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Impact of two digital parent training models for managing challenging behaviors and food selectivity in children with autism spectrum disorder

Short Title: Digital Parent Training for Managing Challenging Behaviors and Food Selectivity in ASD

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Abstract

Objectives: To analyze the feasibility and impacts of parental training programs aimed at reducing challenging behaviors and minimizing food selectivity patterns in children with autism spectrum disorder (ASD).

Methods: An open clinical trial was conducted with 23 children with ASD and their families. The intervention lasted 12 weeks and consisted of online sessions with caregivers, who were divided into two groups: Challenging Behaviors and Food Selectivity. Pre- and post-intervention assessments included the Hamilton Depression Rating Scale, the Autism Behavior Checklist (ABC), and the Brief Autism Mealtime Behavior Inventory (BAMBI). Caregivers also completed daily logs regarding their children's behavioral and feeding challenges.

Results: There was a reduction in challenging behaviors after the intervention ($\mu=50.06$) compared to the pre-intervention period ($\mu=67.81$; $p=0.001$), as well as a decrease in food selectivity ($\mu=45.14$ post vs. $\mu=57.71$ pre; $p=0.012$).

Conclusions: Both interventions demonstrated preliminary evidence of feasibility and potential positive effects for children with ASD.

Keywords: autism spectrum disorder; parent training; applied behavior analysis; food selectivity; challenging behaviors.

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that encompasses deficits in two core domains: social communication and repetitive and stereotyped behaviors. Within the social communication domain, difficulties may include deficits in socio-emotional reciprocity, impairments in non-verbal communicative behaviors used for social interaction, difficulties in understanding and using gestures, and reduced or absent eye contact. In the domain of repetitive and stereotyped behaviors, it is common to identify motor movements, stereotyped or repetitive use of objects or speech, among others.¹

Current data estimate an average prevalence of ASD between 0.9% and 1.5% in populations from different regions of the world. Furthermore, the male-to-female ratio has been established at 4.2:1, and approximately 33% of cases present with comorbid intellectual disability.^{2,3}

Regarding treatment, numerous studies highlight the effectiveness of behavior analytic interventions, particularly Applied Behavior Analysis (ABA).⁴⁻⁸ ABA, or Applied Behavior Analysis, constitutes one of the four domains (Conceptual, Experimental, Applied, and Service Delivery) of behavior science.⁹

Regarding applied research and behavior analytic interventions for individuals with ASD, beyond these dimensions, evidence suggests that some additional parameters must be followed to ensure the effectiveness of ABA-based treatment. Two of the main parameters are treatment dosage and duration. Specifically, interventions should range from 10 to 25 hours per week for focused programs, and from 20 to 40 hours per week for comprehensive programs.^{10,11} Another important factor contributing to greater effectiveness is the use of individualized learning plans and behavior management strategies. However,

these interventions tend to be costly, which often limits their implementation — especially in low-resource countries or contexts.¹²

Given the high cost of traditional ABA interventions, parent training models for families of individuals with ASD have been developed and have shown promising results worldwide,^{13,7,14} and in Brazil, some promising examples already exist.¹⁵⁻¹⁹ Therefore, the next steps for the Brazilian context should aim to consolidate this knowledge through rigorous studies evaluating feasibility and effectiveness, ideally addressing limitations of previous studies such as the inclusion of control groups, medium- or long-term follow-up, and focus on specific behaviors.

One of the most commonly used strategies to reduce these behaviors is Functional Communication Training (FCT).^{20,21} FCT is a procedure that aims to teach more appropriate and alternative communication through pointing, exchanging visual stimuli, or verbal manding.²² A recent systematic review shows a significant reduction in challenging behaviors when FCT is implemented by parents, with changes tending to generalize and producing substantial improvement in families' daily lives.²³ Training delivered by parents, which supports the generalization of FCT gains, has been linked to improvements in feeding selectivity. Additionally, caregiver-mediated interventions are reported with increasing frequency.²⁴

Feeding selectivity may affect up to 90% of children with the disorder²⁵ and can be defined as the highly restricted consumption of food and is characterized across three domains: food refusal, limited food repertoire, and/or exclusive intake of specific foods.²⁶ This issue is often related to the behavioral problems already present in ASD and may render mealtimes highly stressful for the entire family.²⁷ Given its multifactorial nature, food-related issues must be addressed by a transdisciplinary team. One of the most effective treatment approaches for this issue is an intervention that combines ABA-based strategies such as a hierarchy of prompts, task analysis, positive reinforcement schedules, and the consistent use of data collection sheets.²⁸⁻³⁰ A study demonstrated a reduction in parental stress following a parent training program to address such issues.³¹

Given the negative impact of challenging behaviors and food selectivity—alongside limited access to evidence-based treatments of adequate intensity and duration—family training is considered one of the most important alternatives.²⁹ Family members can be trained to carry out activities with their children throughout the day and in multiple contexts, either providing or complementing the implementation of new skills and supporting generalization.^{32,33} Moreover, a systematic review and a report that analyzed over 900 studies published between 1990 and 2017 involving participants with ASD up to 22 years of age found improvements in several developmental domains, particularly in communication, social behaviors, and challenging behaviors.^{8,7}

The primary objective of the present study was to analyze the feasibility and adherence to two online parent training models—one focused on reducing the occurrence of challenging behaviors and the other aimed at modifying patterns of food selectivity in children with ASD. The secondary objectives were to: (i) investigate the impact of these two interventions on reducing challenging behaviors and improving food selectivity; (ii) assess whether the interventions benefited caregivers' mental health; and (iii) evaluate whether the training was still remembered and applied by families two years after the end of the intervention.

Methods

Study Design

This was an open clinical trial with daily data collection, conducted over a 10-week period.

Sample and Setting

Participants were recruited through two main sources: 1) patients referred from two outpatient services in São Paulo (TEAMM-UNIFESP and PROTEA-USP); and 2) an open call on social media published by the Gradual team.

Sample Size

Quasi-experimental design with a convenience sample recruited within the study window; no a priori sample-size calculation. We acknowledge limited statistical power and constraints on causal inference, given the design and sample size.

Challenging Behaviors Group (CBG)

Inclusion criteria: children with a diagnosis of ASD; impaired functional communication (speaking fewer than ten words) but the ability to communicate through gestures and to recognize pictures or photographs; and presence of challenging behaviors.

Exclusion criteria: receiving more than three hours of ABA-based intervention per week and/or using robust alternative communication systems such as PODD (Pragmatic Organization Dynamic Display) or PECS (Picture Exchange Communication System).

These criteria were assessed through an online screening questionnaire completed by parents at the time of registration. Among 1,326 applicants, 61 met the inclusion criteria, and 16 completed both pre- and post-intervention assessments.

Food Selectivity Group (FSG)

Inclusion criteria: children diagnosed with ASD who consumed no more than 15 different types of foods.

Exclusion criterion: participation in any other treatment for food selectivity at the time of intervention.

The same online questionnaire format was used. From 863 applicants, 50 met the inclusion criteria, and 8 completed both pre- and post-intervention assessments.

Selection flow: Supplementary Figure 1.

Assessment Instruments (Pre- and Post-Intervention)

All participants completed the same sociodemographic questionnaire and two structured instruments—the Hamilton Depression Rating Scale and the Autism Behavior Checklist (described below)—before and immediately after the intervention, under the guidance of a trained professional.

In addition, caregivers were instructed and encouraged to complete daily data sheets throughout the ten weeks of training. The **CBG** used two types of logs: one for tracking the frequency of continuous behaviors (e.g., crying) and another for discrete behaviors (e.g., throwing objects). The **FSG** used a single log sheet to record behavior at two different mealtimes each day.

Instruments used in both groups (CBG and FSG):

(a) A **sociodemographic questionnaire** covering caregiver and child information.

(b) The **Brazilian version of the Hamilton Depression Rating Scale** to screen for depressive symptoms in caregivers.^{34,35} The study used a revised and shortened Portuguese version with 17 items. This instrument has adequate psychometric properties and was culturally adapted for the Brazilian context, including content validity, ROC curve sensitivity and specificity, internal validity, and item consistency.³⁴

Instrument used only in the CBG:

(c) The **Autism Behavior Checklist (ABC)**, designed to assess autism-related symptoms in children aged 3 and older. The instrument consists of 57 items across five categories: 1) Sensory, 2) Relating, 3) Body and Object Use, 4) Language, and 5) Social and Self-Help.³⁶ The ABC was translated, adapted, and validated for the Brazilian population³⁷ and was used in this study as a primary outcome measure to detect reductions in ASD symptoms.

Instrument used only in the FSG:

(d) The **Brief Autism Mealtime Behavior Inventory (BAMBI)** is a parent-report questionnaire assessing child mealtime behaviors. It contains 18 Likert-scale items ranging from 1 = “Never/Rarely” to 5 = “At Almost Every Meal”.³⁸ The

BAMBI was translated, adapted, and validated for the Brazilian population³⁸ and served as the primary outcome for food selectivity in this study.

Two-Year Follow-Up Assessment

Families from both intervention groups were contacted via WhatsApp and email and invited to participate in a one-on-one online interview (via Google Meet) to assess the retention and application of the knowledge acquired during the training, two years after its completion.

The research team developed:

- **(A)** A set of multiple-choice questions regarding:
 1. The current use of strategies learned during the program;
 2. The use of data recording sheets;
 3. Dissemination of learned techniques to others;
 4. Participants' perceptions of the quality of the intervention.
- **(B)** A set of semi-structured questions exploring:
 1. Memories about the training experience;
 2. Retention of the content learned;
 3. Current use of that content in daily life.

Procedures, Ethical Considerations, and Study Phases

The study was conducted in three phases, all carried out virtually and synchronously via Google Meet:

1. Pre-intervention assessment, lasting one day and involving administration of the three instruments described above;
2. Parent training program, lasting 10 weeks;
3. Post-intervention assessment, replicating the same procedures as in Phase 1.

This study followed a methodological approach combining evidence-based practices with a training model based on Behavioral Skills Training (BST) and Pyramidal Training,¹⁷ conducted through one weekly meeting, totaling 12 sessions: two for pre- and post-assessments and ten for training.

The project was approved by the Research Ethics Committee of the University of São Paulo (CAAE No. 742.331). Before the pre-intervention assessment, caregivers from both groups were informed about the study and invited to sign—in digital format—the Informed Consent Form and the Image Use Authorization. Data collection only began after obtaining these consents. All questions were answered prior to signing, and confidentiality and the right to withdraw from the study at any time—without any penalty—were guaranteed, as outlined in the consent forms. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Intervention Program – CBG

- Weeks 1–2: Theoretical classes introducing core topics on Challenging Behaviors and teaching communication skills from the ABA perspective. Data recording sheets were distributed during this phase.
- Weeks 3–5: Practical-theoretical sessions focused on producing visual stimuli (e.g., routine charts, Communication Cue Books, and Visual Agreements) to support behavior management and communication skill teaching.
- Week 6: A special lecture by an Occupational Therapist, which is detailed in the Supplementary Material - Text 1.
- Weeks 7–9: Discussion-based meetings to clarify questions and review the families' data records.
- Week 10: Final meeting and closure of the group.

Intervention Program – FSG

- Weeks 1–2: Theoretical classes introducing Food Selectivity and ABA principles.
- Week 3: Families received guidance on selecting a target food, learned how to fill out the data sheet, and how to record videos of the steps.

- Weeks 4–9: Implementation of the New Food Introduction Program, consisting of ten behavioral steps. Each step involved a gradual exposure to the selected food:
 1. Tolerate,
 2. Look at it,
 3. Smell it,
 4. Touch it,
 5. Interact with it,
 6. Touch it to lips,
 7. Lick it,
 8. Bite it,
 9. Chew it,
 10. Swallow it.

Week 10: Final session focused on clarifying questions related to food selectivity and closing the group.

Data Analysis

To assess feasibility, we analyzed adherence rates and successful implementation of procedures, as recorded by caregivers. Step-by-step graphs were generated for each participating family in both intervention groups.

The impact analysis included only those participants who completed both pre- and post-intervention assessments. For the analysis of daily log data, participants also had to meet additional inclusion criteria specific to that phase, as detailed in Supplementary Material - Text 2.

To evaluate evidence of impact, we compared the pre- and post-intervention mean scores from the ABC, Hamilton, and BAMBI scales. After confirming the normal distribution of scores, paired-sample Student's *t*-tests were conducted using SPSS software, version 20.0. *p*-values below 0.05 were considered statistically significant, while values between 0.06 and 0.10 were interpreted as borderline significance.⁴⁰

To assess 24-month recall, semi-structured caregiver interviews were verbatim transcribed and anonymized. A narrative analysis

was conducted using hybrid coding by two analysts through spreadsheet-based coding and consensus. Results are presented as recurrent thematic motifs illustrated with anonymized quotations.

Results

CBG: Feasibility, Impact on Children and Caregivers, and Follow-Up

We begin the results section by addressing the main objective of this study, which was to examine the feasibility and adherence to two parent training models delivered in a virtual format.

Among the 61 participants who began the training, 35 initiated the frequency recording of the target behaviors to be addressed, resulting in a total of 865 entries. Initially, a conversion was performed from continuous behaviors to discrete behaviors, due to the impossibility of consolidating both behavioral formats and their distinct characteristics. This step was necessary because continuous behaviors (e.g., "crying") could be marked up to 15 times over a 15-minute period but still represented a single behavioral episode, which could be long, medium, or short in duration. In the absence of parameters in the literature indicating how to categorize the intensity or duration of such behaviors (like crying), we adopted the following criterion to convert the number associated with the continuous behavior into a reference of equivalence in discrete behavior occurrences.

Using a box plot, the distribution of these behaviors in our sample was established through quartiles, allowing us to create numerical equivalence references that preserved the intensity logic of the sample across measurement ranges. Measurements falling between the first and second quartiles were classified as "short," those between the second and third quartiles as "medium," and those above the third quartile as "long."

Based on this quartile model, we defined the numerical equivalence references by calculating the mean values obtained from the quartiles in the sample:

- Continuous behavior records between Q1 (0) and the Median (4) were converted into $(0 + 4)/2 = 2$ discrete behaviors (i.e., the mean of Q1 and the Median);
- Records falling between the Median (4) and Q3 (9) were converted into $(4 + 9)/2 = 6.5$, which was approximated to 7 discrete occurrences;
- Continuous behavior records between Q3 (9) and the upper limit (15) were converted into $(9 + 15)/2 = 12$ discrete behaviors.

(See Supplementary Material - Figure 2.)

From this point forward, we present the results addressing the secondary objectives of this study, which concern evidence of the impact of the training models on the children themselves and on their caregivers' mental health, as well as the use and recollection of the interventions two years after their completion.

Of the 61 families who completed the pre-intervention assessment, 16 also completed the post-intervention evaluation. Results revealed a mean reduction of 17.8 points on the ABC scale, indicating a statistically significant decrease in ASD-related behaviors ($p = 0.001$). On average, families observed a weekly reduction of 2.7 challenging behaviors.

Caregivers also showed a qualitative improvement in depressive symptoms after the program (mean reduction of 7.9 points on the Hamilton scale), though the difference was not statistically significant ($p = 0.262$).

To evaluate long-term effects, the 16 families who completed the post-intervention phase were invited to participate in a follow-up two years later. Six mothers agreed. Their children (66% boys) were between 3 and 12 years old (mean = 6.7 years).

Among the multiple-choice questions, 33.3% of the mothers reported that they still use emergency communication strategies with their children with ASD, while none of them continued to use the data recording sheets provided during the training. Over the course of the two years following the intervention, 66.6% of the mothers taught the techniques they had learned to others, including school

professionals, their spouses, and/or the child's grandparents. All respondents considered the duration of the intervention to be adequate and said they would recommend the training to another mother of a child with ASD.

The semi-structured questions helped to assess the extent to which the mothers had incorporated the intervention techniques. According to their reports, current use of various strategies was confirmed, including basic ABA concepts, the use of visual routine charts, and functional analysis to understand the function of behavior.

"There was a lot of guidance that I put into practice... I used to see the behavior as just misbehavior. But with the course, I understood that for every behavior, there's an antecedent." (Mother C.)

"Yes, I continued using the idea of anticipating crises and using visuals to explain upcoming events." (Mother A.)

FSG: Feasibility, Impact, and Follow-Up

Regarding the feasibility and adherence to the parent training program for Food Selectivity, 50 caregivers initially enrolled in the program, but only 26 effectively began completing the food introduction logs. A total of 4,292 attempts were recorded by these 26 families (see Supplementary Figure 3). Among these 26 participants who began the recordings, specific exclusion criteria were applied. The first was the inconsistency of the logs and lack of adherence to the protocol. Based on this, 10 families were excluded for presenting records with discontinuity or misalignment with the step transition guidelines.

Initial data revealed a decreasing trend in the success-to-error ratio, which is expected as step difficulty increases. Steps 4, 1, 5, and 2 appeared to be the least challenging, in that order. An anomalous pattern was observed between steps 3 and 4. We believe this discontinuity was due specifically to one child (Child 254 / Child #12), who completed 10 consecutive data collections on step 3, failing the first 7 attempts. This led to a significantly inflated success-to-error ratio for step 3, followed by a sharp drop in the overall group average.

Nevertheless, these results suggest that steps 3 and 7 were, on average, the most challenging for the participating children.

After applying the first exclusion criterion, the resulting sample comprised 18 participants. The second exclusion criterion was related to adherence to the program: 7 families were excluded for completing fewer than two-thirds (66.7%) of the expected data, leaving $n = 11$.

Next, we present the evidence of impact from this intervention on the children and their caregivers. A total of 50 families began the Food Selectivity program and completed the pre-intervention assessments, while 7 completed the post-intervention assessments.

The comparison between pre- and post-intervention data from the BAMBI scale revealed a statistically significant improvement in food selectivity behaviors among the children participating in the study ($p = 0.012$). A qualitative improvement was also observed in the depressive symptoms of the caregivers who participated in the intervention, with a 6.0-point decrease on the Hamilton scale. However, this difference was not statistically significant (Table 1).

Table 1 - Pre-and Pos-Intervention Means for BAMBI and Hamilton Scales.

Scale	N	Pre-Mean	Post-Mean	p	CI
BAMBI	7	57.71	45.14	0.012	95%
Hamilton	7	16.00	10.00	0.065	95%

Note: p = significance level; CI = confidence interval.

Regarding the final secondary objective of the study—evaluating the recollection and continued use of strategies from the Food Selectivity intervention—we initially identified 11 families who had completed at least 66.7% of the daily logs. Of these, 6 responded to the follow-up interview conducted two years after the intervention, all of whom were mothers of boys with ASD, aged between 5 and 14 years (mean = 8.33).

The results showed that 33.3% of the families were still applying the food introduction protocol with their child with ASD, although none of them were still

using the data sheets. The majority of families (83.3%) reported having taught the strategies learned in the training to others, including school staff, spouses, close friends, and the child's grandparents or siblings. As observed in the challenging behaviors training model, 100% of the families said they would recommend the program to another mother of a child with ASD.

Regarding the semi-structured questions, most mothers expressed positive memories about the training, reporting that they greatly appreciated the intervention and its structured steps—particularly those related to the food introduction process.

“He smelled the lettuce. Then one day, he bit and swallowed it. I danced around the house. Then we tried carrots and beets... Now I have more options. I’m so grateful.” (Mother 269)

Regarding the strategies they remembered and continued to apply with their children, the mothers emphasized the importance of staying calm, following the step-by-step process, and respecting the sequence when introducing a new food to their children with ASD—even if they did not remember the exact order of the ten steps. It is worth highlighting that the gradual stepwise process is one of the most important components of the training, and these reports indicate that such concepts were incorporated and retained by the participants.

“What I realized—at least for me—is that you have to start little by little, right? He has to tolerate it first and then go step by step. And it needs to be something similar to what he’s already used to eating, because I wanted to introduce a completely different food, and no—it has to be something close. So, you need to be very patient and not give up, you know?” (Mother 258)

“I’m not sure if I’m remembering it exactly as it was, but I think the first step was staying near the food, tolerating it. Then, touching it, giving it a kiss, smelling it, putting it in the mouth, and if possible, chewing it. I think that’s it. And I remember there was a step with play that I thought was really great.” (Mother 209)

Regarding the use of the strategies learned during the training, some mothers reported applying them in their daily routines, while others mentioned concerns that their children might become even more selective—though without necessarily attributing this to the training itself.

“I believe I do still use it, and the reason is that back then, during the course, it worked—so why wouldn’t it work now, whether I use it regularly or occasionally during mealtimes? And yes, it does work.” (Mother 242)

“I’m afraid he’ll stop eating even the few things he already eats, because his food repertoire is very limited. For example, over the past two years—not because of the protocol—but he stopped eating two fruits he used to like (...) Now I have to insist a lot for him to eat them, and I get scared that if I push too hard with other foods, he might shut down.” (Mother 258)

Discussion

Overall, our study suggests preliminary feasibility and potential benefits for the families who continued participating, even though it was a long intervention, conducted online, and without financial support. Feasibility findings warrant caution given reliance on caregiver self-reports.

Many families discontinued the program—particularly in the FSG. Since a considerable number of caregivers did not initiate or failed to maintain the practice of filling out the daily records, likely due to time constraints in daily routines, we hypothesize that this was one of several reasons for dropout. It is also possible that the slow pace of progress in food acceptance reduced families’ motivation to continue participation. This assumption still requires further investigation in the literature. Data recording sheets are considered extremely important in behavior analysis.⁴¹ Therefore, we recommend the development of digital tools for future research, such as apps that facilitate quick data input and allow families to visualize their child’s progress—enhancing both motivation and adherence.⁴²

Both training programs demonstrated preliminary positive outcomes within the limitations of a quasi-experimental design. In the CBG, a weekly reduction of 2.7 behaviors was observed, while in the FSG, participants showed gradual

improvements across early steps. These findings suggest the feasibility and potential of parent training models to produce scalable outcomes for broader populations, provided adherence challenges are addressed.⁴³

In the FSG, steps such as smelling the food (step 3) and touching it to the tongue (step 7) were particularly difficult. The literature indicates that food selectivity in ASD is often accompanied by sensory processing difficulties,⁴⁴ which affect between 70–95% of individuals on the spectrum.⁴⁵ These sensory challenges were not directly addressed in our current training model. Future versions should consider integrating gradual desensitization strategies to address hypersensitivity and increase the chances of progression through harder steps. This limited progress aligns with prior caregiver-mediated feeding interventions and underscores the complexity of ASD feeding challenges. Despite its limitations, the study indicates the need for longer, multidisciplinary protocols and highlights to families the importance of small progress, which contributes to greater adherence to the protocol.

One of the innovative features of this study was the long-term follow-up. Two years after completing the intervention, families still remembered and applied strategies from the training, indicating long-term generalization. This indirect impact is a meaningful outcome in itself. The model developed by our team aligns with the broader goal of providing evidence-based, accessible interventions to families of children with ASD. Literature suggests that many families abandon treatment due to financial barriers, lack of results, or difficulty implementing techniques.^{42,46}

Although neither of the two training programs demonstrated statistically significant improvements in caregivers' mental health scores, a downward trend was observed in Hamilton scale scores, which started with a high initial group mean of 18.31 points. This improvement appears to be consistent, as it had already been identified in a previous study using the same parent training model for the management of challenging behaviors, which found a significant reduction in caregiver depressive symptoms (mean reduction from 11.87 to 8.9 on the Hamilton scale; $p = 0.05$).¹⁷ In the present study, the benefit to caregivers was not a primary goal of the intervention models, but it may be considered an important "secondary" gain, particularly in light of current literature indicating that

evidence-based intervention models for parents of individuals with ASD are both scarce and urgently needed in low- and middle-income countries.³²

Despite the inherent challenges of conducting a study in a “real-world” setting, we consider this one of the strengths of the research—especially in demonstrating that both intervention models, with high scalability potential, online delivery, and low cost, had a positive impact. Their applicability to everyday practice underscores their social relevance, particularly in contexts of limited human resources and specialized services, as is common in most developing countries.^{47,48,33}

Although promising, this study has some limitations, including the small sample size, absence of a control group, lack of baseline data, and the absence of interobserver agreement measures. These limitations affect the interpretation and generalizability of the results. Future studies should aim to incorporate these elements to strengthen the rigor of analysis and broaden the applicability of the findings.

Conclusion

Parent training programs targeting the management of challenging behaviors and improvements in food selectivity demonstrated feasibility and initial evidence of positive impact. Given the quasi-experimental design, findings warrant caution; even so, the virtual model may broaden access to evidence-based practices in low-resource settings. We believe these models are of great importance for the Brazilian context, considering the high cost of intensive ABA-based interventions and the lack of qualified professionals in various regions of the country, which prevents adequate access for most children with ASD. The virtual format significantly expands access and the scalability of the model, offering a promising solution to overcome barriers to intervention. Future studies should further explore the potential of this technology, including the development of mobile applications to support both the delivery of interventions and the monitoring of outcomes, further optimizing the implementation and reach of parent training programs.

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Supplementary Material

Supplementary Text 1. A special lecture by an Occupational Therapist.

A lecture was delivered by an Occupational Therapist, who discussed how sensory processing difficulties can influence the occurrence of challenging behaviors in children with ASD. The session presented practical strategies for sensory regulation, fine-motor engagement, and environmental adaptation aimed at supporting children's daily routines. Caregivers were encouraged to recognize sensory triggers associated with their children's behaviors and to implement simple home-based adjustments that promote self-regulation and participation in everyday activities. This lecture complemented the behavioral management strategies addressed in previous weeks, incorporating a sensory perspective into the overall parent training model.

Supplementary Text 2. Sample Refinement Procedure

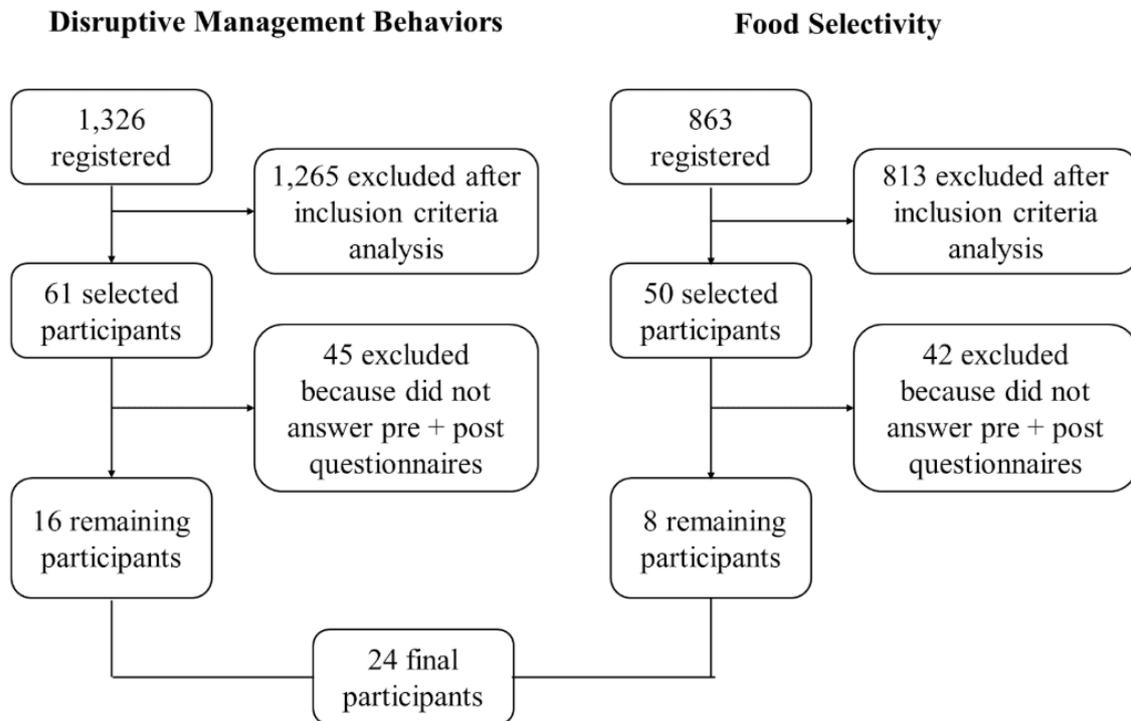
Since no minimum number of measurements had been previously established, a cutoff point was defined based on the profile of the records within the sample. The median was adopted as the reference value, resulting in a cutoff of 24 records. Based on this criterion, 16 family members who had collected fewer than 24 records were excluded. After this exclusion, 19 families remained with at least 24 records.

Before applying the second exclusion criterion, a calibration was performed due to variations in the start dates of recordings among families. To avoid distortion in the interpretations, all data were standardized based on each family's individual start week. For example, if a family began recording in the third week of the program, that week was considered their first week of data collection. Therefore, the individual start date was used rather than the official program start date.

The second exclusion criterion considered the minimum number of weeks with recorded data. The threshold was set at participation in at least two-thirds of the nine weeks, meaning a minimum of six weeks. After applying all criteria, the final sample for this group consisted of 13 families.

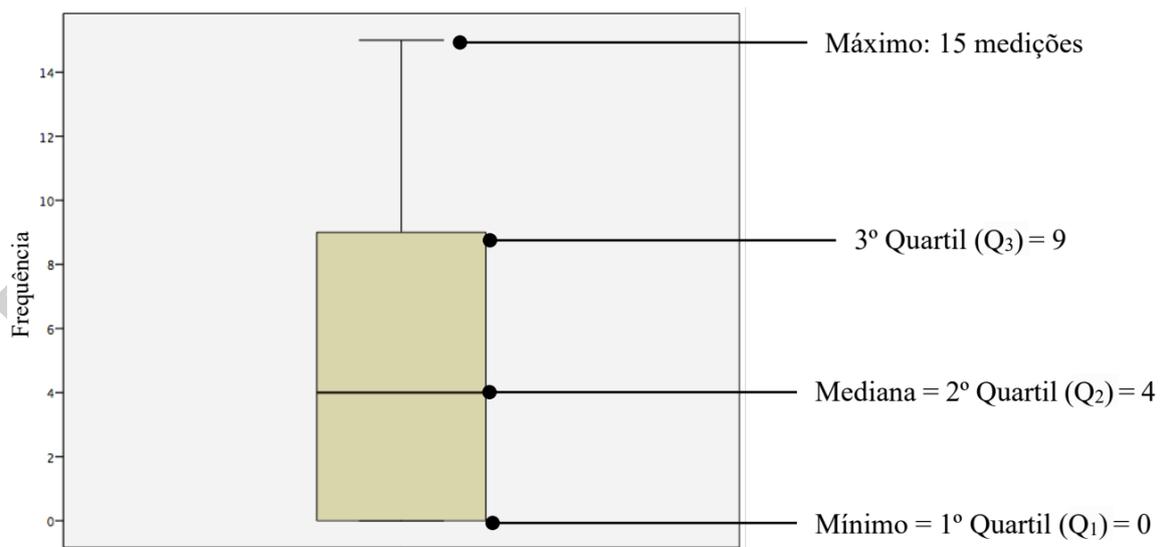
Supplementary Figure 1. Flowchart of the sample selection process.

[See file: Supplementary_Figure_1_Flowchart.tiff]



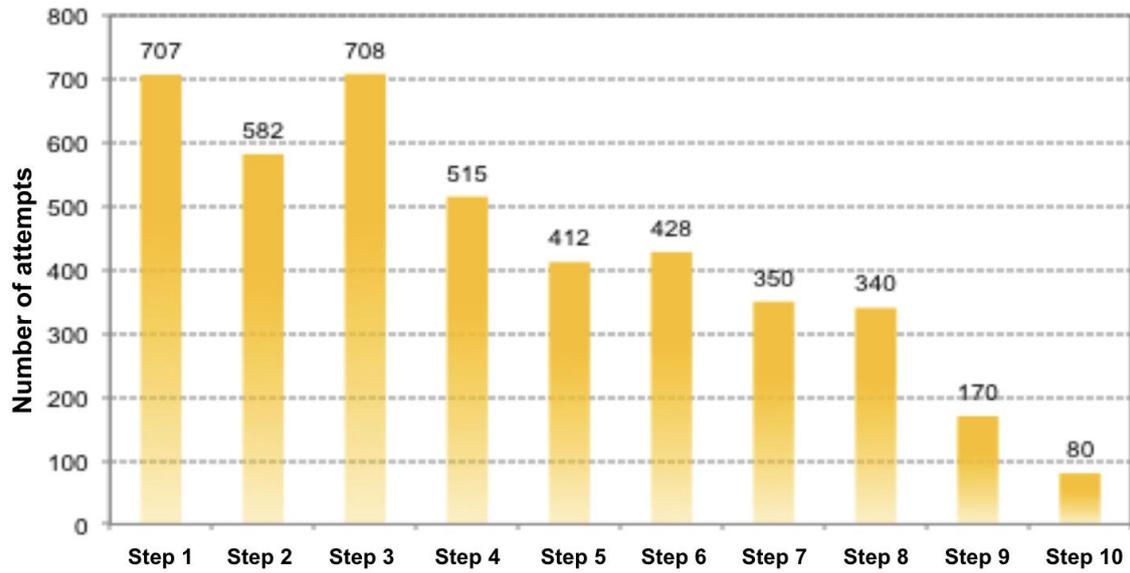
Supplementary Figure 2. Box-plot Diagram.

[See file: Supplementary_Figure_2_Boxplot.tiff]



Supplementary Figure 3. Distribution of the Total Number of Attempts in the Program (N = 26).

[See file: Supplementary_Figure_3_Attempts.tiff]



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