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Using Applied Behavior Analysis in Addressing Biting Behavior of a Child with Autism: A Case Study

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Abstract

Introduction: This study focuses on a boy with autism spectrum disorder presenting with biting behaviors that interfere significantly with functioning.
Method: This was a single-case study design examining how techniques of applied behavior analysis can be utilized to decrease the frequency of the child's biting behavior and increase more adaptive behaviors.
Results: The findings of the functional analysis indicated that other-inflicted biting behaviors were maintained by contingent escape from task demands (demand condition) and access to preferred objects and activities (tangible condition). Moreover, the self-inflicted biting behavior was found to be maintained by sensory stimulation (alone condition). Given these, a structured behavioral intervention, consisting of differential reinforcement of alternative behaviors, coupled with extinction targeted to each function of the behavior, was effective in reducing other-inflicted biting behavior in the demand conditions (67% reduction) and in the tangible conditions (95% reduction) as well as reducing self-inflicted behaviors in the alone conditions (100% reduction). More appropriate, adaptive behaviors like compliance, picture-assisted requests, and oral sensory activities also increased significantly.
Conclusion: These findings indicate that assessment and treatment based on the principles of applied behavior analysis can reduce not only problematic behaviors but also improve adaptive functioning.

Keywords: Applied Behavior Analysis, Autism, Aggressive Behaviors, Functional Analysis, Intervention

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder mainly characterized by clinically significant deficits in receptive-expressive communication and social interaction skills as well as restricted interests and repetitive behaviors [1]. It has been observed that certain populations of children with ASD communicate and interact in maladaptive ways, which drastically interfere with treatment engagement, familial relationships, and learning opportunities [2]. If left untreated, maladaptive behaviors become integrated with the child's behavioral repertoire making them more difficult to address as the child ages [3]. Like any other complex developmental and behavioral disorder, ASD warrants the need for effective and evidence-based interventions focusing on the management of maladaptive behaviors [4]. An intervention that has a solid research base when it comes to effective behavioral management is applied behavior analysis.

Applied Behavior Analysis (ABA) is both a science and a set of techniques dedicated to the selection, modification, and evaluation of human behavior based on the principles and methods of behaviorism. Behaviorism strongly emphasizes the role of environmental histories and contingencies in shaping the behavioral repertoire of an individual [5]. With operant conditioning procedures, behavioral problems associated with children with autism can be significantly addressed [6]. In ABA, the term applied refers to the selection and

evaluation of behavior that is socially significant in relation to its context. In the case of autism interventions, a particular behavior is selected because it plays a huge role in the child's context (e.g., it is dysfunctional and interferes with learning, it is dangerous and compromises the child's and others' health and safety, it is distressing and causes anxiety and frustration for the child's family). Then, the term behavior, from the lens of behaviorism, highlights the observable, measurable, describable behavior of interest such that the intervention can also be evaluated in terms of an observable, measurable, and describable change in behavior. Finally, the term analysis emphasizes the scientific approach to intervention – usually a repeated measures experimental design assessing the behavior before and after the intervention [7].

Several treatment models based on ABA for autism have been developed and established throughout the years [8]. These include but are not limited to Discrete Trial Training (DTT), Incidental Teaching (IT), Pivotal Response Training (PRT), Verbal behavior (VB), Treatment and Education of Autistic and Related Communication-handicapped Children (TEACHH) [5,9] and the Picture Exchange Communication System (PECS) [9].

A lot of the behavioral hallmarks of ASD have been successfully addressed through strategies built from applied behavior analysis [10, 11]. The evidence base on interventions grounded on ABA for children with ASD has constantly been expanding over the past decade. The meta-analysis done by Yu et al. [12] revealed significant effects of ABA-based interventions on socialization, communication, and expressive language domains while comparing experimental and control conditions but no significant effects on receptive language, daily living skills, verbal and non-verbal IQ, motor skills, and cognition. Nonetheless, it was found that long-term, comprehensive ABA-based interventions were beneficial to the lifelong development of children with ASD, particularly in terms of intellectual development, language development, acquisition of independent living skills, and social functioning [13].

For challenging behaviors in general and aggressive behaviors (other-inflicted and self-injurious) in particular, applied behavior analysis has been shown to offer an invaluable tool for assessment known as functional analysis. This method devised by Iwata et al. [14] involves systematic and strategic exposure to a series of conditions under which the behavior is likely to occur. Hypotheses about sources of behavioral maintenance can be made when higher rates of problem behavior are observed under a given condition. Subsequently, the use of functional analysis methodology provides potential targets for the development of more effective, function-based treatments to reduce the frequency of maladaptive behaviors and increase the use of more appropriate skills and adaptive behavioral repertoire [15-17].

The purpose of this study was to examine the basic effectiveness of applied behavior analysis as a method of intervention in addressing a maladaptive behavior (biting) that is both self-inflicted and other-inflicted (directed toward the mother and the caregiver or *yaya*). The research goals correspond to the treatment goals: a) to assess the function of the biting behavior, b) to formulate strategies targeted to decrease the biting behavior, and c) to replace the biting behavior with more appropriate/adaptive behaviors. The significance of this study is established as it captures the effectiveness of applied behavior analysis in the context of maladaptive behaviors among children with autism. Furthermore, this study provides nuanced information on identifying different functions of the same behavior – in this case, a biting behavior that is directed to the self and others. This is the first study to conduct an applied behavior analysis (assessment and treatment) of biting behavior exhibited by a child that is both self-directed and other-directed. The results of this study can guide clinicians to utilize a behavior analytic methodology in addressing problem behaviors of children with autism.

Method

This was a single-case study following an ABAB reversal design that utilized an ABA-based intervention on a child diagnosed with autism spectrum disorder exhibiting a maladaptive behavior (biting). It examined how techniques of applied behavior analysis can be utilized to decrease the frequency of the child's biting behavior and increase more adaptive behaviors. Examination of the child was done before and during the intervention. A case study approach allowed a naturalistic observation of the child, in-depth, individualized conceptualization of the problem behavior, and idiographic formulation of ABA-based intervention.

Case

The participant in this study is a 9-year-old Filipino boy diagnosed with autism spectrum disorder when he was four years old. Based on his assessment by a developmental pediatrician, he was considered non-verbal – unable to use verbal modalities (oral and written) when communicating with other people. He only makes use of gestures (e.g., pointing toward an object or pulling his mother's or *yaya*'s arm) when making a request. He underwent occupational and speech therapy for four years (when he was three years old to seven years old) but did not continue due to financial reasons, as reported by his mother. His last evaluation by a developmental pediatrician was three years ago – which revealed severe deficits in communication skills, mild deficits in daily living and socialization skills, adequate motor skills, and moderate impairment in cognitive functioning. He has never attended school nor has he undertaken any educational program. At present, he displays some independent living skills (e.g., dressing/undressing himself, eating by himself using utensils, drinking from a cup, opening/closing doors, lights, fan, and going to the toilet by himself). Other daily living skills that require assistance include taking a bath, brushing teeth, and going outside the home. Although there is no updated record of his intellectual capacity, he has been observed to demonstrate some skills like coloring pictures in a book, sorting shapes using a shape sorter, sorting balls

according to the same colors, building structures using lego, fixing puzzles, and arranging letters and numbers in order. He is not currently taking any form of medication.

He is an only child and currently lives with his mother and *yaya*. His parents are separated, as mentioned by the mother. His mother works as a public-school teacher, while no other information has been provided about the father aside from the fact that he no longer provides financial support for the family. He spends most of the time (13 h) with his *yaya* every day while he only spends 2 to 3 h with his mother on weekdays and 6 to 8 hours on weekends.

The child's mother requested a behavior assessment of her child's biting behavior (self-inflicted and other-inflicted) at the therapy center where the researcher is also currently working. The biting behavior is characterized by red bite marks on one's forearm leading to bruising. It started eight months ago (September 2021), so the mother seeks for appropriate interventions to address the biting behavior and minimize the risks of injuries. The behavioral assessment and intervention were conducted last year, November 2021.

Behavioral Description

The target behavior is described based on topography (biting behavior), object (biting one's own forearm and biting *yaya*'s forearm), frequency (three times to eight times per day), duration (2 sec to 6 sec per attempt), and intensity (leaving red bite marks leading to bruising). Biting means closure of upper and lower teeth on the skin.

For this study, functional analysis of biting and an ABA-based intervention were utilized. Since home-based services are preferred by the mother and the therapist, all assessments, therapy sessions, and observations were done in the child's home.

Assessment and treatment sessions were conducted in a designated therapy room at the child's home. The room was approximately 7 feet by 13 feet in dimension, with three cushioned chairs, two small tables, a cabinet, and a television on a stand. Two other therapists were also present in the corner of the room to record their observations. Before the initiation of assessment and treatment, parental consent was obtained. The therapists met with the mother to discuss the functional analysis procedures and treatment strategies. Permission was granted for the recording of the sessions. Parental consent was also obtained regarding the submission of this report for publication.

The assessment was done one week prior to the intervention to establish the baseline data of biting behaviors and identify the function(s) of the biting behaviors. Then, the ABA-based therapy sessions (during weekdays) were implemented (with consistent follow-ups by the mother and *yaya* every day), which lasted for 20 days. Twenty days' worth of data about the observed frequency of biting behavior at home were recorded and analyzed.

All therapists involved in the study had previous coursework, training, and experience in the use of behavioral interventions with children with neurodevelopmental disorders, particularly those with autism spectrum disorder.

Functional behavior analysis was conducted to assess the function of the biting behavior, which served as the basis for the formulation of the ABA-based intervention program for the child. In gathering the behavioral data, direct observation of the child's biting behaviors and a recording of the frequency of biting behaviors were done. A behavior tracking sheet was filled out by two therapists (observers) for one week before the intervention.

The functional analysis was conducted using procedures and experimental manipulations were done by Iwata et al. [14] in their functional analysis of self-injury. Five specific conditions, each lasting for 5 min, were presented two times per day in a multi-element design. The conditions were as follows: a) demand condition (the task is presented and immediately terminated when biting behavior occurs; escape from a non-preferred task as the function), b) attention condition (attention is provided through reprimand and brief physical contact when biting behavior occurred; obtaining attention as the function), c) tangible condition (a preferred object or activity is provided following the biting behavior; obtaining an object or activity as the function), d) alone condition (the child was placed in the therapy room alone, without access to toys or any other materials that might serve as external sources of stimulation; sensory stimulation as the function), and e) play condition (no tasks are presented, a variety of toys is available while the therapist maintains close proximity, and biting behavior is ignored unless severity is reached to the point where the session is terminated; control condition).

Four relevant behaviors were recorded: biting behaviors (directed to the self and directed to the *yaya*), compliant behaviors, appropriate self-stimulatory behaviors, and picture-assisted requests (requests for a preferred object or activity while using pictures).

During each 5-min session, two therapists (observers) recorded the occurrence of biting behavior, compliance, self-stimulatory behaviors, and requests from the room during continuous, 10-sec intervals. The rate of biting behavior was calculated by summing the number of recorded responses per min (biting per minute). They independently scored responses in all of the sessions. Occurrence reliability percentage was calculated by dividing the number of agreements by the total number of scored responses (number of agreements plus disagreements) and multiplying by 100 [18]. Percentage occurrence agreement was 96% for biting behavior and 97% for requests.

Treatment effects were evaluated using a reversal (ABAB) design coupled with Differential Reinforcement of Alternative behavior (DRA) plus extinction (EXT). The same behavior tracking sheet used in the assessment was used to monitor treatment effects. Treatment was matched according to the function of the behavior identified in the functional analysis. In addressing the escape function (DRA + escape EXT), the biting behavior was no longer followed by termination of the task; instead, the child was prompted to complete a task on his own (e.g., placing blocks in the container). Completion of the task on his

own (compliance) was followed by a reward – obtaining a small piece of his favorite food, paired with a social reinforcer, verbal praise, and a high-five.

In addressing the tangible function (DRA + tangible EXT), the biting behavior was no longer followed by access to preferred food or activity. The preferred food (e.g., biscuit) or activity (e.g., watching television) could have only been obtained if the child requested for it appropriately. Since the child was non-verbal, the request was in the form of a Picture Exchange Communication System (PECS). Instead of engaging in biting behavior, the child showed a picture of the preferred object or activity to gain access to such [19].

In addressing the sensory function (DRA + sensory EXT), the self-inflicted biting behavior is blocked and redirected to an oral sensory activity (e.g., massaging the mouth for 2-3 min and biting onto a chewy tube) as an appropriate self-stimulatory behavior. Instead of engaging in the biting behavior, the child is prompted to massage his jaw [20] and/or bite on a chewy tube [21] as an alternative. Summary of assessment and intervention sessions is laid out in Table 1.

Table 1. Schedule of Assessment and Intervention Sessions

Phase	Session	Date	Activities
Assessment Phase	Assessment Sessions 1-7	November 02-08, 2021	Recording of frequency of biting behaviors under 5 conditions (demand, attention, tangible, alone, play); Functional analysis of biting behavior
Treatment Phase	Treatment Sessions 1-5 (*baseline*)	November 09-13, 2021	Baseline measurement of biting behaviors under hypothesized functional conditions (demand & tangible conditions for other-directed biting behavior; alone condition for self-inflicted biting behavior)
	Treatment Sessions 6-10 (*introduction of behavioral treatment*)	November 14-18, 2021	Introduction of treatment with recording of biting behaviors: Demand condition – completion of tasks with prompt and immediate reward after a biting behavior Tangible condition – obtaining preferred object after requesting through PECS; withholding preferred object after a biting behavior Alone condition - self-inflicted biting behavior is blocked and redirected to an oral sensory activity (automatic reinforcement)
	Treatment Sessions 11-15 (*return to baseline*)	November 19-23, 2021	Suspension of treatment with recording of biting behaviors: Demand condition – termination of task after a biting behavior Tangible condition – obtaining preferred object after a biting behavior Alone condition - self-inflicted biting behavior is blocked but without redirection to an oral sensory activity
	Treatment Sessions 16-20 (*reintroduction of treatment*)	November 24-28, 2021	Reintroduction of treatment with recording of biting behaviors: Demand condition – completion of tasks with prompt and immediate reward after a biting behavior Tangible condition – obtaining preferred object after requesting through PECS; withholding preferred object after a biting behavior Alone condition - self-inflicted biting behavior is blocked and redirected to an oral sensory activity (automatic reinforcement)

Results

Results of the functional analysis (assessment phase) are illustrated in Figure 1. There are elevated rates of biting behavior during the demand (escape function; M=3.46 rpm; range, 3–4.0 rpm), tangible (tangible function; M=3.35 rpm; range, 2.7–3.85 rpm), and alone (sensory function; M=3.65 rpm; range, 3.25–3.9 rpm) conditions, and low to zero rates in the attention (M=0.42 rpm; range, 0–1 rpm) and play (M=0.27 rpm; range, 0–0.5 rpm) conditions. Interestingly, only self-inflicted biting was observed in the alone condition. In summary, the functional analysis suggests that the child's biting behavior inflicted on others was maintained by escape from demands and by access to tangible items, while the child's biting behavior inflicted on the self was maintained by sensory stimulation.

Treatment results are illustrated in Figures 2, 3, 4, and 5. The initial baseline phase consisted of the relevant functional analysis conditions (i.e., demand, tangible, and alone). The child exhibited moderate rates of biting behavior in the demand condition (M=4.48 rpm; range, 4.0–5.0 rpm), moderate rates in the tangible condition (M=4.4 rpm; range, 4.0.–5.4 rpm), and low to moderate rates in the alone condition (M=3.9 rpm; range, 3.2.–4.8 rpm). Furthermore, at baseline, the child did not appropriately request for desired food, object, or activity in the tangible conditions, with a 0-10% rate of compliance in the demand conditions and no instances of engaging in appropriate oral sensory activities in the alone conditions. The first treatment phase consisted of DRA + tangible EXT sessions (i.e., appropriate requests for food, object, or activity were reinforced, and biting behavior was placed on EXT), DRA + escape EXT sessions (i.e., compliance was reinforced with a small edible item and biting behavior was no longer followed by task termination), and DRA + sensory EXT sessions (i.e., biting behavior is blocked followed by a redirection to oral massage and stimulation). In the first introduction of the DRA + tangible EXT and DRA + escape EXT sessions, there were elevated rates of biting behavior (6.1 rpm and 6.6.

rpm, respectively). Nonetheless, a decreasing trend in the rates of biting behaviors was observed in the subsequent DRA + tangible EXT (M=3.52 rpm; range, 1.5–6.1 rpm), DRA + escape EXT (M=4.2 rpm; range, 2.0–6.6 rpm), and DRA + sensory EXT (M=1.14 rpm; range, 1.0–1.3 rpm) sessions. Furthermore, there is a considerable increase in requests (M=4.6; range, 4.0–5.8), increase in the rate of compliance (M=56.6%; range, 42% to 78%), and an increase in the use of appropriate oral sensory activity (M=5.68; range, 4.5–7.0) during this phase. A reversal to baseline yielded a noticeable increase in biting behavior for the demand, tangible, and alone conditions, as well as concurrent reductions in compliance, requests, and appropriate self-stimulatory behavior. Reinstating the DRA + EXT treatment sessions led to a notable decrease in biting behaviors across all conditions (M=0.55 rpm; range, 0–3 rpm), increased rate of compliance (M=83%; range, 66% to 95%), increased frequency of requests (M=7.28; 6.6-8.0), and increased use of appropriate self-stimulatory behaviors (M=7.26; 7.0-8.0).

Overall, there was a 46% reduction of biting behaviors in the demand condition, 62% reduction of biting behaviors in the tangible condition, 86% reduction of biting behaviors in the alone condition (mean baseline reduction as a measure of effect size was calculated by getting the difference between mean baseline and mean intervention then dividing it by the mean baseline and multiplying it by 100). Furthermore, in line with the decrease in biting behaviors is an increase in maladaptive behaviors (appropriate use of pictures when requesting, compliance to tasks, and appropriate self-stimulatory behaviors).

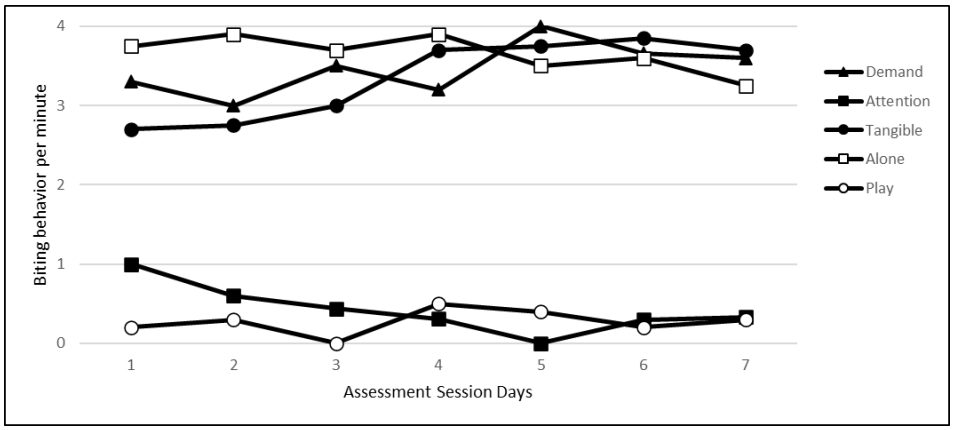

Figure 1. Responses per minute of biting behavior during demand, attention, tangible, alone, and play conditions.

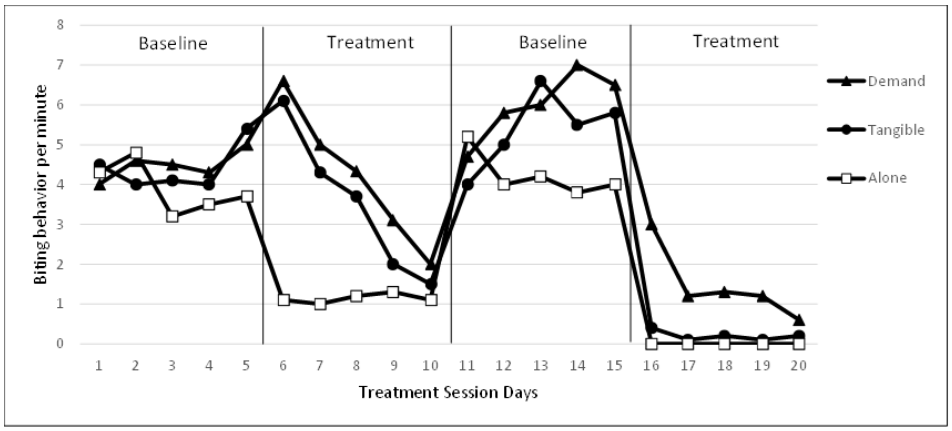

Figure 2. Responses per minute of biting behavior during demand, tangible, and alone conditions.

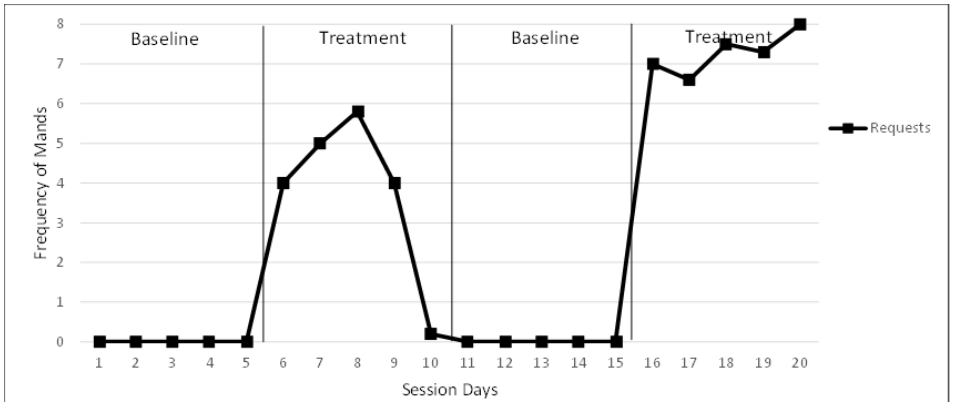

Figure 3. Frequency of picture-assisted requests per tangible conditions.

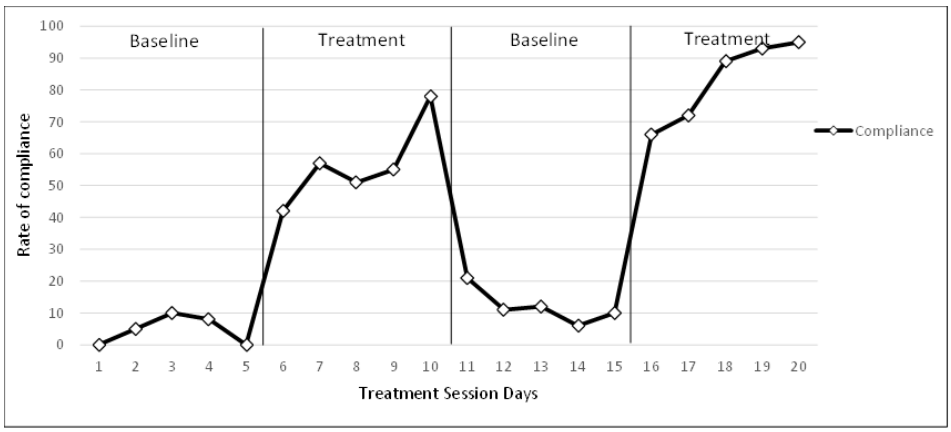

Figure 4. Rate of compliance per demand conditions.

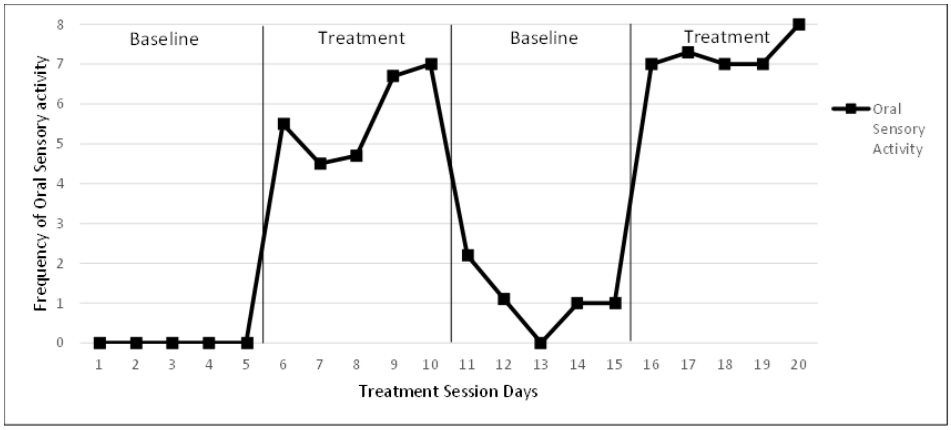

Figure 5. Frequency of appropriate self-stimulatory behavior per sensory conditions.

Discussion

Applied behavior analysis as an assessment and intervention method was effective in targeting the self-directed and other-directed biting behavior of the child. After distinguishing the functions of self-directed and other-directed biting behaviors, an appropriate treatment was established.

Interesting observations and insights arose throughout the treatment process. There is a noteworthy increase in biting behavior in the demand and tangible conditions during the initial sessions of the treatment phase. This would make sense given that a behavior intervention is being introduced (e.g., biting behaviors no longer followed task termination and access to any item, the child is prompted to complete the task and use pictures to request preferred items). These novel changes interact with the nature of autism – those children with autism, most often, exhibit insistence on sameness with rigid adherence to rituals and routines, making them resistant to change [22]. Therefore, an increase in biting behavior during the initial treatment session may be viewed as an expected response to the change. No increase in biting behavior was noted during the initial treatment session in the alone condition because of immediate behavior redirection from biting attempts to oral massage. Moreover, the fact that other-inflicted biting behaviors were reinforced by escape from tasks and access to preferred items or activity means that biting someone else (e.g., caregiver or *yaya*) is a way to communicate either refusal to do a particular task or request to obtain a desired object. Since the child is non-verbal (unable to utilize language), a way to communicate was learned through biting behaviors. Hence, a picture-exchange communication system, also known as PECS, is essential to establish a more adaptive means for communication.

While this study established the effectiveness of an intervention based on the principles of applied behavior analysis, directions for further treatment progress are recommended. First, the PECS was an effective tool in facilitating communication in the form of requests, especially in tangible conditions. This can be utilized further to add pictures to facilitate expression of refusal (e.g., "no" or "I don't want" visual cues) or demand for breaks (e.g., "I want to take a break" visual cues) particular to the demand conditions. While it is great that compliant behaviors are established, it would enhance a sense of autonomy for the child if he can also express refusal when presented with a task and/or demand short breaks during a task. Consistent with the goal of introducing adaptive behaviors, instead of engaging in biting behaviors, the PECS can be used. This would then facilitate the expansion of the child's verbal repertoire that can be used in various situations. Next, a continuous reinforcement schedule was utilized in the intervention program. To prevent dependencies on rewards just to engage in appropriate behaviors, thinning the reinforcement schedule would be the next logical step [23]. As the child showed sustained improvements in compliance with demand conditions and low rates of biting behaviors, task requirements may be systematically extended, requiring completion of a

greater number of tasks before providing the reward. Likewise, for tangible conditions, a sense of discipline may be instilled in the child [24]. While consistent use of PECS to communicate requests may be reinforced, it would be more beneficial for the child to learn the appropriate time and place of using objects, toys, or engaging in activities that he requested through PECS. The child should also learn that not all the time, requests are automatically granted. A daily visual schedule may be implemented to facilitate discrimination of times when requests for particular objects or activities will be granted (e.g., requests for food will be granted during mealtime and requests for toys or other activities will be granted during playtime). Lastly, parent and caregiver (*yaya*) coaching should be implemented as well to ensure consistent application of the behavioral treatment program. The mother and *yaya* should be aware of how to address the child's biting behaviors and reward the child's appropriate behaviors. Research has shown that parent involvement in the child's intervention leads to positive outcomes for adaptive skills and social behaviors [25]. It is imperative that therapists not only implement ABA interventions but also communicate these programs to other care providers, especially parents and caregivers.

There are also limitations to this case study that are worth noting. The case was limited only to targeting a maladaptive behavior such as biting at the home setting. The generalized effects of the behavioral treatment cannot be guaranteed unless functional analysis was also done in other settings where biting behaviors may occur. It would provide either a new or supportive layer of context if different or similar functions of biting behavior can be assessed in other situations. Moreover, the basic effectiveness of applied behavior analysis was based on the twenty-day intervention period. Consistent follow-throughs and continuation of intervention by the mother and *yaya* must be ensured. It is not only important to establish effectiveness (in terms of reduction of problem behaviors and improvement of adaptive behaviors) but also to establish stability of long-term gains. Even though the treatment continued, any subsequent data were no longer used for the purposes of this study.

Conclusion

This case study laid out the assessment and treatment processes in addressing biting behaviors exhibited by a 9-year-old Filipino boy diagnosed with autism spectrum disorder. Results of the functional analysis indicated that other-inflicted biting behaviors were maintained by escape from task demands and access to preferred items, while self-inflicted biting behaviors were automatically reinforced by sensory stimulation. The results informed the behavioral treatment plan, which consisted of DRA (compliance) + escape EXT for biting behaviors that occurred in the context of demands, DRA (request) + tangible EXT for biting behaviors maintained by access to preferred items and/or activity, and DRA (oral stimulation) + sensory EXT for biting behaviors that are automatically reinforced. In summary, relative to baseline levels, the child demonstrated a 46% reduction in escape-maintained biting behaviors, 62% reduction in access to items-maintained biting behaviors, and 86% reduction in automatically reinforced biting behaviors. The reversal (ABAB) design provided evidence to the effectiveness of the behavior intervention in not only reducing biting behaviors but also improving adaptive behaviors. This study demonstrated the value of utilizing a behavioral analytic approach to the treatment of problematic, aggressive behaviors for children with autism spectrum disorder.

Conflict of Interest

The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval

This case study upheld all ethical principles in conducting research. Written informed consent was provided and signed by the child's mother - emphasizing that data gathering, monitoring, and observations are part of the intervention and research protocols. The entire intervention and research process were conducted by licensed clinical psychologists with expertise in neurodevelopmental disorders. All information gathered in this study were kept confidential. After the data gathering, the intervention was continued as part of the services offered in the therapy center, from which any succeeding data were no longer used for the purposes of this research.

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References

1. Christiansz JA, Gray KM, Taffe J, Tonge BJ. Autism Spectrum Disorder in the DSM-5: Diagnostic Sensitivity and Specificity in Early Childhood. J Autism Dev Disord. 2016;46(6):2054-63. https://doi.org/10.1007/s10803-016-2734-4
2. Fulton E, Eapen V, Crnčec R, Walter A, Rogers S. Reducing maladaptive behaviors in preschool-aged children with autism spectrum disorder using the early start denver model. Front Pediatr. 2014;2:40. https://doi.org/10.3389/fped.2014.00040
3. Horner RH, Carr EG, Strain PS, Todd AW, Reed HK. Problem behavior interventions for young children with autism: a research synthesis. J Autism Dev Disord. 2002;32(5):423-46. https://doi.org/10.1023/a:1020593922901
4. Samson AC, Hardan AY, Lee IA, Phillips JM, Gross JJ. Maladaptive Behavior in Autism Spectrum Disorder: The Role of Emotion Experience and Emotion Regulation. J Autism Dev Disord. 2015;45(11):3424-32. https://doi.org/10.1007/s10803-015-2388-7
5. Clark KR. Learning Theories: Behaviorism. Radiol Technol. 2018;90(2):172-5.
6. Wolf M, Risley T, Johnston M, Harris F, Allen E. Application of operant conditioning procedures to the behavior problems of an autistic child: a follow-up and extension. Behav Res Ther. 1967;5(2):103-11. https://doi.org/10.1016/0005-7967(67)90004-6
7. Williams BF, Williams RL. Effective programs for treating autism spectrum disorder : applied behavior analysis models. New York: Routledge; 2011.
8. Fuller EA, Oliver K, Vejnoska SF, Rogers SJ. The Effects of the Early Start Denver Model for Children with Autism Spectrum

Disorder: A Meta-Analysis. Brain Sci. 2020;10(6). https://doi.org/10.3390/brainsci10060368
9. Dyrbjerg P, Vedel M, ProQuest. Everyday education : visual support for children with autism. London ; Philadelphia: Jessica Kingsley Publishers; 2007.
10. Matson JL, Matson JL, SpringerLink. Applied Behavior Analysis for Children with Autism Spectrum Disorders. 1st 2009. ed. New York, NY: Springer New York : Imprint: Springer; 2009.
11. Foxx RM. Applied behavior analysis treatment of autism: the state of the art. Child Adolesc Psychiatr Clin N Am. 2008;17(4):821-34, ix. https://doi.org/10.1016/j.chc.2008.06.007
12. Yu Q, Li E, Li L, Liang W. Efficacy of Interventions Based on Applied Behavior Analysis for Autism Spectrum Disorder: A Meta-Analysis. Psychiatry Investig. 2020;17(5):432-43. https://doi.org/10.30773/pi.2019.0229
13. Makrygianni MK, Gena A, Katoudi S, Galanis P. The effectiveness of applied behavior analytic interventions for children with Autism Spectrum Disorder: A meta-analytic study. Research in Autism Spectrum Disorders. 2018;51:18-31. https://doi.org/10.1016/j.rasd.2018.03.006
14. Iwata BA, Dorsey MF, Slifer KJ, Bauman KE, Richman GS. Toward a functional analysis of self-injury. J Appl Behav Anal. 1994;27(2):197-209. https://doi.org/10.1901/jaba.1994.27-197
15. Hanley GP, Iwata BA, McCord BE. Functional analysis of problem behavior: a review. J Appl Behav Anal. 2003;36(2):147-85. https://doi.org/10.1901/jaba.2003.36-147
16. Saini V, Fisher WW, Retzlaff BJ, Keevy M. Efficiency in functional analysis of problem behavior: A quantitative and qualitative review. J Appl Behav Anal. 2020;53(1):44-66. https://doi.org/10.1002/jaba.583
17. Pelios L, Morren J, Tesch D, Axelrod S. The impact of functional analysis methodology on treatment choice for self-injurious and aggressive behavior. J Appl Behav Anal. 1999;32(2):185-95. https://doi.org/10.1901/jaba.1999.32-185
18. Bailey JS, Burch MR. Research methods in applied behavior analysis. 2nd edition. ed. New York: Routledge; 2018. xxi, 234 pages p.
19. Flippin M, Reszka S, Watson LR. Effectiveness of the Picture Exchange Communication System (PECS) on communication and speech for children with autism spectrum disorders: a meta-analysis. Am J Speech Lang Pathol. 2010;19(2):178-95. https://doi.org/10.1044/1058-0360(2010/09-0022)
20. Baranek GT. Efficacy of sensory and motor interventions for children with autism. J Autism Dev Disord. 2002;32(5):397-422. https://doi.org/10.1023/a:1020541906063
21. Manoharan AKAaAMaA. Addressing Oral Sensory Issues and Possible Remediation in Children with Autism Spectrum Disorders: Illustrated with a Case Study. International Journal of Medical and Health Sciences. 2016;10(7):400-3. https://doi.org/10.5281/zenodo.1126347
22. Sevin JA, Rieske RD, Matson JL. A Review of Behavioral Strategies and Support Considerations for Assisting Persons with Difficulties Transitioning from Activity to Activity. Review Journal of Autism and Developmental Disorders. 2015;2(4):329-42. https://doi.org/10.1007/s40489-015-0056-7
23. Hammond JL, Hall SS. Functional analysis and treatment of aggressive behavior following resection of a craniopharyngioma. Dev Med Child Neurol. 2011;53(4):369-74. https://doi.org/10.1111/j.1469-8749.2010.03887.x
24. Hanley GP, Iwata BA, Thompson RH. Reinforcement schedule thinning following treatment with functional communication training. J Appl Behav Anal. 2001;34(1):17-38. https://doi.org/10.1901/jaba.2001.34-17
25. Helton MR, Alber-Morgan SR. Helping Parents Understand Applied Behavior Analysis: Creating a Parent Guide in 10 Steps. Behav Anal Pract. 2018;11(4):496-503. https://doi.org/10.1007/s40617-018-00284-8