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Research paper

Kia Tīmata Pai Video Project: Impact of an oral language intervention (ENRICH) on linguistic aspects of educator-toddler interactions

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ABSTRACT

This study investigated the impact of an educator-implemented oral language intervention, *Enhancing Rich Interactions* (ENRICH), on linguistic aspects of educator-toddler interactions. Twenty-four early childhood classrooms were assigned to either ENRICH or an Active Control condition; ENRICH educators received professional development in serve-and-return interactions. For book-reading, results revealed effects of ENRICH for educators' shorter conversational turn length and children's increased utterances over time. An exploratory analysis further showed a more balanced child-to-educator conversational turn ratio during book-reading in ENRICH centers. However, there were no significant effects of ENRICH for linguistic aspects of educator-toddler interactions in mealtime, play, group, and diapering/toileting contexts. Professional development programs aimed at improving educator-toddler interactions should consider focusing on specific contexts where the intervention shows promise, alongside strengthening components targeting speech quality across daily routines.

The landscape of early childhood education is changing rapidly worldwide, with children now spending more time in Early Childhood Classrooms (ECCs) than ever before (Burchinal et al., 2015; Molloy et al., 2023; OECD, 2025). ECCs serve as a bridge between informal home environments and structured educational settings of primary schools; educators employ playful and homelike interactions to facilitate a smooth transition for children. This transition is especially significant for toddlers, a period of rapid socioemotional, cognitive, and language development (NICHD Early Child Care Research Network, 2000). High-quality, center-based environments for young children yield positive language outcomes with both short- and long-term effects (US: Vandell et al., 2010; UK: Sylva et al., 2010; Norway: Dearing et al., 2018), whereas low-quality early childhood environments may not produce benefits, and potentially produce negative effects for children at risk (Burchinal et al., 2024; Melhuish et al., 2015). Globally, a meta-analysis revealed that most children attend childcare of average or mediocre quality (see Egert et al., 2018), and high-quality successful oral language interventions for toddlers are rare (for exceptions see Bleses et al., 2020, 2024). Promoting high-quality educator practices via professional development in oral language development is therefore of great importance in supporting children's language growth (Hadley et al., 2023). The aim of the present study was to support educator-toddler interactions via a professional development program called ENRICH (*Enhancing Rich Interactions;* Reese et al., 2023).

Although the sheer quantity of language to which children are exposed lays the foundation for children's linguistic development, high-quality educator-child talk, such as the use of diverse vocabulary and complex syntax, is especially important for children's language development (Barnes & Dickinson, 2017; Huttenlocher et al., 2002). However, many professional development (PD) programs have faced challenges in maintaining high instructional quality and produce only short-term effects (Burchinal et al., 2011, 2015). A low level of support for high-quality educator language to which children are exposed in ECCs could be a contributing factor (Dickinson, 2011). For example, educators rarely use sophisticated words, discuss word meanings, or use linguistically complex sentences with children (Grifenhagen et al., 2017). Consequently, there is a pressing need for educator-implemented interventions that specifically promote high-quality language use,

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especially in the toddler years (1-3 years).

To effectively design and implement such interventions, understanding how language is shaped via different contexts is essential for optimizing educator language practices and child language outcomes (Gardner-Neblett et al., 2021; Torr & Pham, 2016). Language development is a social process, which involves engaging children in context-specific social interactions (Halliday, 1993; Nelson, 2007; Tomasello, 2003). Context extends beyond mere physical location; it encompasses cultural and social norms, as well as language features, purposes, and participants that foster child language learning (Halliday, 1993). Most past observational studies focus on contexts like book-reading that promote complex language use (Barnes & Dickinson, 2017; Dickinson et al., 2014; Dickinson & Smith, 1994; Vanparys et al., 2024; Wasik & Hindman, 2014). Yet, care-related contexts such as mealtime and diapering are often overlooked (Hadley et al., 2023). The present study focuses on assessing the impact of an educator-implemented oral language intervention on the linguistic aspects of educator-toddler talk across five contexts in ECCs: book-reading, mealtime, play, group, and diapering/toileting.

1. The role of high-quality teaching practices on toddler language

As more children enroll in ECCs, educators are actively involved in children's learning and development during the day, which in turn contributes to children's language growth. Children's early language development relies on the presence of external linguistic stimuli, particularly the opportunity to hear and use language (Hart & Risley, 1995; Soderstrom & Wittebolle, 2013). Indeed, young children require exposure to specific vocabulary and syntactic structures to grasp them (Rowe & Snow, 2020). Providing children with enough language examples is therefore crucial for language entrenchment and abstraction (Degotardi, 2021; Lieven, 2019). Although the quantity of language input (i.e., the total number of words and/or utterances) is important, the significance of input quality becomes even more pronounced, especially as vocabulary growth progresses beyond the initial stage (Rowe, 2012). Rowe and Snow (2020) proposed a conceptual model with three dimensions of input quality (linguistic, interactive, and conceptual) in predicting children's language outcomes. They argued that the most effective input for fostering language development is interactionally supportive, linguistically adapted, and conceptually challenging, tailored to the child's age and level of understanding. Children learn from engaging in high-quality interactive and reciprocal conversations at a young age. As they mature, it becomes essential for children to participate in discourse that becomes progressively more sophisticated linguistically while also providing conceptual challenges appropriate to their age.

Along the linguistic dimension, the literature highlights that two linguistic aspects – lexical diversity and syntactic complexity – are associated with toddlers' oral language and later literacy skills (Huttenlocher et al., 2010; Marchman & Fernald, 2008; Rowe, 2012). Lexical diversity is the sheer number of different words children hear, and syntactic complexity is the grammatical complexity of each utterance. It has been argued that toddlers learn languages more effectively when educators employ simple and repeated words (Girolametto & Weitzman, 2002; Huttenlocher et al., 2010), possibly because toddlers' vocabulary is still emerging. However, the relationship between adult syntactic complexity and toddlers' language development yields mixed findings (Bowers & Vasilyeva, 2011; Hoff, 2003, 2006). Some studies indicate the advantages of less complex speech for toddler language development (Bowers & Vasilyeva, 2011; Hoff, 2006). These researchers propose that when input becomes overly complex for children to process, they may selectively filter out such utterances and become less likely to engage in conversation (Hoff, 2006). However, others argue in favor of longer and more complex language when talking to toddlers (Huttenlocher et al., 2002). The theory is that more complex speech is linked to more diverse word input, which may in turn offer contextual cues that help with word learning and sentence comprehension (Weizman & Snow, 2001). These discrepancies in findings could be resolved by longitudinal studies that track toddlers' language development in response to various styles of language input across different contexts over time.

The interactive dimension of Rowe and Snow's (2020) model, particularly extended back-and-forth interactions (serve-and-return; Shonkoff & Bales, 2011), plays an important role in the linguistic features of adult-child conversations. Serve-and-return involves adults responding contingently to children's communicative attempts ("serves") with appropriate, extended responses ("returns") (National Scientific Council on the Developing Child, 2004). Research shows that sensitive and responsive interactions predict stronger language outcomes by maintaining children's attention, providing immediate feedback, and creating opportunities for extended dialogue (Girolametto & Weitzman, 2002; Landry et al., 2014; NICHD Early Child Care Research Network, 2006). The quality of serve-and-return interactions is reflected in specific linguistic features such as turn-taking patterns, utterance length, and lexical diversity. Responsive educators tend to use shorter utterances and shorter turns to maintain the flow of conversation. They also tend to naturally adjust their linguistic features to match children's developmental level while gradually introducing more sophisticated language. For instance, an educator might respond to a toddler's point at a toy truck by first labeling it ("That's a truck!"), then expanding with descriptive language ("It's a big red dump truck"). However, associations between the quality of serve-and-return and linguistic features may vary across different classroom contexts. Therefore, it is worthwhile to investigate fine-grained linguistic features of these interactions to develop more effective language-promoting strategies in early childhood settings.

2. Importance of oral language intervention targeting specific contexts

In a systematic review paper, Hadley et al. (2023) reviewed over 50 past correlational studies of educator language practices and child language outcomes and posited that the place (contexts) where language occurs cannot be divorced from specific purposes, such as promoting child vocabulary. They further emphasized that each context is unique, characterized by distinct practices, intentions, and values. Past interventional studies have found that reading books together in an interactive and responsive style fosters educator-child discussions on abstract topics and promotes the development of diverse vocabulary and complex syntax (Barnes & Dickinson, 2017; Dickinson et al., 2014; Dickinson & Smith, 1994; Vanparys et al., 2024; Wasik & Hindman, 2014). However, most of these oral language interventional studies have focused on preschoolers, revealing a gap for interventions with toddlers (but see Landry et al., 2014; Bleses et al., 2020, 2021, 2024).

One intervention study targeting toddlers examined the effectiveness of the *Responsive Early Childhood Curriculum* (RECC) PD program across sixty-five classrooms over nine months in the United States (Landry et al., 2014). RECC was developed to improve center-based childcare educators' ability to use responsive educator-child interactions. They found that educators in the RECC intervention showed significantly higher levels of book-reading quality nine months later compared to the control group, with a large effect size ($d = .92$). The intervention also led to greater gains in responsive practices, such as using rich language, establishing predictable schedules, and implementing cognitively stimulating activities. However, no significant differences were found between the intervention and control groups for children's language skills. This was perhaps due to the unfavorable educator-child ratio (1:11 for 2-year-olds and 1:15 for 3-year-olds) in the classrooms. Therefore, it is possible that even with improved teaching practices from the RECC intervention, these high ratios would have constrained the opportunity for meaningful, extended back-and-forth language interactions with

individual children — interactions that are essential for language development.

In contrast, the Danish educational system maintains ratios of approximately 1:3 for children aged 0-2 and 1:7 for children aged 3-5 (European Commission, 2009). Bleses et al. (2021) conducted a cluster-randomized controlled trial (RCT) involving 255 childcare centers and 2170 toddlers to examine the effectiveness of an early childhood intervention called *We Learn Together* in Danish childcare centers. In addition to book-reading, group time provides another context for effective early childhood interventions. The *We Learn Together* intervention targets language, math, and social-emotional skills in toddlers aged 18-36 months through a 20-week program during large-group, small-group, and one-on-one interactions. Educators in the intervention group used the word learning and responsive strategies more frequently than control group educators. Moreover, children in the intervention showed significantly greater improvements in receptive and expressive vocabulary compared to control. This result was not moderated by child demographic factors (e.g., gender, age, parental education, or bilingual status), indicating that the intervention was broadly effective in promoting language development across different subgroups of children (but see Bleses et al., 2020).

Early childhood interventions that promote preschool children's language through educator-guided play have also shown promising results. One such intervention is *Read-Play-Learn* (RPL), which was a preschool vocabulary intervention involving 227 low-income children from the United States (Dickinson et al., 2019). The study compared two conditions: book-reading only (RO) and book-reading plus play (R + P). Both conditions involved explicit vocabulary instruction during book reading, with the R + P condition also including play sessions with story-related props. Results showed significant pretest-posttest gains in children's receptive and expressive vocabularies for both conditions, with large effect sizes ($d = .94 – 1.32$). Fidelity to guided book-reading was high. However, fidelity to guided play varied across educators, possibly due to factors such as time constraints and lack of familiarity with the approach. This study highlights that effectiveness of teaching practices may depend on how well they align with educators' experience, skills, and motivation within the context in which they are implemented.

Another relevant preschool language intervention targeted German educators' conversational style in day-to-day interactions in a pre-post design (Schröder et al., 2018). The intervention was successful in increasing the quality of educators' language interactions across the day, with benefits for children's language development relative to age norms. However, the intervention was quasi-experimental, not an RCT, and did not identify changes in the quality of talk in specific contexts, which was the main aim of the present study.

Other than book-reading, group, and play, toddlers spend a great deal of time in care contexts such as eating, dressing, and washing (Torr & Pham, 2016). These caregiving contexts offer unique opportunities for rich language exchanges that can foster toddlers' language development. However, no intervention studies to our knowledge have examined the effects of oral language interventions on educators' teaching practices (e.g., use of diverse vocabulary, complex syntax, and responsive interaction strategies) and toddlers' language outcomes across the full range of contexts in early childhood settings. Given the significance of both the quantity and quality of language input for toddlers' language growth, it is essential to investigate how educator-implemented oral language interventions can be effectively applied throughout the day (Degotardi, 2021). By examining the impact of these interventions across different contexts, researchers can gain insights into the specific strategies that are most effective for promoting high-quality educator-child interactions and supporting language development in each context. This knowledge can inform the design of targeted, context-specific PD programs for early childhood educators, ultimately leading to improved language outcomes for young children.

3. The current study

In New Zealand, an evidence-based approach with parents called *Tender Shoots* fosters preschoolers' oral language and literacy skills (Reese et al., 2023; Riordan et al., 2021; Schaughency et al., 2023; Timperley et al., 2022) through interactive book-sharing and reminiscing about children's own experiences related to book themes, as well as sound play to support early literacy. Building upon the principles of *Tender Shoots* and other oral language interventions, *Enhancing Rich Interactions* (ENRICH) was developed as a downward extension for toddlers that builds on serve-and-return interactions during book-reading, mealtime, play, group, and diapering/toileting (Reese et al., 2023). This study is part of a larger randomized controlled trial (RCT) called Kia Tīmata Pai (KTP) aiming to enhance oral language and self-regulation skills in children aged approximately 1.5 to 7 years (see Reese et al., 2023). The KTP main trial involved randomly assigning 136 early childhood centers to either ENRICH or the Active Control condition. ENRICH targets toddlers and employs a book- and conversation-based approach to promote children's oral language skills through serve-and-return interactions. In Active Control centers, educators instead received professional training about childhood nutrition at the same times as ENRICH training, but without additional resources.

The efficacy of ENRICH for improving toddler outcomes was recently demonstrated in the KTP main trial with 1481 children (Reese et al., in press). Findings showed that by age 3, children in ENRICH centers exhibited stronger oral language, self-regulation, early literacy, and social skills compared to an Active Control group. The current Video Project sub-study seeks to understand these child-level outcomes by investigating whether ENRICH led to improvements in the quality of educator-child interactions, the hypothesized active ingredient of the intervention. Using naturalistic observation in a subset of 24 centers, we examined how ENRICH influenced the quantity and linguistic quality of educator-toddler conversations in the first year following implementation (see Swearingen et al., 2026 for a focus on temporal and conversational outcomes of ENRICH). The research questions and preregistered hypotheses (https://doi.org/10.17605/OSF.IO/QMXU8) for this study are as follows.

1. We predicted that educators and children in ENRICH centers would produce more total utterances and completed words (Hart & Risley, 1995; Lieven, 2019) than those in Control centers over time for each of the five contexts.
2. We also predicted that educators and children in ENRICH would use a higher number of different words (by type), longer mean length utterance (MLU) in morphemes, and more statements and questions (Cabell et al., 2015; Justice et al., 2018), greater responsivity to questions (Barnes & Dickinson, 2017; Deshmukh et al., 2019; Gámez, 2015), but lower numbers of simple Yes/No responses to questions (Hargrave & Sénéchal, 2000) compared to those in Control centers over time for each of the five contexts.
3. In line with serve-and-return practices, we predicted that educators in ENRICH centers would use shorter turn lengths (indicating more interactive talk; Reese et al., 2021), whereas children in ENRICH centers would use longer turn lengths over time, than in Control centers.

4. Method

4.1. Study design

The current study specifically investigated the Video Project of the first year of ENRICH implementation in KTP, focusing on centers that were assigned to either the ENRICH or Active Control condition across two timepoints (see Fig. 1): baseline (June-July 2021) and one-year follow-up (June-July 2022). Each year, we collected video recordings of educators and children from 24 of the 136 centers in the trial to assess

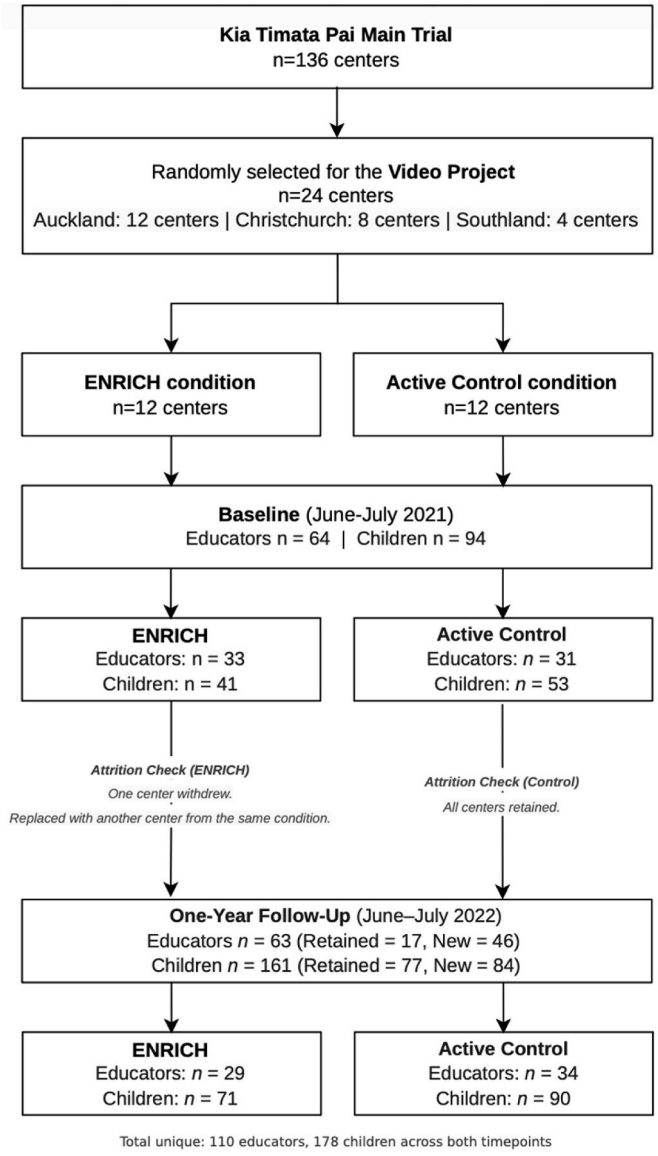

Fig. 1. Flow of centers and participants of the Kia Tīmata Pai Video Project Study from baseline to one-year follow-up.

intervention fidelity and to gain a deeper understanding of the intervention's impact on educator-child interactions. These centers were randomly selected from the two conditions in 3 regions in New Zealand, including Auckland (12 centers), Christchurch (8 centers), and Southland/Otago (4 centers). Twenty-three of the 24 original centers were retained at the one-year follow-up. One center from the ENRICH/Control condition withdrew from the study after baseline. To maintain the design balance and sample size, it was replaced with another center from the same condition within the main KTP trial, resulting in a final sample of 24 centers at follow-up.

4.2. Participants

The present study drew participants from 24 early childhood education centers (out of 136 centers from the main trial) that included 110 educators (64 at baseline and 63 at one-year follow-up). Of these educators, 17 participated at both timepoints. An analysis of demographic characteristics showed no statistically significant differences between educators in ENRICH and Active Control as a function of age (χ^2 (3) = 5.81, p = .12), years of teaching experience (χ^2 (4) = 3.11, p = .54), or education level (χ^2 (5) = 7.57, p = .18). Similarly, ethnic composition was balanced across both conditions, with no significant disparities observed among educators of European (χ^2 (1) = 0.27, p = .60), Asian (χ^2 (1) = 0.00, p = 1.00), Māori (χ^2 (1) = 0.01, p = .92), or Pacific peoples (χ^2 (1) = 0.38, p = .54). Educators were recruited from the service and consented via an online link or paper forms. Educators' demographics are specified in Table 1.

The children's sample consisted of 178 children recruited through centers, including 94 children at baseline (*Mean age* = 20.81 months, *SD* = 3.71) and 161 children at one-year follow-up (*Mean age* = 30.90 months, *SD* = 4.81). Of these participants, 77 were present at both timepoints. Parents of these children signed a consent form before data collection. Children's demographic characteristics are specified in Table 2. For those children whose parents did not provide consent, we communicated with them through a letter prior to data collection specifically explaining the purpose of the video project, and requested parents to inform the educator if they preferred their children not to appear in the footage.

Demographic data for both educators and children were compared with national statistics from the 2023 New Zealand Census (Stats, 2023). The ethnic composition of the educator and toddler samples was broadly representative of the New Zealand population, with similar proportions of European, Māori, Asian, and Pacific Peoples. However, the study sample was underrepresented in terms of children from low-income households according to parental occupations relative to national distributions (Reese et al., in press).

The flow of centers and participants through the Video Project from

Table 1
Characteristics of educator participants in the KTP Video Project (collapsed across baseline and 1-year follow-up).

Educator Characteristics	n	%
Age		
≤24 years	10	12.4%
26-35 years	23	28.4%
36-45 years	32	39.5%
≥46 years	16	19.8%
Total	81	100%
Sex		
Female	84	76.4%
Male	0	0%
Other	0	0%
Total	84	76.4%
Ethnicity		
European	48	57.1%
Asian	33	39.3%
Māori	7	8.3%
Pacific	5	6.0%
Total[a]	84	111%
Teaching Experience		
≤2 years	13	15.9%
3-6 years	21	25.6%
7-10 years	24	29.3%
11-15 years	10	12.2%
≥16 years	14	17.1%
Total	82	100%
Education Level[a]		
School Certificate (5th Form) NCEA Level 1	3	3.2%
School Certificate (6th Form) NCEA Level 2	6	6.3%
University Bursary, NCEA Level 3	6	6.3%
Polytechnic Qualification/Diploma	17	17.9%
University Degree	50	52.6%
Postgraduate Qualification	13	13.7%
Total	95	100%

[a] *Note.* Ethnicity = total response ethnicity; caregivers could nominate more than one ethnicity, so the total is more than 100%. High school in New Zealand ranges from Years 9-13. Students take national educational examinations (NCEA), at the end of Years 11 (NCEA Level 1), 12 (NCEA Level 2), and 13 (NCEA Level 3). 5th Form/NCEA Level 1 is equivalent to 1 year of high school, 6th Form/NCEA Level 2 is equivalent to 2 years of high school, and University Bursary/NCEA Level 3 is equivalent to high school completion.

Table 2
Characteristics of child participants in the KTP Video Project (collapsed across baseline and 1-year follow-up).

Child Characteristics	*n*	%
Sex		
Female	80	45.7%
Male	95	54.3%
Other	0	0%
Total	175	100%
Ethnicity		
European	122	70.9%
Asian	47	27.3%
Māori	27	15.3%
Pacific	13	7.6%
Total[a]	172	122.7%
Language spoken at home		
English	138	80.7%
Non-English	33	19.3%
Total	171	100%
Family SES[b]		
Low (1-2)	13	7.6%
Medium (3-4)	63	36.6%
High (5-6)	96	55.8%
Total	172	100%

[a] *Note.* Ethnicity = total response ethnicity; caregivers could nominate more than one ethnicity, so the total is more than 100%. SES = Socioeconomic Status.
[b] Parent-reported occupation was used to construct a three-level SES index (low, middle, high) based on the New Zealand Socio-Economic Index (Boven et al., 2022). The original six-category classification was merged into three SES groups because of the small number of children in the lowest three categories.

baseline to one-year follow-up is summarized in Fig. 1. Ethical approval of the video project study was granted by the University of Otago Human Ethics Committee on 23 November 2020 (H20/116). Furthermore, the project was reviewed positively for cultural sensitivity by the Ngai Tāhu Research Advisory Committee in 2020, renewed in 2022. The main trial, Kia Tīmata Pai, is registered in the Australian New Zealand Clinical Trial Registry (ANZCTR) under the identifier ACTRN12621000845831.

4.3. Procedure

Videotaping. Participating educators and toddlers from 24 nationwide early childhood education centers were videotaped at both timepoints. Half of the centers had been assigned to ENRICH and half to Active Control conditions after baseline. At each timepoint, postgraduate researchers, working in pairs, aimed to capture video data of interactions between educators and toddlers during five contexts (toileting was added to diapering at the one-year follow-up). Researchers who collected, coded, and analyzed the video data were unaware of the centers' condition at the time of data collection and coding. Prior to visits, the researchers coordinated with the educators at each center to schedule a suitable time, ideally during meal or snack time. Each visit was kept to a maximum duration of 90 minutes. In keeping with the study's naturalistic design, researchers did not disclose the specific context they intended to film before their arrival. Each context was recorded for an average of 5 minutes, adding up to approximately 25 minutes of filming at every center. The 5-minute duration for each context is supported by past research (see Pauker et al., 2018; Prime et al., 2015; Sokolovic et al., 2021).

During both visits, the researchers filmed educators and children during their naturally occurring activities. To identify the children participating in the study, educators were asked to either place stickers on their clothes or have them wear a special vest. For videos involving diapering/toileting, researchers only started recording after receiving verbal consent from the educators, capturing solely the audio of the educator-child interaction and excluding any visual recording of the children. During small-group time, educators were the main facilitators, whereas play time was largely filled with children's spontaneous activities. Filming of mealtimes commenced once the children were seated, and the food was on the table. The recording of book time initiated when educators began to read a word or picture book.

Transcription and coding. Upon completion of each data collection phase, the video footage was classified into one of the five contexts. This classification was performed independently by two sets of researchers, with each video undergoing dual coding. Following categorization, researchers took on the task of transcribing the video sessions independently. These transcriptions were then verified by a separate researcher for accuracy. To examine the linguistic aspects of educator-child speech, the transcripts were further processed for the Systematic Analysis of Language Transcripts (SALT 20; Miller et al., 2019). A postgraduate researcher adhered to the SALT convention manual to prepare the transcripts. Another researcher then inspected each transcript formatted in SALT assessing it for consistency in C-unit segmentations, contractions, conventions, and spelling.[1]

Professional development (PD). ENRICH is a center-based intervention that employed a 'train the trainer' model across all center teaching staff over an 18-month period with two workshops and four sets of resources. The PD focused on serve-and-return interactions across five daily contexts. To build upon the educators' existing knowledge and practices to enhance the effect of ENRICH, implementation of ENRICH was co-designed by academics (experts in child development and language acquisition) and professional practice leaders (PPLs) — all of whom had at least 10 years of experience in early childhood education — and facilitated by implementation leaders at a not-for-profit non-governmental organization. This collaboration ensured the intervention was both evidence-based and practical. The research team provided training to six PPLs at each 9-monthly phase, who then delivered workshops to educators in centers, either online or in person, using a researcher-designed PowerPoint presentation and activities. Each ENRICH center received a new set of researcher-designed resources (i.e., books with inserted prompts, instructional cards, and videos) at each workshop and 3-4 months later. PPLs followed up with educators at individual centers as needed. This approach helped to ensure the intervention content was delivered uniformly, while allowing for minor presentational adaptations based on the PPLs' expertise and knowledge of individual centers. The national management maintained a TEAMS folder with all ENRICH workshop slides and materials that only ENRICH centers could access; every ENRICH center was encouraged to use the folder to induct new staff in ENRICH techniques. The second ENRICH workshop also served to review techniques for continuing and new staff, as well as to encourage progression of ENRICH techniques as study children grew older and more linguistically capable.

Conditions. Educators in the ENRICH condition received one phase of professional development following baseline in 2021 and a second phase 9 months later in 2022. Educators were encouraged to apply ENRICH techniques in any language that both educators and children understood whenever possible, particularly during the five target contexts. Resources included two sets of informational cards on ENRICH techniques across the five contexts and four new books: *The Noisy Book* by Soledad Bravi, *Hoihoi Turituri* translated by Ruia Aperahama, *Mahi/Actions* by Kitty Brown and Kirsten Parkinson, and *Kare ā-roto/Feelings* by Kitty Brown and Kirsten Parkinson (see examples of ENRICH prompts in Appendix). The intervention targeted both New Zealand English and te reo Māori; this paper focuses only on English language outcomes (see Mitchell et al., 2025 for te reo Māori outcomes). Books included conversation prompts on each page that were specially designed to help educators sustain extended and meaningful serve-and-return interactions with young children. Educators in the Active Control condition received two webinars on childhood nutrition, a topic selected in collaboration with the early childhood service. These webinars, each

[1] Details of the SALT transcription conventions, including C-unit segmentation, contraction handling, coding conventions, and spelling standardization, are provided in Section S1 of the Supplemental Materials.

lasting approximately an hour, were presented by child nutrition experts with PhD qualifications.

4.4. Measures

The linguistic aspects of educator-toddler talk were measured during naturalistic interactions at both data collection timepoints for both conditions across five contexts. We examined diverse measures of language use, which we categorized into quantity and quality measures. Quantity measures included the frequency of specific utterance types, namely the number of statements, questions, and yes/no responses to questions.[2] Quality measures included the number of different words (NDW), which serves as a measure of lexical diversity; the mean length of utterance in morphemes (MLU), a measure of syntactic complexity calculated by dividing the total morphemes by the total utterances, and a measure of responsivity to questions (the proportion of adult questions that received a relevant child response). To capture the interactive patterns of serve-and-return, we also analyzed mean length of conversational turns (MTL), with shorter educator turns potentially indicating more balanced back-and-forth interactions, and a ratio variable of the number of child-to-educator conversational turns. All variables were analyzed on a per-minute basis by dividing the total of each variable by the length of the video, except for MLU in morphemes because it is already a proportional measure, calculated by dividing the total number of morphemes by the total number of utterances, and the child-to-educator turn ratio.

4.5. Analysis plan

We ran a series of descriptive statistics for all variables for both educators and children across conditions and timepoints. To analyze the variations in educator-child conversations between the ENRICH and Control conditions over time, we then conducted a series of Generalized Estimating Equations (GEEs) in SPSS 29 (Hubbard et al., 2010). GEEs are a type of linear regression model to handle correlated or clustered data, such as educators and children within ECCs. Whereas linear regression aims to estimate subject-specific effects, GEEs prioritize population-averaged effects using Estimated Marginal Means (EMMs; Van Bergen et al., 2020). Thus, differences between EMMs in follow-up comparisons of significant interactions directly quantify unstandardized effect sizes, reflecting population-level means. GEEs are also proficient at handling data missing-completely-at-random (Hubbard et al., 2010; Karin et al., 2018). This feature allowed us to incorporate five contexts from each center into our analysis, even with missing educator-child data in some contexts (e.g., if a center did not hold a group or book time during recording).

As a flexible, semi-parametric regression approach, GEEs do not require normality assumptions for outcome variables. This is advantageous given our small sample size, as parametric models often rely on distributional assumptions that are difficult to satisfy with limited data (Hardin & Hilbe, 2012). However, the primary advantage of GEEs over alternative approaches like multilevel modeling (MLM) is that mis-specified covariance matrices in MLM can result in misleading estimates and biased inference, whereas in GEE, a mis-specification may reduce efficiency but does not nullify the findings (Huang, 2022; Hubbard et al., 2010; Overall & Tonidandel, 2004). This makes GEE a more conservative approach for our analysis, as it does not require precise specification of correlation patterns within the data. Although we know clustering occurred at the center level, the exact nature of these correlations may vary across different contexts. When using the GEE regression procedure, it is necessary to specify a working correlation matrix structure (Hardin & Hilbe, 2012; Van Bergen et al., 2020). We opted for an "exchangeable" structure, which assumes the matrix variance and covariance as equal.

For each GEE regression model, we used a dataset comprising 24 centers across two timepoints. To assess the significance of each effect, we prioritized testing the interaction between observation timepoint and condition using Wald Chi-Square (W_T) test statistic of the EMMs. When significant interactions emerged, we conducted post-hoc pairwise group comparisons to interpret the change over time within each condition. At baseline, missing data were observed at 13 centers for book-reading (4 ENRICH, 9 Control), 1 for mealtime (0 ENRICH, 1 Control), 4 for play time (2 ENRICH, 2 Control), 8 for group time (3 ENRICH, 5 Control), and 8 for diapering/toileting (4 ENRICH, 4 Control). At one-year follow-up, data were missing at 12 centers for book-reading (6 ENRICH, 6 Control), 1 for mealtime (0 ENRICH, 1 Control), 1 for play time (0 ENRICH, 1 Control), 3 for group time (2 ENRICH, 1 Control), and 8 for diapering/toileting (4 ENRICH, 4 Control). Little's Missing Completely at Random (MCAR) test showed that data in the present study were missing completely at random for educators, χ^2 (394) = 372.45, $p = .78$, and children, χ^2 (514) = 430.68, $p = .98$, across condition and timepoints.

4.6. Sensitivity analyses

To make sure that our findings were not dependent on any single set of modeling assumptions, we conducted two types of sensitivity checks following best-practice recommendations for GEE (Ballinger, 2004; Hardin & Hilbe, 2012). First, we varied the working correlation structure (exchangeable, independent, AR[1], and unstructured). Second, we compared the primary Normal distribution with identity link against a Gamma distribution with log link to assess robustness to distributional assumptions for skewed linguistic rate data. Full details are provided in Section S2 of the Supplemental Materials.

5. Results

5.1. Preliminary analyses

The quality of participating ECCs was evaluated using New Zealand's official assessment framework: the Education Review Office's Assurance Review (*Akanuku*) system (Education Review Office, 2021). These evaluations, conducted between 2016 and 2020, typically occur every 3-5 years and employ a 4-point scale ranging from 0 ("not well placed") to 3 ("very well placed"). Of the Control centers, 10 were rated as "well placed", one as "very well placed", and one without a rating. Of the ENRICH centers, 10 were rated as "well placed", two as "very well placed", and one assessed under a different system as "meeting" requirements. These comparable quality ratings indicate that centers in both conditions were generally performing at a satisfactory level before the intervention.

Due to the age range of the participating children and the natural progression within early childhood education, some had transitioned to older-age classrooms at one-year follow-up. To account for these differences, we conducted a preliminary analysis with Fisher's Exact Tests to determine if the classroom type differed by intervention condition for each context. We coded classroom type for each context using the following system: "0" representing children under 2 years old, "1" representing children over 2 years old, and ".5" representing centers with a mixture of age groups. Fisher's Exact Tests revealed no statistically significant associations between classroom type (toddler versus preschool) and condition for mealtime ($p = 1.0$), play ($p = 1.0$), group ($p = 1.0$), or at the follow-up. For book-reading, however, the value of Fisher's exact test statistic was 4.20 ($p = .09$), which was marginally significant, suggesting a potential association between classroom type and intervention condition. There was a tendency for more children in ENRICH to be in an under-2 classroom for book-reading compared to children in the Control condition to be in over-2 and mixed-age groups for book-reading. Given

[2] Due to low rates of educators' yes/no responses to questions, this variable was not included in the analysis.

this potential influence of classroom type during book-reading, we have controlled for classroom type in subsequent analyses of book-reading to account for this association.

5.2. Descriptive analyses

We present the EMMs and standard errors of linguistic measures for children (see Table 3) and educators (see Table 4) separately based on conditions and timepoints across five contexts.

5.3. ENRICH effects on book-reading

Total utterances. The GEE analyses showed a significant interaction between condition and timepoint for children's total utterances per minute during book-reading, $W_T = 4.62$, $p = .03$, indicating different patterns over time for ENRICH versus Active Control centers (see Fig. 2). Children in ENRICH centers showed a significant increase in utterances during book-reading from baseline to follow-up ($W_T = 44.86$, $p < .001$), whereas children in control centers showed no significant change over time ($W_T = 0.13$, $p = .72$). There was no other significant time by condition interactions for children's total utterances in other contexts, or any significant time by condition interactions for educators' total utterances in any context.

Mean length of conversational turns (MTL). The GEE analyses showed a significant interaction between condition and timepoint for educators' MTL per minute during book-reading, $W_T = 5.37$, $p = .02$, indicating different patterns over time for ENRICH versus Active Control centers (see Fig. 3). Educators in ENRICH centers showed a significant decrease in MTL during book-reading from baseline to follow-up ($W_T = 7.40$, $p = .01$), whereas educators in control centers showed no significant change over time ($W_T = 0.00$, $p = .98$). There was no other significant condition by time interactions for educators' MTL in other contexts, or any significant condition by time interactions for children's MTL in any context.

Other linguistic variables. The GEE analyses showed no significant condition by time interactions for total completed words, number of different word types, statements, questions, yes/no responses to questions (children only), or responsivity to questions for educators or children during book-reading.

5.4. Exploratory analysis

Ratio of Child-to-Educator Turns. To better understand the nature of the conversational turn-taking during book-reading, we conducted a follow-up analysis by calculating a ratio of the number of child turns per educator turn. This ratio provides a measure of conversational balance, with a higher value indicating greater child participation relative to the educator (see Fig. 4). The GEE analyses on this ratio during book-reading showed a significant interaction between condition and timepoint, $W_T = 17.54$, $p < .001$. Educators in ENRICH centers showed a significant increase in the child-to-educator turn ratio from baseline to follow-up ($W_T = 991.10$, $p < .001$), whereas educators in control centers showed no significant change over time ($W_T = 2.77$, $p = .10$). This indicates that the decrease in educator MTL in the ENRICH group was accompanied by a relative increase in child turns, leading to a more balanced conversational structure.

5.5. ENRICH effects on diapering/toileting

MLU in morphemes. The GEE analyses showed a significant interaction between condition and timepoint for educators' MLU in morphemes during diapering/toileting, $W_T = 4.15$, $p = .04$, indicating different patterns over time for ENRICH versus Active Control centers (see Fig. 5). Educators in Control centers showed a significant increase in MLU during diapering/toileting from baseline to follow-up ($W_T = 11.83$, $p < .001$), whereas educators in ENRICH centers showed only a marginal increase in MLU over time ($W_T = 3.00$, $p = .08$). There was no other significant condition by time interactions for educators' MLU in other contexts, or any significant condition by time interactions for children's MLU in any context.

Other linguistic variables. The GEE analyses showed no significant condition by time interactions for total utterances, total number of words, number of different word types, statements, questions, yes/no responses to questions, responsivity to questions, or mean

Table 3
Estimated marginal means and standard errors of each linguistic variable across condition (ENRICH versus active control) and timepoints (baseline versus one-year follow-up) for children.

	ENRICH *(SE)*		Active Control (*SE*)		ENRICH (*SE*)		Active Control (*SE*)		ENRICH (*SE*)		Active Control (*SE*)	
	Baseline	One-year Follow-up	Baseline	One-year Follow-up	Baseline	One-year Follow-up	Baseline	One-year Follow-up	Baseline	One-year Follow-up	Baseline	One-year Follow-up
	Total utterances				**NDW**				**Questions**			
Book	2.19 (0.52)	9.20 (1.27)	7.31 (2.04)	8.06 (1.53)	2.22 (0.48)	6.56 (0.89)	4.59 (1.95)	6.43 (1.27)	0.03 (0.02)	0.42 (0.15)	1.40 (0.84)	0.57 (0.33)
Mealtime	2.14 (0.49)	4.26 (0.85)	1.66 (0.32)	3.58 (0.55)	1.49 (0.33)	4.07 (0.69)	1.00 (0.20)	3.99 (0.52)	0.07 (0.03)	0.23 (0.08)	0.23 (0.13)	0.20 (0.12)
Play	2.24 (0.43)	5.88 (0.71)	3.02 (0.52)	5.72 (0.70)	2.15 (0.55)	5.27 (0.81)	2.27 (0.41)	5.73 (0.83)	0.23 (0.08)	0.22 (0.06)	0.08 (0.05)	0.29 (0.05)
Group	2.05 (0.58)	6.10 (0.98)	2.17 (0.47)	4.72 (0.56)	1.05 (0.38)	4.35 (0.74)	1.45 (0.39)	4.66 (0.83)	0.06 (0.05)	0.32 (0.19)	0.16 (0.12)	0.13 (0.05)
Diapering/ toileting	3.15 (0.69)	3.30 (0.53)	4.45 (0.98)	2.53 (0.68)	2.32 (0.48)	2.66 (0.70)	2.98 (0.72)	2.42 (0.86)	0.24 (0.17)	0.20 (0.06)	0.20 (0.14)	0.16 (0.10)
	NTW				**MLU in morphemes**				**Yes/No responses to questions**			
Book	2.81 (0.68)	10.97 (2.31)	8.72 (3.11)	9.47 (2.41)	1.30 (0.43)	1.97 (0.27)	2.46 (0.64)	2.05 (0.17)	0.05 (0.03)	0.13 (0.06)	0.40 (0.33)	0.29 (0.08)
Mealtime	2.12 (0.55)	6.75 (1.52)	1.33 (0.35)	6.77 (1.12)	1.24 (0.06)	2.13 (0.17)	1.20 (0.07)	2.44 (0.20)	0.13 (0.04)	0.08 (0.03)	0.10 (0.05)	0.09 (0.05)
Play	2.54 (0.73)	9.05 (1.76)	3.21 (0.60)	8.96 (1.91)	1.28 (0.11)	2.03 (0.18)	1.34 (0.11)	2.24 (0.20)	0.30 (0.16)	0.22 (0.06)	0.12 (0.08)	0.27 (0.10)
Group	1.53 (0.58)	8.38 (1.52)	2.08 (0.51)	7.20 (1.57)	1.30 (0.14)	2.38 (0.31)	1.28 (0.04)	2.16 (0.22)	0.02 (0.02)	0.23 (0.13)	0.05 (0.03)	0.34 (0.13)
Diapering/ toileting	3.12 (0.76)	3.54 (0.93)	4.35 (1.07)	3.17 (1.02)	1.31 (0.10)	1.35 (0.23)	1.21 (0.08)	1.38 (0.34)	0.26 (0.14)	0.43 (0.13)	0.10 (0.05)	0.18 (0.11)
	MTL				**Statements**				**Responsivity to questions**			
Book	0.36 (0.09)	0.25 (0.03)	0.34 (0.05)	0.41 (0.08)	1.54 (0.38)	3.83 (0.82)	4.33 (1.81)	2.93 (0.76)	3.75 (1.13)	12.93 (0.64)	5.65 (2.42)	17.65 (6.85)
Mealtime	0.25 (0.02)	0.40 (0.12)	0.26 (0.02)	0.26 (0.03)	1.39 (0.44)	2.52 (0.40)	0.80 (0.22)	2.53 (0.33)	2.94 (0.89)	6.15 (1.57)	2.77 (0.75)	5.18 (1.00)
Play	0.28 (0.04)	0.26 (0.02)	0.26 (0.02)	0.26 (0.02)	1.24 (0.27)	3.52 (0.55)	1.48 (0.29)	3.01 (0.48)	3.78 (0.78)	7.82 (0.99)	5.40 (1.64)	6.87 (0.75)
Group	0.30 (0.05)	0.33 (0.04)	0.25 (0.03)	0.26 (0.01)	0.50 (0.14)	2.75 (0.58)	1.12 (0.28)	2.05 (0.42)	2.04 (0.85)	6.02 (1.26)	3.25 (1.23)	6.55 (1.20)
Diapering/ toileting	0.41 (0.07)	0.30 (0.06)	0.44 (0.08)	0.42 (0.13)	1.39 (0.37)	1.48 (0.33)	2.49 (0.80)	1.41 (0.38)	6.13 (1.75)	6.19 (2.21)	10.02 (2.27)	9.98 (6.39)

**Note.:* MTL = Mean length of conversational turns; NTW = Total completed words; NDW = Number of different words; MLU = Mean length of utterance.

Table 4
Estimated marginal means and standard errors of each linguistic variable across condition (ENRICH versus active control) and timepoints (baseline versus one-year follow-up) for educators.

	ENRICH (*SE*)		Active Control (*SE*)		ENRICH (*SE*)		Active Control (*SE*)		ENRICH (*SE*)		Active Control (*SE*)	
	Baseline	One-year Follow-up	Baseline	One-year Follow-up	Baseline	One-year Follow-up	Baseline	One-year Follow-up	Baseline	One-year Follow-up	Baseline	One-year Follow-up
	Total utterances				**NDW**				**Questions**			
Book	20.24 (2.45)	16.55 (1.51)	22.45 (4.25)	19.81 (3.46)	35.87 (4.45)	27.15 (2.56)	23.40 (6.02)	35.74 (7.55)	4.03 (1.38)	4.80 (0.74)	6.33 (2.59)	5.95 (0.78)
Mealtime	12.31 (2.06)	10.73 (1.10)	14.34 (0.62)	13.82 (2.44)	16.42 (2.51)	21.42 (3.64)	22.01 (1.90)	25.02 (2.74)	3.63 (0.60)	2.28 (0.43)	4.87 (0.46)	3.44 (0.56)
Play	15.34 (1.18)	13.22 (0.76)	15.00 (1.48)	13.20 (1.33)	21.11 (1.62)	19.77 (1.37)	18.55 (1.76)	22.03 (1.98)	5.67 (0.75)	4.88 (0.61)	4.44 (0.72)	4.16 (0.64)
Group	18.80 (0.69)	14.71 (1.78)	18.21 (0.51)	14.45 (1.24)	20.27 (3.02)	22.96 (2.39)	18.68 (1.87)	20.44 (1.91)	4.98 (0.58)	3.64 (0.56)	4.41 (0.54)	3.30 (0.52)
Diapering/ toileting	17.95 (1.63)	17.95 (1.50)	18.20 (2.11)	15.42 (1.96)	25.36 (2.00)	29.72 (2.79)	25.91 (2.71)	30.75 (4.28)	4.22 (1.21)	5.76 (0.74)	5.90 (0.86)	4.89 (1.01)
	NTW				**MLU in morphemes**				**Yes/No responses to questions**			
Book	85.05 (6.99)	68.24 (6.24)	74.06 (21.83)	82.37 (16.27)	3.96 (1.10)	4.96 (0.70)	6.10 (1.45)	5.20 (0.38)	0.00 (0.00)	0.09 (0.05)	0.00 (0.00)	0.03 (0.03)
Mealtime	37.29 (7.50)	36.66 (4.44)	47.74 (3.63)	62.77 (8.76)	3.76 (0.20)	4.95 (0.35)	4.22 (0.22)	5.62 (0.29)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.02 (0.02)
Play	51.50 (4.62)	48.15 (4.28)	43.94 (5.74)	57.25 (7.21)	3.89 (0.18)	4.61 (0.25)	3.73 (0.19)	5.15 (0.17)	0.12 (0.08)	0.00 (0.00)	0.00 (0.00)	0.04 (0.03)
Group	45.83 (5.74)	64.78 (10.88)	44.23 (6.37)	50.36 (6.28)	4.12 (0.23)	5.10 (0.44)	3.93 (0.28)	4.80 (0.26)	0.00 (0.00)	0.00 (0.00)	0.03 (0.03)	0.00 (0.00)
Diapering/ toileting	54.83 (6.68)	70.19 (8.78)	52.32 (6.47)	59.55 (8.14)	3.56 (0.22)	4.27 (0.46)	3.00 (0.25)	5.45 (0.64)	0.11 (0.10)	0.00 (0.00)	0.00 (0.00)	0.03 (0.02)
	MTL				**Statements**				**Responsivity to questions**			
Book	3.60 (1.14)	0.49 (0.08)	1.16 (0.48)	1.09 (0.32)	11.65 (1.73)	8.40 (0.74)	9.93 (5.07)	8.98 (1.51)	3.30 (2.31)	14.19 (4.80)	11.48 (4.87)	7.50 (4.37)
Mealtime	2.06 (0.53)	2.86 (1.89)	2.81 (0.61)	0.99 (0.19)	6.50 (1.20)	7.32 (0.73)	6.55 (0.63)	9.40 (1.84)	5.02 (2.50)	3.10 (1.73)	8.17 (3.28)	11.63 (4.47)
Play	2.07 (0.33)	0.63 (0.08)	1.58 (0.33)	0.62 (0.05)	6.78 (0.62)	5.75 (0.41)	6.69 (0.74)	7.44 (0.82)	11.81 (5.65)	10.00 (2.66)	4.86 (2.52)	15.17 (2.12)
Group	2.86 (0.47)	0.87 (0.12)	3.24 (1.11)	0.94 (0.09)	4.91 (1.12)	8.71 (1.32)	6.12 (1.40)	7.05 (0.92)	6.18 (3.24)	−1.00 (0.69)	5.56 (2.46)	5.22 (2.62)
Diapering/ toileting	3.46 (0.94)	2.83 (0.60)	2.35 (0.62)	5.76 (2.19)	10.90 (1.43)	9.86 (1.18)	8.44 (1.50)	7.88 (1.20)	11.32 (6.39)	12.19 (4.50)	7.52 (5.28)	16.38 (9.86)

*_Note._ MTL = Mean length of conversational turns; NTW = Total completed words; NDW = Number of different words; MLU = Mean length of utterance.

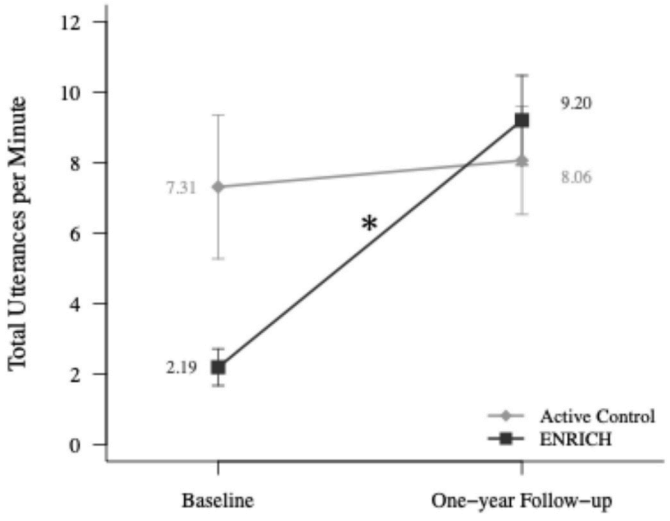

Fig. 2. Condition by time interaction effect for children's total utterances per minute during book-reading for ENRICH and Active Control conditions. *$p < .05$.

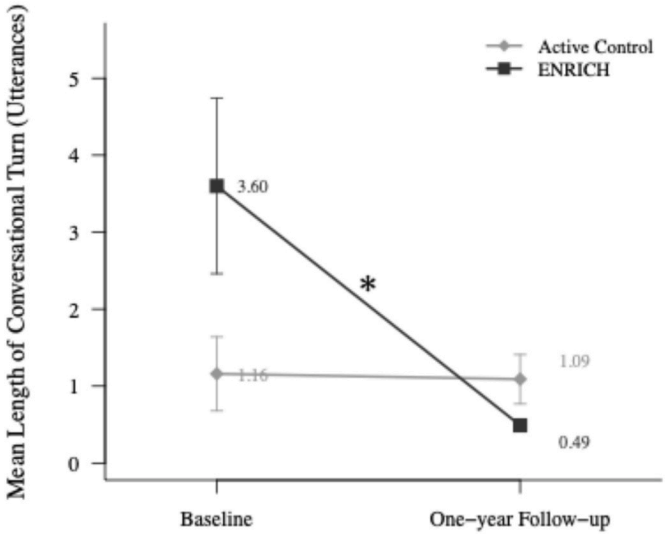

Fig. 3. Condition by time interaction effect for educators' mean length of conversational turns during book-reading for ENRICH and Active Control conditions. *$p < .05$.

conversational turn length for educators or children during diapering/ toileting.

5.6. ENRICH effects on mealtime, play, and group time

The GEE analyses showed no significant condition by time interactions for MLU, total completed words, number of different word types, statements, questions, yes/no responses to questions, responsivity to questions, or mean conversational turn length for educators or children during mealtime, play, and group time.

5.7. Sensitivity analyses

The results of the primary analyses were robust across all sensitivity checks. Both the inferential conclusions and the point estimates of the

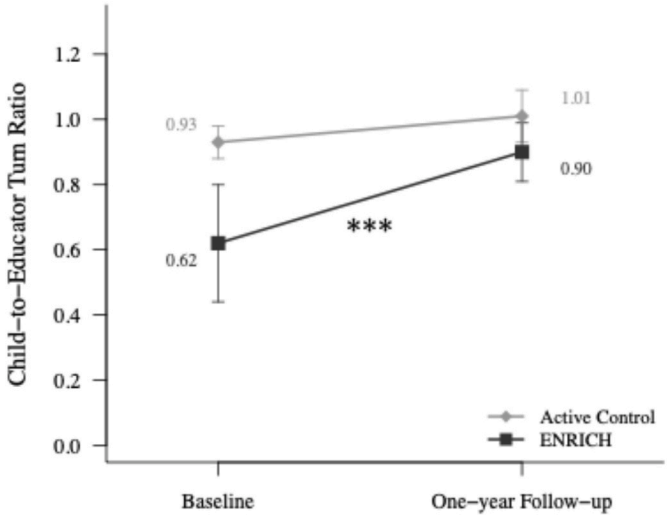

Fig. 4. Condition by time interaction effect for ratio of child-to-educator turns during book-reading for ENRICH and Active Control conditions. ***$p < .001$.

condition by timepoint interaction were consistent across all 20 model specifications (4 outcomes × 5 specifications), indicating that the reported findings are not sensitive to assumptions about the distributional family, link function, or working correlation structure (see Section S2 and Table S1 in the Supplemental Materials).

6. Discussion

The current study aimed to examine the impact of an educator-implemented oral language intervention (ENRICH) on the linguistic aspects of educator-child interactions across five contexts in toddler classrooms. Few other studies have examined long-term effects on educator-child interactions of large-scale interventions targeting infants and toddlers within ECCs (but see Bleses et al., 2020, 2024; Landry et al., 2014), and no previous intervention to our knowledge has analyzed resulting educator-toddler interactions at a fine-grained linguistic level. The study revealed three findings. First, as hypothesized, children in ENRICH centers showed significantly increased utterances during book-reading over time, while children in control centers showed no change. Second, supporting our predictions about serve-and-return interactions, educators in ENRICH centers used shorter conversational turn lengths during book-reading over time compared to educators in control centers. An exploratory analysis showed that ENRICH educators became more balanced in their back-and-forth exchanges over time, allowing more conversational turns for children. Third, contrary to our hypothesis, educators in ENRICH centers did not use significantly more complex utterances (MLU) during diapering/toileting over time compared to educators in control centers who increased in complexity over time.

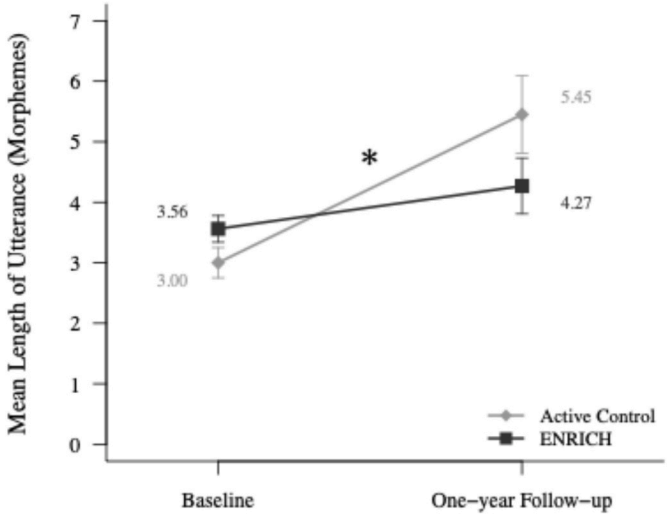

Fig. 5. Condition by time interaction effect for educators' MLU in morphemes during diapering/toileting for ENRICH and Active Control conditions. *$p < .05$.

6.1. ENRICH effects on book-reading interactions

As hypothesized, we found a significant interaction effect for children's total utterances during book-reading, with children in ENRICH producing more total utterances than control at one-year follow-up. This finding aligns with previous research showing that language interventions targeting rich language input can increase the amount of child talk during book-reading (Vanparys et al., 2024; Wasik & Hindman, 2014). This increase was impressive given that children in ENRICH centers were using significantly fewer utterances at baseline than children in control centers. The ENRICH intervention focuses on sensitive serve-and-return interactions during book-reading as well as other contexts. Combined with the finding that educators in ENRICH centers were also using shorter turn lengths as hypothesized at follow-up, this finding indicates that educators have become more interactive in their book-reading over time as a result of ENRICH.

Although turn length is not a direct representation of the number of turns taken between educators and children, it can serve as an indicator of the quality of turn-taking. Within the same time frame (per minute), shorter turn lengths suggest that more interactional turns were initiated by the speaker. Our exploratory analysis of the child-to-educator turn ratio confirmed that this change in educator behavior facilitated greater child participation over time. The significant increase in this ratio within the ENRICH group indicates that the educators' shorter turns created space for and were met with more turns from the children. This provides direct evidence that the intervention successfully shifted the dynamic toward more balanced, reciprocal interactions, rather than simply reducing educator talk. This pattern of results is consistent with studies highlighting the importance of conversational reciprocity for language development. For instance, coaching parents to increase turn-taking advances infant language outcomes (Ferjan Ramírez et al., 2020). Similarly, other experimental studies have shown that responsive, communication-facilitating behaviors, such as creating opportunities for children to contribute, support the language skills of both toddlers (Bleses et al., 2024; Landry et al., 2014) and preschoolers (Cabell et al., 2011; Justice et al., 2018). These interventions likely heightened educators' awareness of the importance of balanced, reciprocal interactions, encouraging them to create more opportunities for multiple children to initiate and contribute to conversations over time.

Similarly, the ENRICH training consistently emphasized the concept of serve-and-return, where educators actively respond to the child's initiations, creating a balanced, extended back-and-forth exchange that supports the child's language development and engagement in the conversation. The fact that these changes were observed specifically during book-reading may reflect the structured nature of this context, which provides natural opportunities for educators to pause, ask questions, and encourage children's contributions. The ENRICH intervention appears to have helped educators modify their interactive style during book-reading to better support children's active participation through serve-and-return exchanges.

Below (see Table 5) are examples of an ENRICH educator-toddler book-reading interaction (on the left) and a Control educator-toddler book-reading interaction (on the right) at follow-up (E = educator and C1 & C2 = child). Notice how the ENRICH educator uses language-promoting strategies such as asking questions, extending children's responses, and encouraging turn-taking. This contrasts with the Control educator, who primarily reads the text without inviting interaction,

resulting in longer turn lengths.

However, this change in the interactive nature of educators' speech was only observed during book-reading and not in other contexts. Book-reading is a more structured and focused activity that naturally lends itself to language-rich interactions. The book itself provides a shared context and visual cues that can facilitate conversation. Moreover, educators in ENRICH were trained in serve-and-return conversations and all ENRICH books contained conversation-starters on each page to help scaffold educators to engage in serve-and-return interactions. Perhaps educators needed more scaffolding to change the interactive qualities of speech in the other contexts.

6.2. ENRICH effects on diapering/toileting interactions

The only significant condition effect during diapering/toileting was that educators in the Control condition exhibited more syntactically complex speech over time compared to ENRICH educators, who increased only marginally in syntactic complexity. This result was counter to our hypothesis, so we interpret it with caution. The foundation of ENRICH training was to enhance serve-and-return interactions. Perhaps ENRICH educators were adjusting their sentence complexity more sensitively to toddlers' own sentence complexity, but it is difficult to know because there was no corresponding effect for children's speech in this context as there was in book-reading. Notably, previous research is mixed on the benefits of adults' syntactic complexity for very young children's language development (Bowers & Vasilyeva, 2011; Hoff, 2003, 2006).

Our findings on educators' MLU in morphemes during diapering/toileting can be viewed in light of previous research on linguistic attunement during caregiving interactions. Reissland et al. (2003) found that non-depressed mothers adapted their MLU based on their child's age, using shorter utterances with younger infants (around 6 months) compared to older infants (around 10 months). In contrast, mothers with depressed mood did not adjust their MLU, suggesting a lack of attunement to their child's developmental stage. However, the absence of a corresponding effect on children's speech in this context means we cannot confirm that the pattern in our data reflects responsive attunement.

Other studies conducted in the home and educational settings have argued that more complex adult speech is more beneficial for children's language acquisition (Gámez, 2015; Hoff, 2003). This argument stems from the idea that longer utterances often contain more diverse and sophisticated words, thus exposing children to a rich linguistic environment. In the current study, this finding was only observed during diapering/toileting and not in more learning-oriented contexts such as book-reading. Thus, we interpret this finding with caution and suggest that more work needs to focus on diapering/toileting as an opportunity for 1:1 high-quality language exchanges.

Table 5
Examples of educator-toddler book-reading interaction for ENRICH and Active Control.

ENRICH educator-toddler interaction	Control educator-toddler interaction
E: The cold goes … achoo! C1: Choo! E: Does [name] go achoo?	E: They only travel during the night. Only night cos they don't want the sun to … know that they were coming.
E: Ready?	E: But what happened next?
E: Achoo!	C1: At night.
C2: Choo.	E: They traveled where the sun is. Soon they reach the … reach the sun.
E: Achoo!	
E: Good job.	E: Help me build the walls, said Māui.
C1: Mmmm!	E: Hurry my brothers, the sun is beginning to … away.
E: You say ta please?	
C1: Ta please [reaching out C2 for cup].	E: The five brothers perched behind a wall.
C1: Please?	

*Note. Mean age of children in ENRICH center = 31 months. Mean age of children in Control center = 29 months.

6.3. The impact of ENRICH across other contexts

In sum, ENRICH resulted in some significant changes but varied by context. First, in line with our predictions, the intervention improved the interactive quality of conversations during book-reading, evidenced by increased child utterances, shorter educator turn lengths, and a more balanced child to educator turn ratio. Second, and contrary to our hypothesis, ENRICH was not associated as expected with educators using more syntactically complex language during diapering/toileting compared to control. Moreover, we did not find any significant impacts of ENRICH on educator-toddler language measures during mealtime, group, or play contexts. One explanation could be that these contexts usually involve many children sitting or playing together, either around a table or in a circle, limiting individual conversations between educators and children. Educators may find it difficult to implement the serve-and-return and linguistic features of ENRICH in large-group interactions.

These variations in the effects of language intervention across contexts are a reminder that educators likely require ongoing professional development and support to refine and tailor their teaching practices to adapt to different contexts over time. This aligns with findings from Gardner-Neblett et al. (2021) showing that coaching helps educators feel more confident in adapting their language practices across different classroom contexts. KTP offered workshops every 9 months and new resources every 4 months, but future versions could also offer Q&A sessions and individualized feedback to help educators with any ongoing issues they face during practice. To better understand what factors contribute to successful intervention implementation, it would be valuable to identify the centers that achieved the greatest improvements in the video project and explore the "active ingredients" that differentiate these centers from those that implemented ENRICH less successfully (see Burchinal et al., 2024).

6.4. Strengths, limitations, and future directions

This study examined the impact of an educator-implemented language intervention on toddler language development through naturalistic observation across multiple contexts within ECCs. The use of a naturalistic design is advantageous as it represents a more authentic, real-life scenario. However, conducting such a study is costly and time-consuming due to the involvement of multiple parties and the need for extensive travel, which explains why these studies are relatively rare compared to in-lab experiments. Moreover, it is even more challenging to retain a high retention rate for longitudinal studies. In this case, our follow-up data was collected during the Omicron outbreak in New Zealand, which led to significant absences and educator turnover during the first year of ENRICH. Given this difficult time for all, it is notable to find even limited benefits of ENRICH. The present study also achieved a high retention rate over the year, with 23 out of 24 centers remaining in the Video Project from the initial baseline to the one-year follow-up. This minimal loss of participating centers not only enhances the overall reliability and validity of the Video Project but also provides valuable insight into the individual and collective growth in the language used by these centers over time.

The current study has several limitations that should be acknowledged. While the ethnic composition of our sample was representative of Aotearoa New Zealand's diverse population, it underrepresented children from low-income families (Reese et al., in press). This limits the generalizability of our findings to more socioeconomically disadvantaged communities, where the impact of such interventions might be different. Another limitation is that since we used GEE for our analysis, we were unable to calculate standardized effect sizes, as GEE is based on

population-level estimates rather than sample-based estimates. However, the unstandardized effects can be readily interpreted using the original unit of measurement. For instance, our main finding showed that children in ENRICH centers increased from baseline rates of only 2 utterances/minute ($SE = 0.52$) during book-reading to over 9 utterances/minute ($SE = 1.27$) at follow-up (see Table 3). This increase represents meaningful real-world change.

Our data collection was limited to a maximum of 25 minutes in each center over a 90-minute timeframe, which may not have captured representative interactions of all the relevant contexts. Some important language-rich contexts (e.g., book-reading) could have occurred outside the timeframe of our observations, and we were unable to include them in our analysis. This time constraint may have led to an incomplete representation of the language environment in the participating centers.

The intervention did not significantly impact some key indicators of language quality, such as lexical diversity, for either educators or children. This lack of effect on vocabulary was unexpected given ENRICH's emphasis on supporting children's vocabulary using serve-and-return interactions during book-reading and other contexts. It is possible that changing habitual vocabulary use may require more training sessions and more time. To address this, we are continuing to assess the ongoing effects of ENRICH up to 2 years later in these same centers in terms of the quantity and quality of educator-child language interactions. These analyses will track changes in diverse vocabulary at further follow-ups in this study, when children are older and educators have implemented the intervention for longer.

7. Conclusion

In conclusion, this study provides preliminary evidence that training educators to engage in language-rich conversational techniques can positively impact educator-toddler interactions in the short-term, particularly in the context of shared book-reading. This research contributes to the existing literature on methods for enhancing the quality of early language intervention programs serving toddlers. However, the precise ways in which educators modulate their language use across classroom settings and the subsequent effects on children's language growth require further research. Examining the mechanisms underlying effective language interventions can inform professional development models that support educators in engaging children in high-quality interactions across learning contexts. Investing in enriching the language environment of early childhood settings is of great importance given the significant impact of early linguistic experiences on later academic and social outcomes.

CRediT authorship contribution statement

Yuxin Zhang: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Tuğçe Bakir-Demir:** Writing – review & editing, Supervision, Project administration, Formal analysis, Data curation. **Mele Taumoepeau:** Writing – review & editing, Supervision, Resources, Methodology, Conceptualization. **Karen Salmon:** Writing – review & editing, Methodology, Conceptualization. **Elaine Reese:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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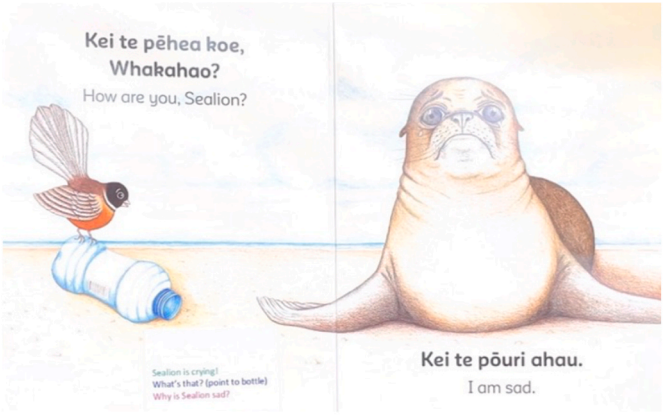
Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tate.2026.105596.

APPENDICES.

Appendix 1. An example of ENRICH book prompts (green for less challenging; blue for moderately challenging; and magenta for more challenging)



Fantail (point) is saying hello to kōkako (point).
What's her name? (point to kōkako)
Who's that? (point to baby)
Why is kōkako excited?

There's Fantail again (point) and there's Tuatara (point).
What is Fantail doing? (eating a worm)
Do you ever get grumpy (hōhā) like Tuatara?

Sealion is crying!
What's that? (point to bottle)
Why is Sealion sad?

Data availability

The authors do not have permission to share data.

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