Spring 2023

Enticing Communication: An Examination of Environmental Arrangement Strategies in Early Intervention Settings

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Under the Advisement of Dr. Heather Moore

June 7, 2023

Language learning is an essential component of child development. Most children develop language naturally as they interact with their family and community, but some children experience communication delays due to unknown reasons or secondary to developmental disabilities (e.g., Autism, Down syndrome, Cerebral Palsy). For very young children with communication delays, intervention by a qualified speech-language pathologist (SLP) has been shown to improve language and communication skills (Akamoglu et al., 2016). One intervention approach, which has been widely researched and is considered best practice, is naturalistic communication intervention (Hemmeter & Kaiser, 1994). Naturalistic communication intervention (NCI) encourages functional communication in everyday activities and involves sets of strategies that 1.) expose children to language input, 2.) encourage children to communicate for a variety of reasons (e.g., to request, to comment), and 3.) provide linguistic feedback to children after they communicate (Pretti-Frontczak & Bricker, 2004). Often, experts (typically SLPs) teach parents or teachers to implement NCIs during day-to-day interactions at home or in childcare/educational settings (termed parent-implemented NCI or teacher-implemented NCI) (Akamoglu & Meadan, 2018; Kaiser & Roberts, 2011).

In recent years, researchers have shown that experts can successfully coach others to effectively implement NCIs and both parent-implemented and teacher-implemented NCI has a measurable effect on child language abilities (Akamoglu & Meadan, 2018; Heidlage et al., 2018). Akamoglu & Meadan (2018) conducted a scoping review of 20 NCI studies with parent outcomes between 2000-2016 and all demonstrated an increase in the frequency of NCI strategies utilized by parents following intervention. Nineteen of those studies also measured child outcomes (a total of 381 children across the studies) and all demonstrated improvements in child language and

communication. Heidlage et al. (2018) conducted a systematic review of 25 randomized controlled trials (a total of 1434 child participants across the studies) of parent-implement NCIs. Moderate increases were found in child expressive vocabulary and slight increases in total child expressive language following intervention. Both of these reviews show positive outcomes in a child's communication and expressive language abilities with strong evidence supporting the success of NCIs.

Environmental Arrangement

A core component of NCI, most commonly referred to as "environmental arrangement" (EA), involves a set of strategies used by intervention agents (e.g., parents, teachers, SLPs) to entice a child to communicate without direct instruction. These strategies are sectioned into two categories: those that encourage requesting and those that encourage commenting. The requesting strategies are used to prompt a child to ask for desirable items; the commenting strategies are used to prompt a child to remark on interesting details in their environment.

Environmental Arrangement Literature Review

The authors of this paper conducted a review of the EA literature base. The following search terms were put into Google Scholar: "environmental arrangement", "environmental arrangement toddler speech therapy", "communication delay environmental arrangement", "environmental arrangement strategies toddlers", "children with communication delays". Twenty-six peer-reviewed journal articles, which included EA strategies, were identified (marked with an * in our reference list), including 22 experimental studies and 4 expert opinion articles. All articles were published between 1981 and 2021. The articles were reviewed to determine whether the

authors a.) defined EA, b.) identified the settings in which EA strategies were used and the

people who implemented EA (i.e. agents), c.) listed and described specific EA strategies, and d.)

measured EA strategy use and then linked use to specific child outcomes. Findings are

summarized in Table 1 and described below.

Defining EA. Although all studies included the use of EA strategies, only 58% included a

specific definition for EA, and across those studies the way EA was defined varied considerably.

In one article EA was described as simply "creating a need to communicate," which albeit

accurate, isn't very descriptive (McCathren, 2010, p. 247). Others were detailed, describing EA

as when an adult "arranges the environment to set the stage for adult-child interactions and to

increase the likelihood that the child will initiate to the adult" (Kaiser & Roberts, 2012, p. 7).

Keywords, such as "modify," "set up," and "arrange," were often paired with the term

"environment." The variability in which EA is described creates a significant problem for

practitioners because it leaves the precise meaning of EA open to interpretation.

Settings and Agents. Settings and intervention agents also varied across studies. The vast

majority of the articles (16/25) were parent-implemented NCIs (e.g. Hemmeter & Kaiser, 1994;

Kashinath et al., 2006; Moore et al., 2014). Four were teacher-implemented (Schwartz et al.,

1989; Halle, et al., 1981; Kaiser et al., 1993; McCathren, 2000) and one was

clinician-implemented (Hwang & Hughes, 2000). Most studies implement NCI during play

routines (72%), but others implemented NCI during home routines (32%) or school routines

(12%).

Strategies. Specific strategies that were considered EA also varied across studies. "In View and Out of Reach" (IVOR) was most frequently cited (15/25), followed by selecting materials that require assistance (12/25), and selecting desirable materials (12/25). See Table 1 for a comprehensive list of EA strategies found in the reviewed literature as well as the articles which referenced each strategy.

Table 1. Environmental arrangement strategies described in the research literature.

Strategy	Definition	Articles Cited in
Material Selection	Specifically choosing a variety of materials that are desirable to the child.	Erturk et al. (2021); Halle & Anderson (1984); Hemmeter & Kaiser (1990); Hwang & Hughes (2000); Kaiser et al. (1993); Kashinath et al. (2006); Lane et al. (2016); McCathren (2000); McGee et al. (1999); Moore et al. (2014); Roper & Dunst (2003); Wetherby & Woods (2016); Windsor et al. (2019); Woods & Kashinath (2007)
Arrange/Manage Materials	Agent of intervention is in control of the materials.	Erturk et al. (2021); Halle & Anderson (1984); Hemmeter & Kaiser (1990); Hwang & Hughes (2000); Kaiser et al. (1993); Kashinath et al. (2006); McCathren (2000); McGee et al. (1999); Moore et al. (2014); Windsor et al. (2019); Woods & Kashinath (2007)
Assistance	Choosing materials and toys that require the child to request help from an adult.	Erturk et al. (2021); Fey (2006); Halle & Anderson (1984); Hemmeter & Kaiser (1990); Hwang & Hughes (2000); Kaiser et al. (1993); Kashinath et al. (2006); McCathren (2000); McCathren (2010); McGee et al. (1999); Moore et al. (2014); Windsor et al. (2019); Woods & Kashinath (2007)
In View and Out of Reach (IVOR)	Placing a desirable object(s) out of reach of the child but where they can see it in order to prompt the kid to request.	Erturk et al. (2021); Fey (2006); Halle & Anderson (1984); Halle et al. (1981); Hemmeter & Kaiser (1990); Hwang & Hughes (2000); Kaiser et al. (1993); Kashinath et al. (2006); Lane et al. (2016); McCathren (2000); McCathren (2010); McGee et al. (1999); Meadan (2016); Roper & Dunst (2003); Wetherby & Woods (2016); Windsor et al. (2019); Woods & Kashinath (2007)
Piece by Piece	Doling out a desirable set of food or toys one at a time, requiring the child to request each piece in turn.	Erturk et al. (2021); Halle & Anderson (1984); Kaiser et al. (1993); Schwartz et al. (1989); Windsor et al. (2019); Woods & Kashinath (2007)
Withholding	Withholding a desirable object from a child to prompt a request for it.	Erturk et al. (2021); Halle et al. (1981); Halle & Anderson (1984); Hemmeter & Kaiser (1990); Kaiser et al. (1993); Lane et al. (2016); McCathren (2010); McGee et al. (1999); Moore et al. (2014)
Time Delay	After providing an opportunity to communicate, waiting for an appropriate length of time for the child to take advantage of the opportunity without verbal prompting.	Halle et al. (1981); Halle & Anderson (1984); Hemmeter & Kaiser (1990); Hwang & Hughes (2000); Kashinath et al. (2006); Lane et al. (2016); McGee et al. (1999); Meadan (2014); Meadan (2016); Schwartz et al. (1989); Windsor et al. (2019); Woods & Kashinath (2007)
Unexpected / Silly	Introducing something new, unexpected, or silly into an interaction in order to prompt communication.	Erturk et al. (2021); Fey (2006); Moore et al. (2014); Roper & Dunst (2003)
Pausing Play	Halting an enjoyable activity so that the child needs to request the adult to continue (ex: cloze procedure).	Halle et al. (1981); Halle & Anderson (1984); McCathren (2000); Meadan (2016); Roper & Dunst (2003)

EA Outcomes and Measurement. Most of the studies examined the effect of their entire NCI

program on intervention agent and child outcomes and did not directly measure use of EA as an

outcome variable. Only seven studies specifically measured agent use of EA following training

(Erturk et al., 2021; Hemmeter & Kaiser, 1990; Hemmeter & Kaiser, 1994; Kaiser et al., 1993;

Kashinath et. al., 2006; Lane et al., 2016; Woods & Kashinath, 2007). Throughout the articles,

EA was measured in a variety of different ways. Both Lane (2016) and Hemmeter and Kaiser

(1990) directly counted parent's use of EA, while both Kashinath et al. (2006) and Woods &

Kashinath (2007) measured the frequency of EA as a target strategy usage per session. Erturk et

al. (2021) calculated the percentage of treatment fidelity in 5-, 4-, and 8- item task analyses. Only

one variable remained constant throughout the studies: all EA measurements were conducted

from video analysis. Across all the reviewed literature, there was not one method determined to

best measure EA use.

Just three studies tied EA strategy use to a specific child outcome; child engagement and

spontaneous language use (Hemmeter & Kaiser, 1990), communicative responses and targets

(Kaiser et al., 1993), and vocal initiations/responses (Lane et al., 2016). Only Hemmeter and

Kaiser's 1990 study concluded that, for their single parent-child dyad, "child engagement and

spontaneous language use and father responsiveness to child requests and attempts to teach

language all increased" as a result of EA interventions.

Literature Review Summary. The definition of EA, intervention agents implementing EA, and

the manner in which EA was measured varied considerably across the studies reviewed. Most of

the articles discussed EA as one component of NCI, not a separate and distinct set of strategies

that can be linked directly to child outcomes. As a result, the effectiveness of using EA strategies has not been effectively measured, even though most NCI researchers claim EA is effective and teach EA strategies as part of their NCI programs.

Effect of EA Strategy Use on Child Rate of Communication

Since the overarching reason for using EA strategies is to entice a child to communicate more frequently, it could be hypothesized that when intervention agents increase their use of EA strategies that child rate of communication would increase. Therefore, child rate of communication is an obvious way to measure the effectiveness of EA strategy use. As reported above, no studies have examined EA strategy use on child rate of communication.

Measuring Rate of Communication

Although rate of communication hasn't been directly studied in relation to EA strategies, rate of communication has been calculated as both a child outcome and a predictor of overall language outcomes in numerous studies (e.g. McCathren et al., 1999; Paul & Roth, 2011; Crais et al., 2009; Calandrella & Wilcox, 2000). Rate of communication is typically calculated by counting the number of times a child communicates in a recorded language sample and dividing that by the number of minutes in a language sample.

The Present Study

This study describes the outcomes of a quasi-experimental study conducted to determine the effect of parent-implemented EA strategy use during daily home routines on child rate of communication. Specifically, we posed the following research questions and hypotheses:

1. Is child communicative rate related to caregiver use of EA strategies? Since use of EA strategies are meant to provide more opportunities for children to communicate, it is anticipated that consistent use of these strategies by caregivers during home routines will cause children to communicate more often.

2. Is child rate of intentional initiation related to caregiver use of EA strategies? Since use of EA strategies are meant to provide more opportunities for children to communicate without prompting, it is anticipated that consistent use of these strategies by caregivers during home routines will cause children to intentionally initiate more frequently.

3. Is child rate of requesting related to caregiver use of EA requesting strategies? Since EA requesting strategies are intended to encourage children to request, it is anticipated that successful use of EA requesting strategies will cause children to request more often.

4. Is child rate of commenting related to caregiver use of EA commenting strategies? Since EA commenting strategies are intended to encourage children to comment, it is anticipated that successful use of EA commenting strategies will cause children to comment more often.

Method

Participants. Data for the 10 caregiver-child dyads in this study were obtained from a larger data set collected from families who participated in the Language and Play Every Day (LAPE) program over a 4-year period. At the time this analysis was conducted, these were the only participants whose data were available for requisite time periods (before and after intervention).

Demographic information was gathered from a Family Questionnaire completed by the caregiver at post-intervention and the child's early intervention treatment plan (if the child had one) supplied by their early interventionist at pre-intervention.

Of the 10 children included in this study, there were 2 females and 8 males. Their ages ranged from 17 months to 43.7 months with a mean of 29.52 months. None of the children had received services from an SLP previously and all but one were either currently receiving services or had previously received services from an Early Intervention specialist. Data were also gathered recording how many areas of delay (e.g., cognitive delay, fine or gross motor delay, social emotional delay), in addition to communication, the children exhibited on a scale from 0 (no additional areas of delay) to 5 (five additional areas of delay). The participants ranged from having a minimum of 1 additional area of delay to 5 additional areas of delay; the mean amount was 2 additional areas of delay.

The caregivers who acted as the primary agents of intervention were aged 24- to 43-years old, with a mean of 32-years. All but one of the caregivers in the videos were the children's mothers (one father also participated). Four caregivers had "vocational training or some college, but no degree" and three selected "Master's, Doctoral, Medical, Law, or other professional degree." One caregiver selected "high school diploma, GED, or equivalent," one selected "Bachelor's degree," and one selected "Associate's degree." Two families made over $80,000, three families made between $50,001 and $60,000, two families made between $30,001 and $40,000, one family made between $40,001 and $50,000, one family made $10,000 or less, and one family preferred not to answer.

Language and Play Every Day (LAPE)

The LAPE program LAPE is an established evidence-based caregiver-implemented naturalistic communication intervention (CI-NCI; Cycyk, et al., 2020; Moore et al., 2014) that teaches caregivers to use language-facilitating strategies during their daily home routines (e.g., diapering, dressing, play, reading, shopping) in order to provide consistent, high-dosage intervention to their young children with language disorders. The LAPE curriculum includes four components that together target 16 CI-NCI strategies. The components include "Get Ready for Success" (i.e., setting up success- ful caregiver–child routines for targeting communication), "Create Communication Opportunities" (i.e., environmental arrangement strategies), "Watch and Identify" (i.e., waiting for child initiation and responding contingently), and "+1 Respond to Teach Something New" (i.e., expanding on children's communication attempts). The CI-NCI strategies within each component are specifically chosen to increase child (a) rate of intentional communication, (b) rate of initiation, and (c) expressive and receptive vocabulary size.

The 10 families included in this study participated in an average of 6 total LAPE group sessions (range of 5 to 7) over an average of 2.84 months (range 1.6 to 4.8). All received two individual assessment sessions (pre- and post-intervention), as well as a combination of group caregiver coaching sessions, and individual coaching sessions. All assessment and group coaching sessions took place in a community center while children attended a playgroup in a separate room. All individual coaching sessions took place in the families' homes. Licensed SLPs supervised graduate students enrolled in a speech-language pathology clinical training program who implemented the program.

Table 2. Coaching activities used to teach LAPE strategies.

Group Coaching	All new components and corresponding strategies were presented to the group as supported by written material and video reviews. Caregivers received handouts that defined and described the strategies and were encouraged to take these materials home to share with others and use for future reference. Videos collected from other caregivers of young children with language disorders provided examples of strategy use. While watching the videos, caregivers identified when caregivers in the videos used the targeted strategies and brainstormed on missed opportunities.
Group Discussions	Caregivers participated in group discussions to reflect on their own use of communication strategies at home and offer peer support to other caregivers.
Reflection	Caregivers watched their own video-recorded home routines and individually reflected with coaches about times when they used specific strategies and how their child reacted as well as times when they could have used the strategies to further encourage communication.
Practice	Caregivers had the opportunity to practice implementing the strategies in routines with their children during the home visit and reflect in real time with the coaches (and coaching supervisors) about strategy use. If needed, coaches modeled the targeted strategies within the routine.
Individual Coaching	Caregivers met individually with their coaches and discussed how to embed strategies into their home routines at the end of most coaching sessions. Together, they developed detailed written plans for home implementation in between sessions.

Measures

Caregiver–Child Interaction Samples. At pre- and post-intervention, families video-recorded a minimum of two home routines selected in consultation with the LAPE intervention team to assess both caregiver and child communication outcomes. Caregivers received a digital camera and visual and verbal instructions for recording at least 5 min of a chosen home routine. The first recordings were completed after the first LAPE-e session and brought to the intervention assessment session, whereas the second recordings were completed after the last intervention session and brought to the post-intervention assessment session.

For this study, a total of 13 pre-intervention/ post-intervention videos were used, including three sets of videos for the same caregiver-child dyads. Home routines included toy play, shared reading, meal time, and personal care.

A multistep process was followed to select and analyze the videos. First, two trained graduate students reviewed all of the pre- and post-intervention videos in their entirety. Caregivers recorded between two and four videos at pre-intervention and between two and five videos at post-intervention, varying in length from 1 to 30 min. Because the quality of the videos was quite variable, 5 min of pre-intervention and post-intervention videos were retained and selected for analysis for each family if (a) the caregiver and the child were visible in the camera frame, (b) the caregiver and the child interacted during the recording, and (3) the language used by the caregiver and child was audible. Several videos included two caregivers; however, only data for caregivers who attended the majority of the intervention sessions were used when analyzing caregiver outcomes. Efforts were made to select the same routine for pre- and post-intervention.

Videos between 1 and 5 min were analyzed in their entirety, whereas 5-min segments judged to represent the greatest amount of caregiver–child interaction were analyzed for longer videos.

For every pre- and post-video, undergraduate and graduate students independently transcribed and coded the videos online using a *Language and Play Every Day (LAPE) Caregiver-Child Transcription and Coding Manual* created by Dr. Heather Moore. Under the direction of Dr. Heather Moore, a research assistant would transcribe a video. Then, a second research assistant would review and check for any inconsistencies and make the needed changes. After this step, a third research assistant would code the verbal and non-verbal communicative behaviors of both the caregiver and the child. After, a fourth assistant would code verbal and non-verbal communicative behaviors independent of the first coder. This method was completed for every pre- and post-video. Overall reliability for the larger data set is 85%.

Analyses. Data were collected from the coding sheets of 13 fully transcribed and coded video sets. Data were also pulled from a collection of paper files compiled for each patient. Data collected from the coding sheets and paper files were inputted into the statistical software SPSS. After the information was pulled and organized, a visual inspection of the data was sufficient to analyze trends because of the small sample size.

Multiple variables examined were calculated to find specific rates using the length of the video in minutes for each pre- and post-video.

Table 3. Formulas used to calculate rates.

Variable Name	Formula
Child communicative rate	Number of intentional communicative turns / video length
Child rate of intentional initiation	Number of intentional initiations / video length
Child rate of requesting	Number of requests / video length
Child rate of commenting	Number of comments / video length
Adult EA requesting rate	Number of EA requesting strategies used / video length
Adult EA commenting rate	Number of EA commenting strategies used / video length

EA with time delay (TD) refers to when an adult, after providing an opportunity to communicate, waits for an appropriate amount of time for the child to take the opportunity. The amount of time needed depends on the EA strategy used.

Results

Results are presented below, according to the stated research hypotheses.

Research Question 1: Relationship Between Caregiver Use of Environmental Arrangement Strategies and Child Rate of Communication

When comparing means from pre-intervention (Pre-TX), to post-intervention (T1), caregivers increased their rate of use of EA strategies (with TD) from 0.82 to 1.25 times per minute and children increased their rate of intentional communication from 7.35 to 8.3 times per minute (see Figure 1).
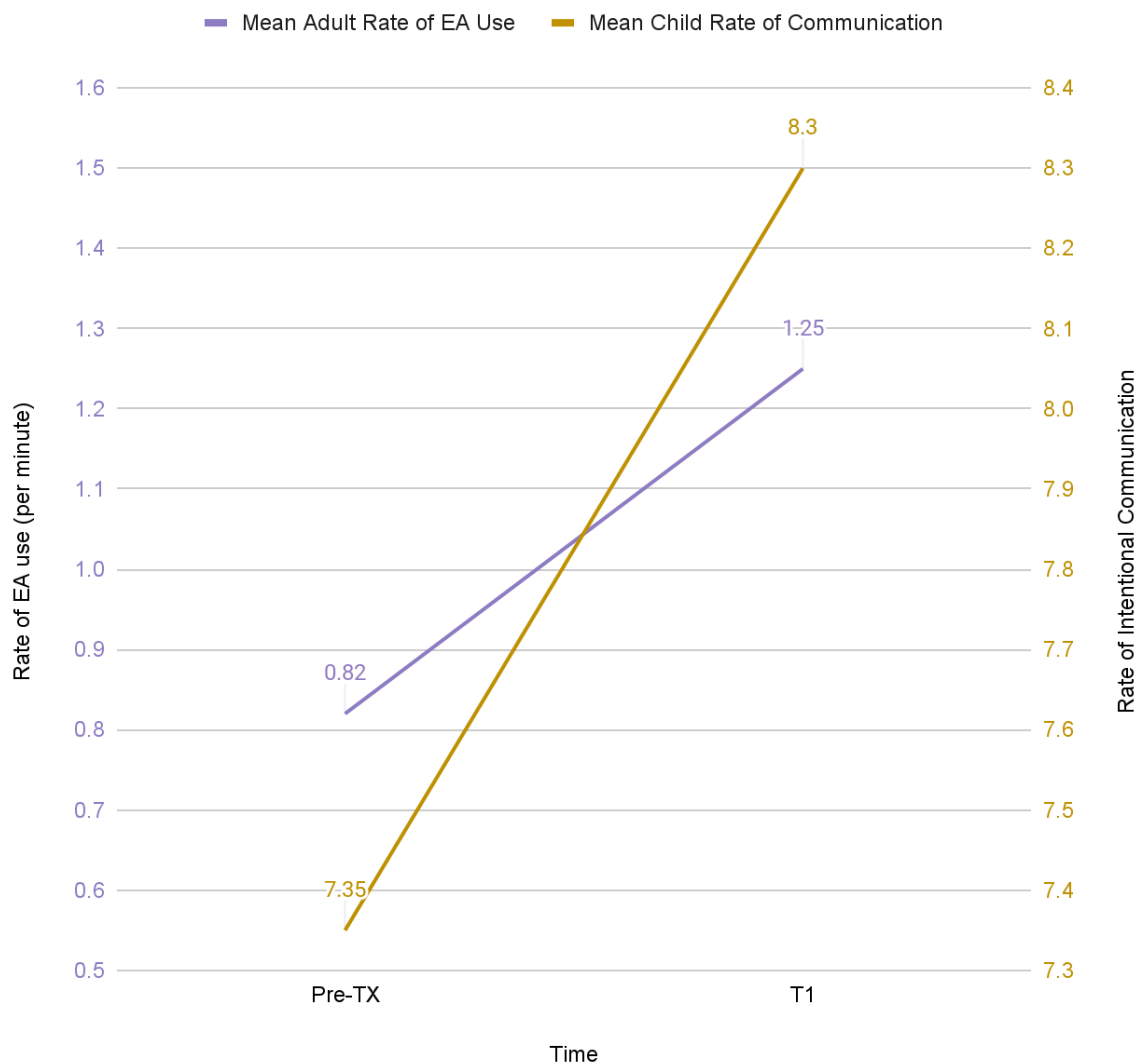
Figure 1. Mean adult rate of EA use and child rates of intentional communication (n = 13) across timepoints.

However this trend was not consistent across caregivers; 46% of caregivers increased their use of EA, 31% of caregivers decreased their use of EA, and 23% of caregivers registered no change (see Figure 2.).
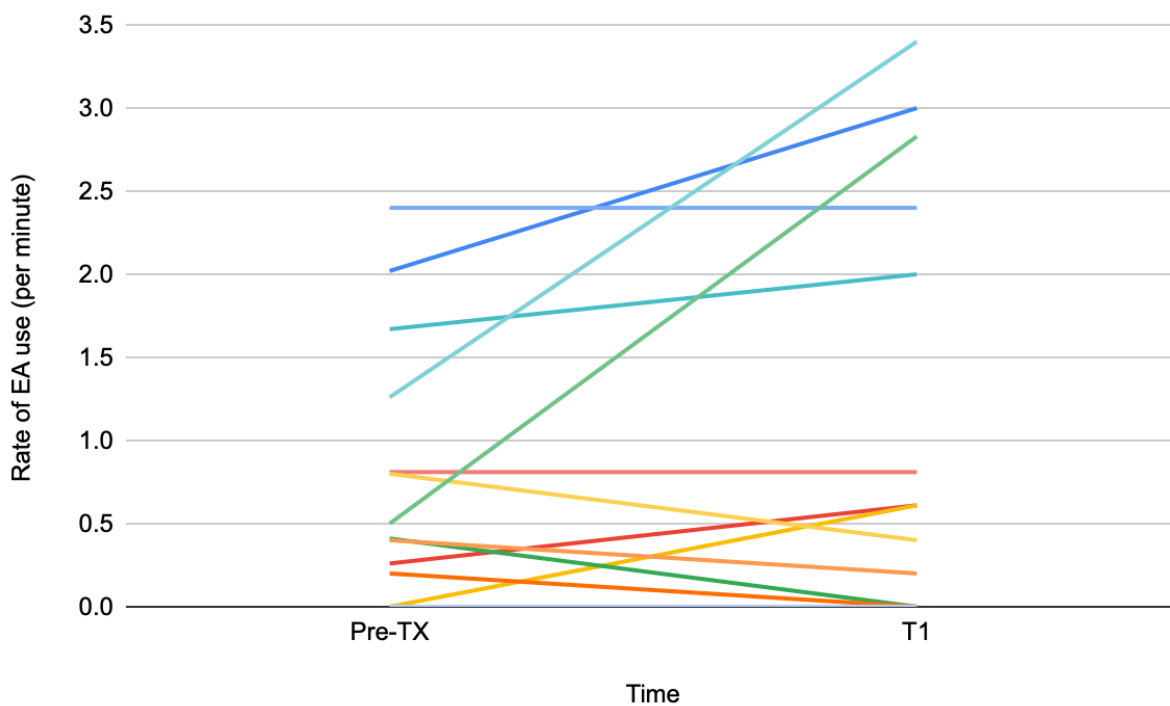
Figure 2. Adult rates of EA use for each caregiver (n = 13) across timepoints.

The trend was also not consistent across children. While 46% of children increased their rate of communication, 23% did not demonstrate a significant change in rate of communication, and 31% slightly decreased their rate of communication (see Figure 3).
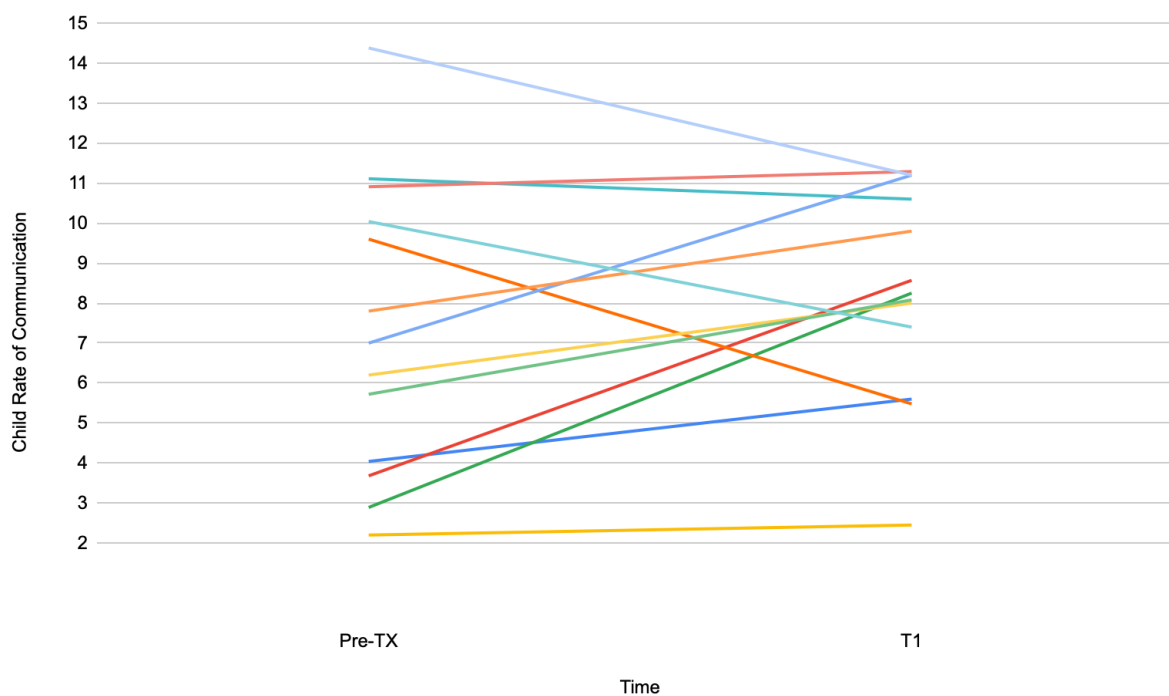
Figure 3. Child rate of communication across timepoints (n=13).

Most significantly, the caregivers who increased their rate of EA (with TD) use did not

consistently align with the children who increased their rate of communication (as indicated by

matching colored lines in Figures 2 and 3).

Research Question 2: Relationship between Caregiver Use of Environmental Arrangement

Strategies and Child Rate of Intentional Initiation

When comparing the means rate of EA usage from pre-intervention (Pre-TX), to

post-intervention (T1), caregivers increased their rate of use of EA strategies from 0.82 to 1.25

times per minute and children increased their rate of intentional communication from 3.62 to

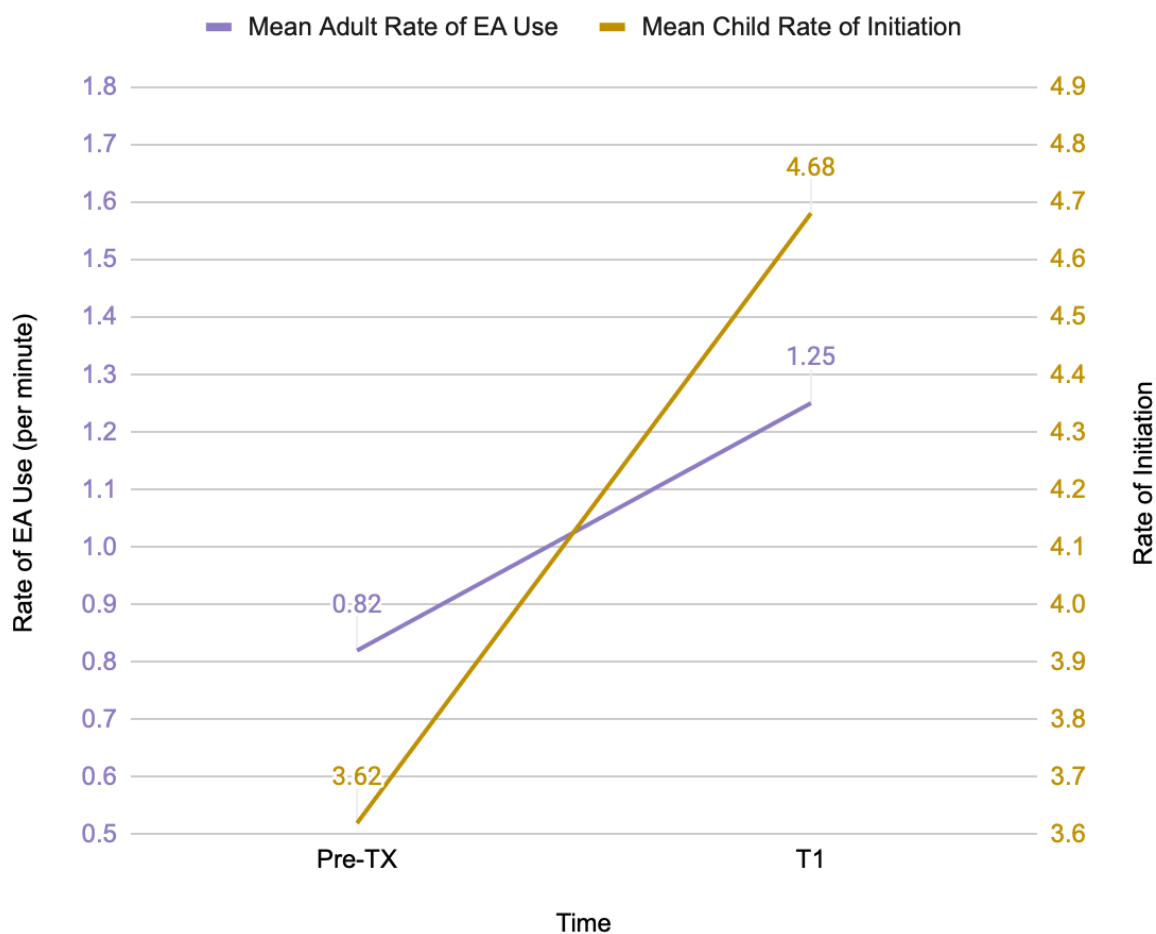4.68 times per minute (see Figure 4).

Figure 4. Mean adult rate of EA use and mean child rate of initiation across timepoints (n=13).

Inconsistently, 69% of the children increased their rate of intentional communication from Pre-TX to T1 and 31% had a decrease in rate of intentional communication (see Figure 3).

Research Question 3: Relationship between Caregiver Use of Requesting Strategies and Child Rate of Requesting

The data on adult use of EA requesting strategies and child rate of requesting revealed a general upwards trend across participants. As seen in Figure 5, across the 13 caregivers from Pre-TX to

T1, there was a 0.37 increase on average in EA rate of requesting. This trend is similar to the

child rate of requesting that increased by 0.62 on average from Pre-TX to T1.
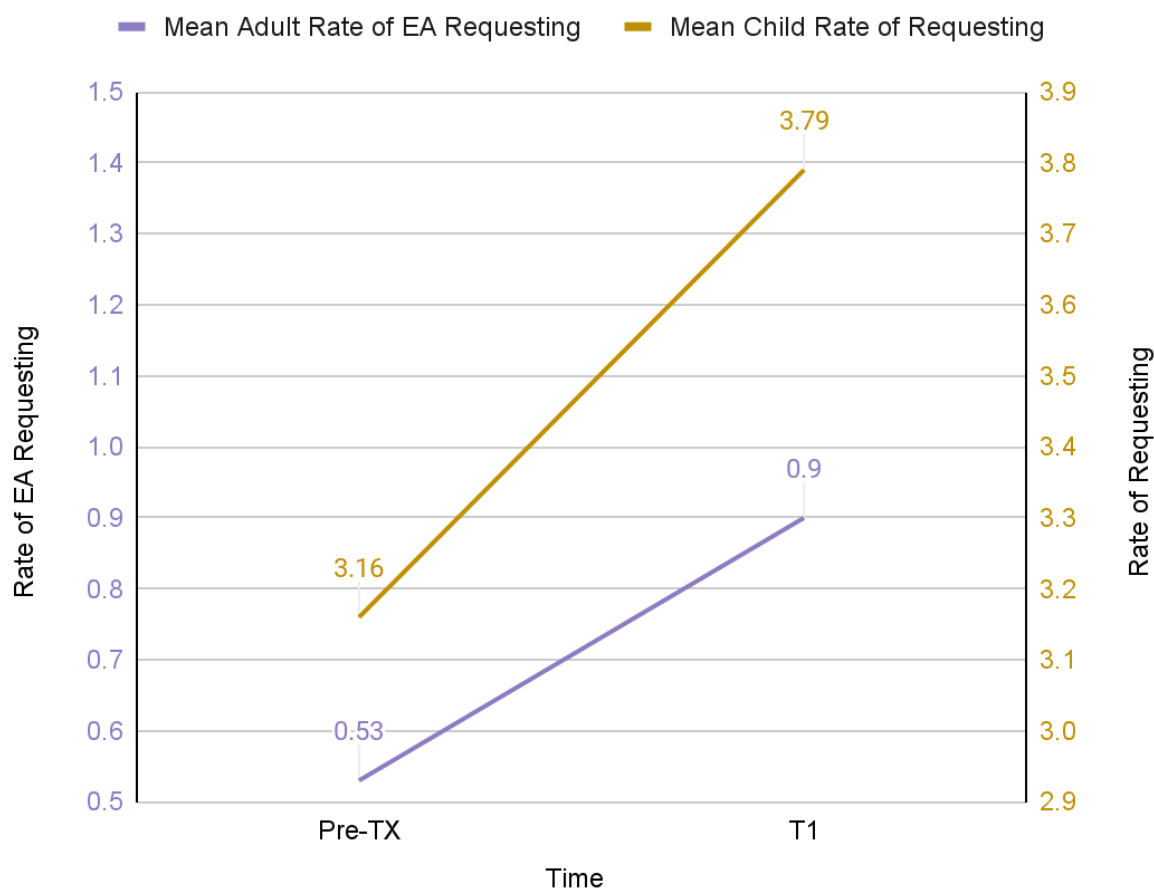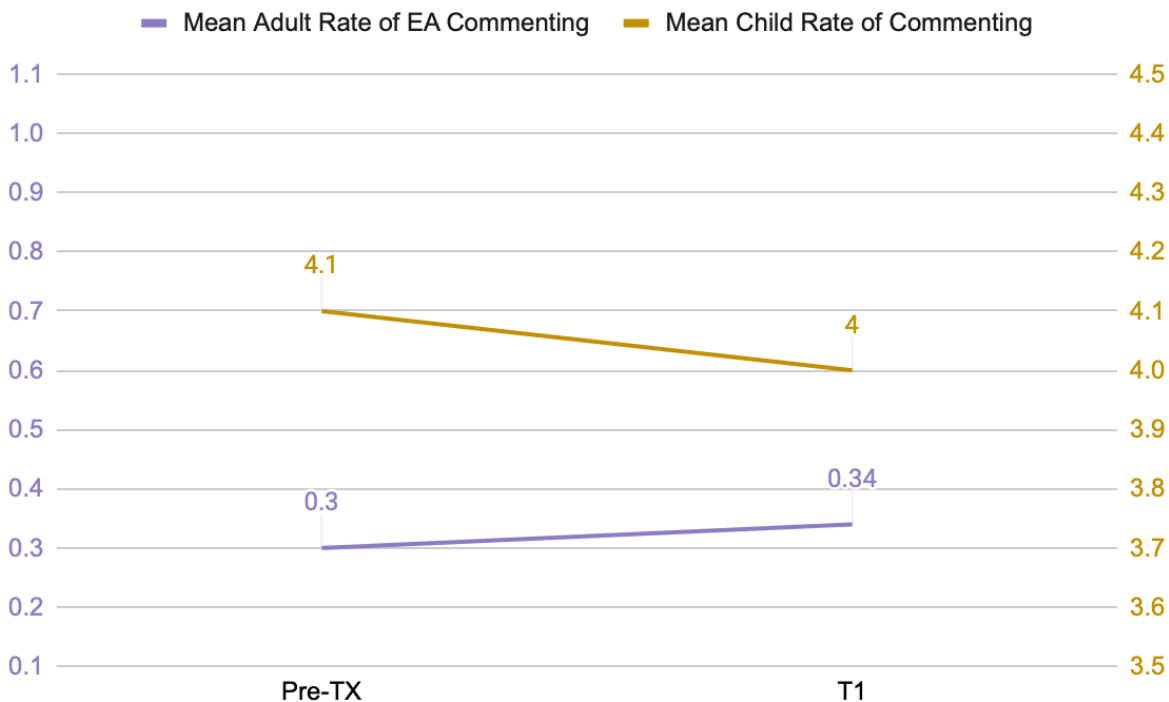

Figure 5. Mean adult rate of EA requesting strategies and mean child rate of requesting across

timepoints (n = 13).

Research Question 4: Relationship between Caregiver Use of Commenting Strategies and

Child Rate of Commenting

The extremely slight upwards trend was observed when examining adult use of EA commenting

strategies. As seen in Figure 6, across the 13 adults, there was a slight increase of 0.04 on

average in the rate of EA commenting from Pre-Tx to T1. This same pattern was not seen with

the mean rates of the children where there was, on average, a 0.1 decrease in child rate of commenting.

Figure 6. Mean adult rate of EA commenting strategies and mean child rate of commenting across timepoints (n = 13).

Discussion

We hypothesized that when caregivers increased their rate of EA strategy use during home routines following intervention, we would see a corresponding increase in the rate of communication and intentional initiation in their children. Similarly, we predicted that child rates of requesting and commenting would increase alongside caregivers' use of specific EA strategies that encourage child requesting and commenting. While mean data supported a relationship between EA use and rate of intentional communication, there was no clear relationship when looking at trends by child-caregiver dyad. Video samples in which children increased their

communication rate during home routines from pre-intervention to post-intervention, did not consistently show that caregivers increased their rate of use of environmental arrangement strategies. Therefore, a clear relationship between these variables was not identified.

When looking at the averages of the data, we saw an increase in EA strategies which may indicate that parents learned and improved their use of EA strategies through the LAPE program. However, these increases were rather small, given the length of intervention. We saw a slight increase in the children's rate of communication. This change could be accounted for by the natural progression of a child's language development.

Limitations and Future Research

There are several factors that may have influenced these results. Sample size was a clear limitation of the study: there were only 13 video sets studied and the video speech samples were under 5-minutes long. Due to the small number of participants, we could not run any statistics. Additionally, the video samples might not be representative of the caregivers' learning or children's communicative rate purely because of time limitations. The caregivers self-reported how often they used EA strategies, but their reports varied considerably from how many EA strategies were observed and coded in the video samples.

Of the children selected for this current study, many started with high rates of communication, which might have influenced the results and may explain why we didn't see higher increases in the participants' rate of communication. Caregivers were told during the intervention that EA strategies were most effective for children with communicative rates under 2-times per minute.

The average communicative rate for this sample was over 7-times per minute. Therefore, by the end of the intervention, caregivers might have found some of the LAPE strategies to be more effective for their children and therefore weren't using the EA strategies.

This current study involved a very small sample. The larger LAPE study included more than thirty families and would be better representative of the population. When a larger data set is available, we will be able to run statistics to determine if there is a statistically significant correlation between caregiver EA usage and child rate of communication and we can look more specifically at children who started with a very low rate of communication (under 2-times per minute) to see if their caregivers more consistently used EA strategies. Additional research about EA strategy use and effects on child rate of communication is needed before conclusions about the relationship between these variables can be made.

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