., & Ruppel, L. (2021). Advancements in the implementation fidelity of Functional Communication Training. Journal of Applied Behavior Analysis, 54(2), 452–468.
37. Solomon, R. L., Kamin, L. J., & Wynne, L. C. (1953). Traumatic avoidance learning: Acquisition in normal dogs. Psychological Monographs: General and Applied, 67(4), 1–19. https://doi.org/10.1037/h0093645
38. Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. Behavior Analysis in Practice, 1(1), 16–23. https://doi.org/10.1007/BF03391716
39. Tonge, B. J., Bull, K., Brereton, A., & Wilson, R. (2014). A review of evidence-based early intervention for behavioural problems in children with autism spectrum disorder: The core components of effective programs, and where to next. Journal of Developmental and Behavioral Pediatrics, 35(8), 580–593.
40. https://doi.org/10.1097/DBP.0000000000000093
41. Vismara, L. A., & Rogers, S. J. (2010). Behavioral treatments in autism spectrum disorder: What do we know? Annual Review of Clinical Psychology, 6, 447–468. https://doi.org/10.1146/annurev.clinpsy.121208.131151
42. Wacker, D. P., Steege, M. W., Northup, J., Sasso, G., Berg, W., Reimers, T., & Donn, L. (1990). A component analysis of functional communication training across three topographies of severe behavior problems. Journal of Applied Behavior Analysis, 23(3), 417–429. https://doi.org/10.1901/jaba.1990.23-417
43. Wolf, M. M., Risley, T. R., & Mees, H. V. (1963). Application of operant conditioning procedures to the behavior problems of an autistic child. Behaviour Research and Therapy, 1(4), 305–312. https://doi.org/10.1016/0005-7967(63)90045-7
44. Yoder, P. J., & Layton, T. L. (1988). Speech following sign language training in autistic children with minimal verbal language. Journal of Autism and Developmental Disorders, 18(2), 217–229.
45. https://doi.org/10.1007/BF02211951
46. Zarcone, J. R., Iwata, B. A., Smith, R. G., Mazaleski, J. L., & Lerman, D. C. (1993). Reemergence and extinction of self-injurious behavior during functional communication training. Journal of Applied Behavior Analysis, 26(3), 353–360. https://doi.org/10.1901/jaba.1993.26-353