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Natural Environment Teaching for Functional Communication in Children with Speech Delay

Pembelajaran dalam Lingkungan Alamiah untuk Komunikasi Fungsional pada Anak dengan Keterlambatan Bicara

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Abstract

This study evaluates the efficacy of Natural Environment Teaching (NET) in enhancing functional communication for children with speech delay. Utilizing a rigorous ABAB single-subject experimental design, the investigation focused on a four-year-old male diagnosed with Language Disorder. Results demonstrated a clinically significant elevation in Functional Communication Responses (FCR), with mean frequencies escalating from 2.4 at baseline to 11.4 during the final intervention phase. Visual analysis confirmed a robust functional relationship, supported by 0% data overlap and Non-Overlap of All Pairs (NAP) values between 0.96 and 1.00. Furthermore, the participant exhibited a systematic reduction in prompt dependency and successful generalization of communicative gains to domestic settings and unfamiliar partners. Concomitant decreases in maladaptive behaviors suggest that NET effectively replaces non-verbal topographies with functional verbal repertoires. These findings strongly validate NET as a scalable, ecologically valid intervention model particularly suited for the Indonesian clinical landscape where specialized therapeutic resources remain highly limited.

Abstrak

Penelitian ini mengevaluasi efikasi Natural Environment Teaching (NET) dalam meningkatkan komunikasi fungsional bagi anak dengan keterlambatan bicara. Menggunakan desain eksperimental subjek-tunggal ABAB yang ketat, investigasi ini berfokus pada seorang anak laki-laki berusia empat tahun dengan diagnosis Gangguan Bahasa. Hasil penelitian menunjukkan peningkatan signifikan secara klinis pada Respons Komunikasi Fungsional (FCR), dengan frekuensi rata-rata melonjak dari 2,4 saat prapantau menjadi 11,4 selama fase intervensi akhir. Analisis visual mengonfirmasi hubungan fungsional yang kuat, didukung oleh 0% tumpang tindih data dan nilai Non-Overlap of All Pairs (NAP) antara 0,96 hingga 1,00. Selain itu, partisipan menunjukkan pengurangan sistematis pada ketergantungan bantuan dan keberhasilan generalisasi perolehan komunikatif ke lingkungan domestik serta mitra yang belum dikenal. Penurunan perilaku maladaptif yang menyertai menyarankan bahwa NET secara efektif menggantikan topografi nonverbal dengan repertoar verbal fungsional. Temuan ini memvalidasi NET sebagai model intervensi yang skalabel dan valid secara ekologis, terutama sesuai bagi lanskap klinis Indonesia saat sumber daya terbatas.

A. INTRODUCTION

1. Background

Speech delay, defined as a significant lag in the acquisition of expressive and receptive language skills relative to chronological age expectations, constitutes one of the most prevalent developmental concerns in pediatric clinical practice. Epidemiological studies consistently report prevalence rates ranging from 5% to 12% among preschool-aged children; however, these estimates vary depending on the specific definitional criteria and assessment instruments employed.[1] In Indonesia, the escalating demand for early intervention services at specialized facilities, such as the Yamet Child Development Center in Jakarta, underscores the substantial burden that speech delay imposes on familial units, educational frameworks, and healthcare systems.[2]

According to the criteria established by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM-5-TR), speech and language delays are categorized into several distinct diagnostic entities, including Language Disorder (F80.9), Speech Sound Disorder (F80.0), and Social (Pragmatic) Communication Disorder (F80.89).[3] Language Disorder is characterized by persistent deficits in the acquisition and utilization of language across diverse modalities, resulting in functional impairments in communication and academic achievement. Longitudinal data indicate that approximately 25–60% of children identified with language delay at age two exhibit sustained difficulties upon school enrollment, thereby underscoring the critical necessity of early, high-intensity intervention.[4]

Children with speech delays frequently exhibit a constricted repertoire of functional verbal operants as operationalized within Skinner's verbal behavior framework. These deficits typically encompass a limited capacity to request desired items (mands), label environmental stimuli (tacts), and engage in reciprocal verbal exchanges (intraverbals)

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[1] Eileen Haebig, Jenny R. Saffran, and Susan Ellis Weismer, "Statistical Word Learning in Children with Autism Spectrum Disorder and Specific Language Impairment," *Journal of Child Psychology and Psychiatry* 58, no. 11 (November 2, 2017): 1251–63, https://doi.org/10.1111/jcpp.12734.

[2] Sharynne McLeod and Kathryn Crowe, "Children's Consonant Acquisition in 27 Languages: A Cross-Linguistic Review," *American Journal of Speech-Language Pathology* 27, no. 4 (November 21, 2018): 1546–71, https://doi.org/10.1044/2018_AJSLP-17-0100.

[3] American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. (Washington, DC: American Psychiatric Association Publishing, 2022), Page, 55. https://doi.org/10.1176/appi.books.9780890425787.

[4] Mary R McLaughlin, "Speech and Language Delay in Children," *American Family Physician* 83, no. 10 (2011): 1183–88.

in response to the verbal behavior of others.[5] These limitations exert significant consequences that transcend linguistic deficits; specifically, affected children frequently manifest a higher incidence of maladaptive behaviors, including tantrums, aggression, and self-injury. Within clinical frameworks, such behaviors are widely interpreted as functional communicative acts employed in the absence of established verbal topographies.[6,7]

Conventional intervention paradigms for speech delay have historically prioritized Discrete Trial Training (DTT). Although DTT demonstrates significant efficacy in early-stage skill acquisition, a recurrent constraint involves the restricted generalizability of these skills to naturalistic, everyday environments.[8,9] Natural Environment Teaching (NET), a core component of the Naturalistic Developmental Behavioral Interventions (NDBI) framework, directly mitigates generalization deficits by embedding instructional opportunities within the child's ecologically valid routines and play-based interactions.[10] NET is conceptually anchored in the principles of Applied Behavior Analysis (ABA) specifically Motivating Operations (MOs), differential reinforcement, and systematic prompt fading while simultaneously prioritizing child-led interactions and ecologically valid learning contexts.[11]

The empirical foundation supporting NET and associated NDBI paradigms has expanded considerably in recent years. A landmark meta-analysis of 120 studies involving 5,765 children, conducted by Sandbank et al., demonstrated statistically significant improvements in expressive language (g = 0.31), social interaction (g = 0.28),

[5] Burrhus Frederic Skinner, *Verbal Behavior* (New York: Appleton-Century-Crofts, 2014). Page, 40.
[6] Jeffrey H Tiger, Gregory P Hanley, and Jennifer Bruzek, "Functional Communication Training: A Review and Practical Guide," *Behavior Analysis in Practice* 1, no. 1 (June 1, 2008): 16–23, https://doi.org/10.1007/BF03391716.
[7] Nancy C Brady et al., "Communication Services and Supports for Individuals With Severe Disabilities: Guidance for Assessment and Intervention," *American Journal on Intellectual and Developmental Disabilities* 121, no. 2 (March 1, 2016): 121–38, https://doi.org/10.1352/1944-7558-121.2.121.
[8] John O Cooper, Timothy E Heron, and William L Heward, *Applied Behavior Analysis* (New York: Pearson Education, 2020). Page, 104.
[9] Michelle A. Frank-Crawford et al., "Discrete-trial Teaching: A Scoping Review," *Behavioral Interventions* 39, no. 3 (July 23, 2024), https://doi.org/10.1002/bin.2012.
[10] Laura Schreibman et al., "Naturalistic Developmental Behavioral Interventions: Empirically Validated Treatments for Autism Spectrum Disorder," *Journal of Autism and Developmental Disorders* 45, no. 8 (August 4, 2015): 2411–28, https://doi.org/10.1007/s10803-015-2407-8.
[11] Jiedi Lei and Pamela Ventola, "Pivotal Response Treatment for Autism Spectrum Disorder: Current Perspectives," *Neuropsychiatric Disease and Treatment* Volume 13 (June 2017): 1613–26, https://doi.org/10.2147/NDT.S120710.

and adaptive behavior (g = 0.2).[12] Corroborating these findings, Tiede and Walton reported a robust pooled effect size of g = 0.42 across 23 NDBI investigations, further validating the clinical utility of naturalistic behavioral approaches in enhancing developmental outcomes.[13] In a randomized controlled trial, Gengoux et al. demonstrated that Pivotal Response Treatment (PRT) yielded significant enhancements in spontaneous communication (d = 0.71), with these gains being effectively maintained at a three-month follow-up assessment.[14] Furthermore, Kaiser and Roberts demonstrated that parent-implemented Enhanced Milieu Teaching (EMT) yielded a substantial effect size of d = 0.68 for spoken language outcomes, underscoring the efficacy of caregiver-mediated naturalistic interventions in promoting linguistic development.[15]

The neurobiological mechanisms underlying the efficacy of NET have increasingly become the focus of empirical inquiry. Notably, Mundy and Mastergeorge established that joint attention training induces measurable neuroplastic changes within social cognition networks, particularly involving the activation and connectivity of the superior temporal sulcus (STS).[16] Kuhl reviewed empirical evidence indicating that learning situated within motivationally salient social contexts preferentially recruits dopaminergic reward pathways a neural activation pattern often absent during repetitive massed-trial practice. This divergence in neurological recruitment provides a mechanistic explanation for the superior generalization outcomes observed in Natural Environment Teaching (NET) compared to traditional structured protocols.[17] A robust consensus within the NDBI literature underscores that parental involvement is indispensable for the attainment of optimal developmental outcomes. Specifically, a Cochrane systematic review conducted by Oono et al. demonstrated that parent-mediated interventions yield significant

[12] Micheal Sandbank et al., "Project AIM: Autism Intervention Meta-Analysis for Studies of Young Children.," *Psychological Bulletin* 146, no. 1 (January 2020): 1–29, https://doi.org/10.1037/bul0000215.
[13] Gina Tiede and Kristen M Walton, "Meta-Analysis of Naturalistic Developmental Behavioral Interventions for Young Children with Autism Spectrum Disorder," *Autism* 23, no. 8 (2019): 2080–95, https://doi.org/10.1177/1362361319836182.
[14] Grace W Gengoux et al., "A Pivotal Response Treatment Package for Children With Autism Spectrum Disorder: An RCT," *Pediatrics* 144, no. 3 (September 1, 2019): e2020021330, https://doi.org/10.1542/peds.2019-0178.
[15] Ann P Kaiser and Megan Y Roberts, "Parent-Implemented Enhanced Milieu Teaching with Preschool Children Who Have Intellectual Disabilities," *Journal of Speech, Language, and Hearing Research* 56, no. 1 (2013): 295–309, https://doi.org/10.1044/1092-4388(2012/11-0231).
[16] Peter Mundy and Amanda Mastergeorge, "A Review of Joint Attention and Social-Cognitive Brain Systems in Typical Development and Autism Spectrum Disorder," *European Journal of Developmental Psychology* 9, no. 2 (2012): 129–46, https://doi.org/10.1080/1080/17405629.2012.655786.
[17] Patricia K Kuhl, "Early Language Acquisition: Cracking the Speech Code," *Nature Reviews Neuroscience* 5, no. 11 (November 2004): 831–43, https://doi.org/10.1038/nrn1533.

enhancements in child communication, provided that caregivers are proficiently trained to implement naturalistic strategies with high procedural fidelity.[18]

Notwithstanding significant advancements in behavioral intervention science, substantial challenges persist in the clinical management of speech delays. A primary concern involves generalization deficits, wherein skills acquired within highly structured therapeutic environments frequently fail to transfer to the child's naturalistic home, educational, and community settings. Furthermore, the diminished intrinsic motivation often associated with traditional, top-down instructional models may inadvertently suppress spontaneous communicative initiations. In the Indonesian context, therapeutic intensity is further constrained by logistical and socio-economic barriers, limiting the frequency of clinic-based sessions available to most families. These cumulative challenges underscore the imperative for an evidence-based, caregiver-implemented approach that is both ecologically valid and demonstrably effective in enhancing functional communication. Although the NDBI evidence base continues to expand globally, systematic data derived from single-subject experimental designs within Indonesian pediatric clinical settings remain conspicuously absent from the international literature a critical gap that the current study seeks to address.

2. Research Questions

This study was guided by the following research questions:

a. To what extent does Natural Environment Teaching (NET) elicit a clinically significant increase in the frequency of functional communicative responses in a child diagnosed with Language Disorder, as evaluated through a controlled ABAB single-subject experimental design?

b. Do prompt dependency levels exhibit a systematic reduction across NET intervention phases, reflecting the acquisition of communicative autonomy?

c. To what extent do communicative gains achieved during clinic-based NET sessions generalize to the domestic environment and unfamiliar communicative partners?

[18] Inalegwu P Oono, Emma J Honey, and Helen McConachie, "Parent-Mediated Early Intervention for Young Children with Autism Spectrum Disorders (ASD)," *Cochrane Database of Systematic Reviews* 2013, no. 10 (April 30, 2013): CD009774, https://doi.org/10.1002/14651858.CD009774.pub2.

3. Research Methods

The present investigation utilized a single-subject experimental design (SSED) employing an ABAB withdrawal (reversal) framework. The selection of the ABAB paradigm was predicated on its capacity to facilitate a rigorous visual and quantitative evaluation of the functional relationship between the independent variable (NET implementation) and the dependent variable (frequency of functional communication). By systematically withdrawing and subsequently reintroducing the intervention, this design establishes experimental control while mitigating common threats to internal validity, such as maturation and historical confounding. The experimental sequence comprised four distinct phases: A1 (initial baseline; absence of NET), B1 (primary NET intervention), A2 (withdrawal; return to baseline conditions), and B2 (reintroduction of the NET intervention).[19]

a. Participant and Setting

The participant, a male aged 4 years and 8 months (pseudonymously referred to as A.R.), was diagnosed with Language Disorder (DSM-5-TR F80.9). This clinical profile was substantiated through a comprehensive psychological evaluation, including the Preschool Language Scale, Fifth Edition (PLS-5). Differential diagnostic procedures utilizing the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) ruled out Autism Spectrum Disorder (ASD), and audiological screening confirmed auditory acuity within normal limits. During the baseline phase, A.R.'s expressive capabilities were restricted to the single-word level with negligible spontaneity; communicative efforts primarily relied on non-verbal topographies, such as leading caregivers by the hand, crying, and pointing without accompanying vocalizations. Inclusion criteria comprised: (1) a confirmed diagnosis of Language Disorder without comorbid ASD or auditory impairment; (2) expressive language functioning at or below the single-word level; (3) informed written parental consent; and (4) the capacity to maintain engagement in play-based activities for a minimum of 10 minutes.

Experimental sessions were conducted across two ecologically valid environments. Primary sessions (encompassing all four phases) took place in a child-centered therapy room at the Yamet Child Development Center in Jakarta, which was arranged to simulate

[19] Robert H Horner et al., "The Use of Single-Subject Research to Identify Evidence-Based Practice in Special Education," *Exceptional Children* 71, no. 2 (January 1, 2005): 165–79, https://doi.org/10.1177/001440290507100203.

a naturalistic play environment. Generalization sessions, conducted during the B1 and B2 phases, occurred within the participant's home to evaluate the transfer of skills to the domestic environment, with the primary caregiver implementing the NET protocol under therapist supervision and coaching.

b. Measurement and Inter-observer Agreement

The primary dependent variable was the frequency of Functional Communication Responses (FCRs) per session. An FCR was operationally defined as any instance of verbal approximation, intelligible word/word combination, or intentional vocalization immediately preceded (within 5 seconds) by a communicative gesture (e.g., pointing, reaching, or eye contact) in response to a naturalistic communicative opportunity. Non-functional vocalizations and physical acts lacking vocal components were excluded. A secondary dependent variable was the level of instructional support required to occasion each FCR, recorded using a five-level prompt hierarchy: 5 (physical prompt), 4 (verbal model), 3 (indirect verbal), 2 (gestural), and 1 (independent).

To establish inter-observer agreement (IOA), a second trained observer independently coded 30% of the sessions (n = 8) selected randomly across all phases. IOA was calculated using point-by-point agreement, yielding a mean of 87.3% (range: 83.1%–91.7%), which exceeds the recommended 80% threshold for SSED research. Cohen's Kappa was calculated at $\kappa = 0.84$, indicating strong agreement beyond chance.

c. Experimental Design and Procedure

This study employed a single-subject experimental design (SSED) using an ABAB withdrawal framework to evaluate the functional relationship between NET implementation and FCR frequency. The design consisted of four phases: A1 (initial baseline), B1 (primary NET intervention), A2 (withdrawal of intervention), and B2 (reintroduction of NET). The NET protocol was operationalized based on the frameworks established by Koegel et al. and Schreibman et al., comprising: (1) a three-session pairing phase; (2) pre-session free-operant preference assessments; (3) environmental arrangement to elicit communicative needs; (4) naturalistic teaching trials utilizing active Motivating Operations (MOs) with a 3–5 second time delay; and (5) structured caregiver-mediated generalization coaching.

d. Ethical Monitoring and Data Analysis

Ethical safeguards prioritized the participant's welfare; monitoring criteria specified that if FCR frequency dropped below baseline for two consecutive sessions or if

the participant exhibited significant distress, the withdrawal phase would be terminated and B2 initiated immediately. Data were evaluated via visual inspection examining level, trend, variability, and overlap. To complement visual analysis, the Non-Overlap of All Pairs (NAP) statistic was calculated. NAP values > 0.80 were considered indicative of a clinically meaningful and robust intervention effect.[20]

B. DISCUSSION

1. Outcomes of the Natural Environment Teaching (NET) Intervention on Functional Communication

a. Frequency of Functional Communication Responses Across Experimental Phases

Table 1 summarizes the frequency of FCRs per session across all four experimental phases. During the initial baseline (A1), FCR frequency was characterized by low and stable levels (M = 2.4; range: 2–3) with no discernible trend. This data pattern underscores the participant's restricted spontaneous communicative repertoire prior to the implementation of NET protocols.

Table 1. Summary of Functional Communication Response Data Across ABAB Phases

Phase	n	FCR Range	FCR Mean (±SD)	Dominant Prompt Level	NAP
A1 — Baseline	5	2–3	2.4 (±0.5)	Level 5 (Physical)	—
B1 — NET Intervention 1	8	5–10	8.0 (±1.7)	Level 2–3 (Gesture–Verbal)	0.96
A2 — Withdrawal	5	3–5	3.8 (±0.9)	Level 3–5 (Verbal–Physical)	—
B2 — NET Reintroduction	8	7–15	11.4 (±2.6)	Level 1–2 (Independent–Gesture)	1.00

Note. FCR = Functional Communication Response; S^D = Standard Deviation; NAP = Non-Overlap of All Pairs (calculated against A1 baseline; values > 0.80 indicate a clinically meaningful effect). Prompt levels: 1 = Independent, 2 = Gestural, 3 = Indirect Verbal, 4 = Verbal Model, 5 = Physical Prompt.

[20] Richard I. Parker and Kimberly Vannest, "An Improved Effect Size for Single-Case Research: Nonoverlap of All Pairs," *Behavior Therapy* 40, no. 4 (December 2009): 357–67, https://doi.org/10.1016/j.beth.2008.10.006.

Intervention Phase (B1): The introduction of NET in phase B1 resulted in an immediate and clinically significant elevation in FCR frequency. The mean frequency rose to 8.0 responses per session (range: 5–10), representing an approximate 233% increase relative to the A1 baseline mean. Furthermore, a consistent upward trend was observed across all eight intervention sessions, indicating rapid acquisition of functional communicative behaviors under naturalistic contingencies.

Withdrawal Phase (A2): Upon the withdrawal of NET procedures in phase A2, FCR frequency regressed toward baseline parameters, yielding a mean of 3.8 responses per session (range: 3–5). An immediate downward trend was observable from the onset of this phase. This regression establishes a clear functional relationship between the NET protocol and the elevated communicative output observed in B1. However, the failure of the data to return completely to A1 baseline levels suggests partial retention of acquired skills or residual effects of the Motivating Operations (MOs) established during the preceding intervention phase.

Reintroduction Phase (B2): Following the reintroduction of NET in phase B2, FCR frequency recovered rapidly and subsequently surpassed B1 levels, achieving a mean of 11.4 responses per session (range: 7–15). This phase was characterized by a robust upward trend and increasing stability in the final sessions. These findings are consistent with cumulative learning effects and suggest that the reintroduction of naturalistic reinforcement schedules effectively bolstered the participant's communicative autonomy.

b. Visual Analysis

Visual inspection of the graphed data across all four experimental phases revealed robust and unambiguous patterns supporting a functional relationship between the NET intervention and FCR frequency. A clinically significant upward level shift in mean FCR frequency was observed at each A→B phase transition, with mean values increasing from 2.4 in A1 to 8.0 in B1, and subsequently from 3.8 in A2 to 11.4 in B2. Conversely, a distinct downward level shift at the B1→A2 transition (8.0 to 3.8) confirmed the functional relationship through systematic replication of the effect. Regarding trend and variability, the initial baseline (A1) exhibited a stable, near-zero slope with minimal variability, whereas the primary intervention phase (B1) demonstrated a consistent upward trajectory across all eight sessions. Upon the cessation of NET procedures in A2, a clear downward trend emerged immediately, which was followed by a strong, accelerating

upward trend upon reintroduction in B2, suggesting that naturalistic contingencies facilitated rapid communicative recovery. These visual findings were further substantiated by a complete lack of data overlap (0%) between the respective baseline and intervention phases, corresponding to Non-Overlap of All Pairs (NAP) statistics of NAP = 0.96 (A1 vs. B1) and NAP = 1.00$ (A2 vs. B2). Since both values substantially exceed the 0.80 interpretive threshold, the results provide compelling evidence of a functional relationship between the NET protocol and improved functional communication in the participant.

c. Prompt Dependency Reduction

A significant secondary outcome involved the systematic attenuation of instructional support (prompt levels) required to elicit FCRs throughout the intervention phases. During the initial baseline (A1), a substantial majority of communicative responses (>90%) necessitated high-level intrusive support, specifically physical prompts (Level 5) or verbal models (Level 4). By the conclusion of phase B1, the modal prompt level transitioned toward less intrusive supports, predominantly indirect verbal (Level 3) and gestural (Level 2) prompts, alongside the emergence of autonomous (Level 1) responses. Although prompt dependency partially regressed toward baseline parameters following the withdrawal of NET in phase A2, the participant demonstrated communicative mastery by the final sessions of B2. In this final phase, the majority of FCRs occurred independently (Level 1) or via gestural cues (Level 2), requiring only infrequent indirect verbal support. This progression aligns with the theoretical postulations of NET, suggesting that leveraging naturally occurring Motivating Operations (MOs) fosters communicative autonomy rather than habitual prompt dependency.

d. Generalization Outcomes

Generalization data collected during home-based probes in phases B1 and B2 evidenced a robust trans-situational transfer of FCR gains to the domestic environment. During the B1 generalization phase, the participant's primary caregiver recorded a mean frequency of 5.2 FCRs per session (range: 4–7) across ecologically valid contexts, including mealtimes, play, and self-care routines representing a substantial increase over pre-intervention levels. This frequency further accelerated during the B2 generalization probes, reaching a mean of 8.6 FCRs per session (range: 7–11). Notably, by the concluding sessions of B2, the participant demonstrated spontaneous communicative initiations with both the primary caregiver and an untrained novel interactant (the maternal

grandmother). This finding suggests successful stimulus generalization across novel social partners in the absence of direct intervention training for all caregivers.

e. Collateral Behavioral Changes

Beyond the primary communicative outcomes, several concomitant behavioral shifts were observed throughout the study. Caregiver-reported data indicated a significant attenuation in the frequency of tantrums, which declined from an estimated 8–12 episodes daily at baseline to 2–4 episodes per day by the conclusion of phase B2. Concurrently, the frequency of non-verbal requesting topographies decreased as verbal FCRs increased; this inverse relationship suggests a functional substitution effect, wherein communicative intent was successfully transferred from non-verbal to verbal modalities. Furthermore, the participant demonstrated a marked increase in eye contact during communicative attempts over the intervention period. These collateral improvements align with extant literature, which posits that the acquisition of functional communication skills is intrinsically linked to a reduction in challenging behaviors that previously served maladaptive communicative functions.

2. Efficacy of Natural Environment Teaching (NET)

a. Alignment with the Literature

The present findings establish a robust functional relation between the implementation of NET and the increased frequency of FCRs, as evidenced by the systematic ABAB reversal pattern, a complete absence of data overlap (0\%), and NAP values ranging from 0.96 to 1.00. These outcomes corroborate and expand the prevailing NDBI evidence base. While Sandbank et al. (2017) reported significant expressive language gains across a meta-analysis of 120 studies, the current research offers critical single-case experimental evidence within the Indonesian pediatric context a geographic region that remains conspicuously underrepresented in the international literature.[21] Notably, the accelerated improvement observed in phase B2 (M = 11.4) compared to B1 (M = 8.0) suggests that the initial exposure to naturalistic contingencies during B1 established a foundational communicative repertoire. This repertoire was ostensibly reactivated with greater efficiency upon the reintroduction of the intervention, a

[21] Sandbank et al., "Project AIM: Autism Intervention Meta-Analysis for Studies of Young Children."

phenomenon consistent with the concept of "primed generalization" within NDBI frameworks.[22]

b. Role of Motivating Operations

The progressive attenuation of prompt dependency transitioning from high-intensity physical and modeling prompts during the initial phases to predominantly autonomous and gestural responses in B2 is best elucidated through the theoretical framework of Motivating Operations (MOs). Within the NET framework, A.R.'s communicative attempts were elicited by endogenous motivational states (e.g., a desire for specific tangibles or the continuation of preferred activities) rather than being solely contingent upon a therapist-delivered discriminative stimulus (S^D).This robust motivational substrate fostered communicative topographies that were inherently more spontaneous and ecologically embedded than behaviors typically trained under the rigid antecedent control characteristic of Discrete Trial Training (DTT). Furthermore, the precipitous recovery of performance during the B2 reintroduction phase following the regression observed in A2 supports the interpretation that the MO-governed communicative repertoire remained intact throughout the withdrawal period. Rather than a dissolution of the acquired skills, the reduced frequency during A2 likely reflected a temporary suppression of behavior resulting from the absence of the specific environmental contingencies and reinforcement schedules that previously evoked and maintained the responses.

c. Generalization in the Indonesian Clinical Context

The seamless generalization of FCR gains to the domestic setting and to novel communicative partners achieved without direct intervention training constitutes one of the most pivotal clinical outcomes of this investigation. This result directly mitigates a pervasive critique of clinic-based behavioral interventions: the failure of acquired skills to transfer to naturalistic environments. Furthermore, these findings carry profound implications for the Indonesian clinical landscape. Given the systemic scarcity of specialized therapists across various regions and the significant disparity between limited clinical contact hours and the abundance of domestic engagement time, the successful extrapolation of NET gains to caregiver-implemented home sessions validates the viability of a parent-mediated extension model. This evidence aligns with the

[22] Schreibman et al., "Naturalistic Developmental Behavioral Interventions: Empirically Validated Treatments for Autism Spectrum Disorder."

empirical recommendations of Oono et al and Kaiser and Roberts, suggesting a scalable and sustainable pathway for increasing intervention dosage beyond the constraints of traditional clinic-based services.[23,24]

d. Collateral Reductions in Challenging Behavior

The concomitant reduction in tantrum frequency and non-verbal communicative topographies occurring in inverse proportion to the increase in FCR frequency substantiates the functional properties of these challenging behaviors at baseline. This developmental trajectory, wherein the acquisition of functional communication parallels the attenuation of problematic behavior, is a robustly validated phenomenon within the Functional Communication Training (FCT) literature. It reflects the systematic extinction of previously reinforced maladaptive responses as more efficient verbal alternatives emerge within the participant's repertoire. From a clinical management perspective, these findings underscore that intervention for speech delay transcends mere linguistic acquisition; it is fundamentally a process of equipping children with prosocial repertoires for effectively negotiating environmental contingencies and influencing their social surroundings through socially appropriate modalities.

e. Limitations

Notwithstanding the robust functional relationship established in this investigation, several limitations warrant consideration. First, the idiographic nature of the single-subject experimental design (SSED) inherently circumscribes the external validity of the findings; while the ABAB framework provides rigorous evidence of internal validity for the individual participant, broader generalizability to the wider pediatric population with Language Disorders cannot be definitively established from a single case. Second, procedural integrity (treatment fidelity) was not systematically quantified via a formal standardized checklist. Consequently, the extent to which outcome variability might be attributed to implementation inconsistencies rather than participant response remains a methodological constraint that future replications should address. Third, although generalization data were collected within the domestic environment, these metrics relied on caregiver reports without independent observational validation, potentially introducing social desirability or measurement bias.

[23] Oono, Honey, and McConachie, "Parent-Mediated Early Intervention for Young Children with Autism Spectrum Disorders (ASD)."
[24] Kaiser and Roberts, "Parent-Implemented Enhanced Milieu Teaching with Preschool Children Who Have Intellectual Disabilities."

Fourth, the present study lacked a longitudinal maintenance phase. Consequently, the durability of the observed FCR gains at one, three, or six months following the cessation of active intervention remains undetermined. Finally, the monocentric nature of this study conducted at a single clinical site in Jakarta may limit the applicability of the results to children across diverse regional, linguistic, and socioeconomic strata within the heterogeneous Indonesian archipelago. Future investigations should prioritize multi-site replications with larger cohorts and include rigorous longitudinal follow-up and systematic fidelity assessments to further validate the clinical utility of NET in non-Western contexts.

C. CONCLUSIONS

Utilizing a rigorous ABAB single-subject design, this study demonstrates that Natural Environment Teaching (NET) elicits clinically significant improvements in functional communication frequency for a child with language disorder. The functional relationship was corroborated by 0% phase overlap and Non-overlap of All Pairs (NAP) statistics ranging from 0.96 to 1.00. Furthermore, secondary outcomes including reduced prompt dependency, generalization across settings and novel partners, and collateral decreases in challenging behaviors reinforce the clinical utility of NET as a primary intervention strategy for speech delays. The successful implementation of parent-mediated NET in home settings, achieved through relatively brief caregiver training, suggests that the model is scalable beyond clinical environments. This scalability is particularly salient within the Indonesian healthcare context, where access to specialized services remains limited. Future research should prioritize: (1) replication across diverse participants and diagnostic profiles, including children with comorbid Autism Spectrum Disorder (ASD); (2) comparative analyses of NET, Discrete Trial Training (DTT), and hybrid approaches using multiple-baseline designs; (3) the systematic integration of treatment fidelity and social validity assessments; and (4) longitudinal evaluations of communication gains through early school age, with an emphasis on establishing a culturally contextualized evidence base within the Indonesian clinical framework.

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