# Advancing Caregiver-Implemented Naturalistic Developmental Behavioral Interventions With Families of Children With Autism and Developmental Language Disorders


- Ann P. Kaiser, PhD
- Lauren Hampton, PhD
- Hannah Fipp-Rosenfeld, PhD
- Kathryn M. Bailey, PhD

# Naturalistic Developmental Behavioral Interventions (NDBI)

Evidence-based communication intervention

Grounded in behavioral and developmental theories of learning

Naturalistic, child-driven intervention designed for use in everyday environments

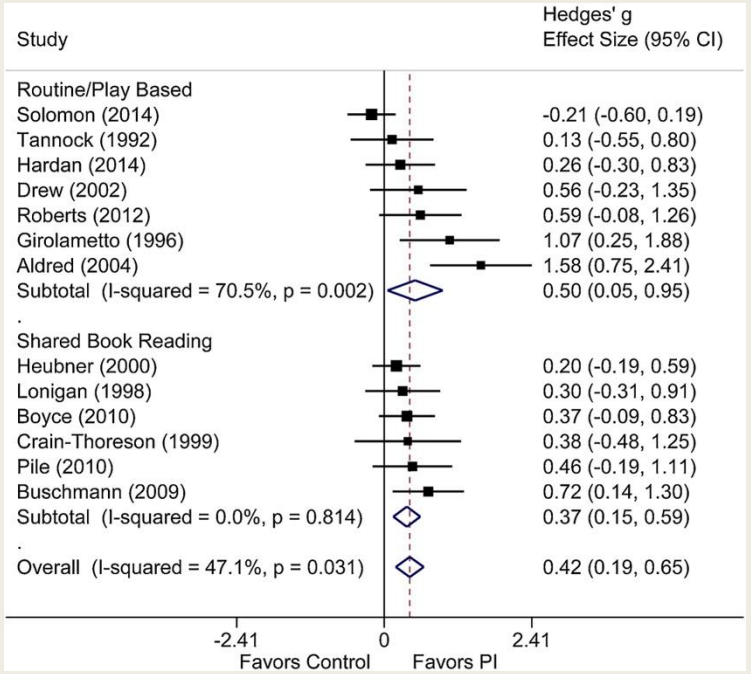
Overall positive outcomes for caregivers and children

Bruinsma et al., 2020; Schreibman et al. 2015;

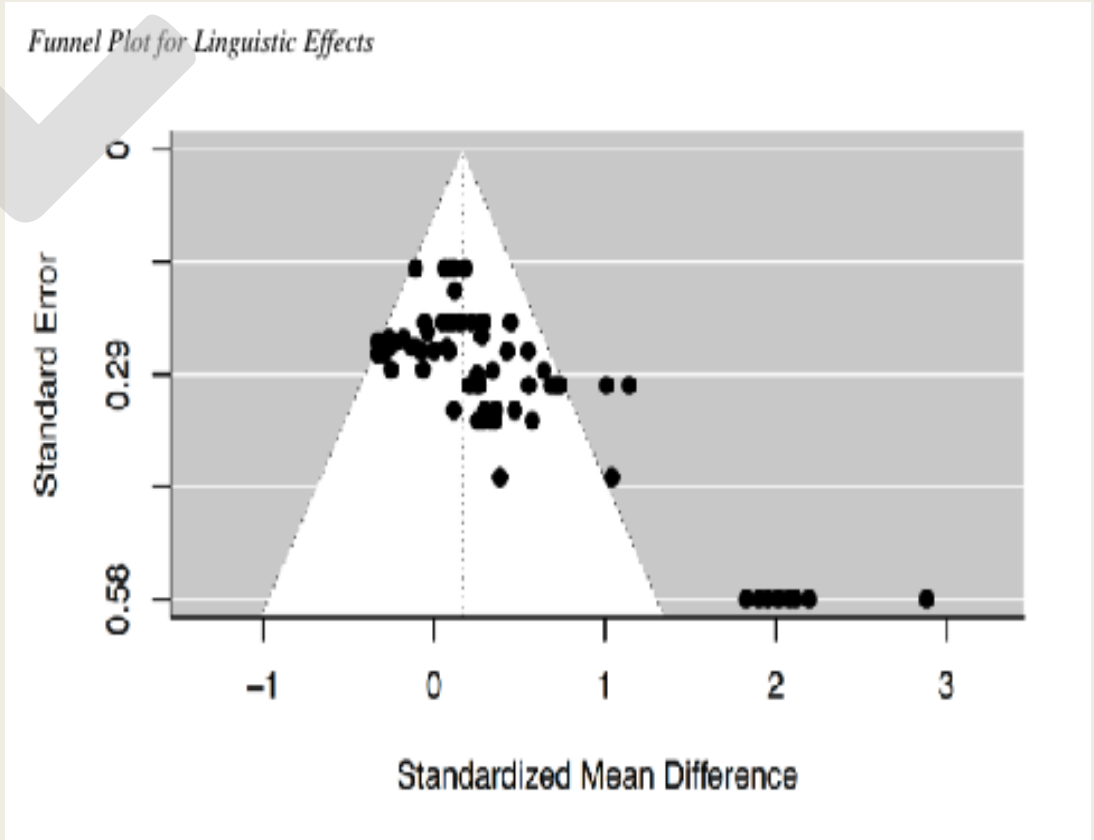
# Caregiver-Implemented Naturalistic Developmental Behavioral Interventions (CI-NDBIs)

- Caregivers as primary implementers
- Systematic instruction, with coaching and practice in interactions
- Skills taught to caregivers
  - Responsive Interaction strategies
  - Modeling and Expanding
  - Prompting and practice in play and routines
  - Specific child skills, most often social communication related

# Meta analysis evidence of effectiveness of caregiver-implemented NDBIs




- Heidlage et al., 2021
- Roberts et al., 2019
- Hampton & Kaiser, 2016
- Roberts and Kaiser, 2011
- Pak et al., 2023




# Building More Effective CI-NDBIs

- Examining and strengthening the benefits to caregivers as well as children
- Expanding effective and efficient methods for delivering CI-NDBIs
- Analyzing the key components to more ensure more robust and dependable outcomes

# Presentations

Feasibility and Acceptability of a Telehealth Caregiver-Mediated Intervention for a Representative Sample of Parents of Autistic children with Younger Siblings:
A Pilot study

Hannah Fipp-Rosefeld

Feasibility and Effectiveness of Cognitive Behavioral Interventions for Caregivers of Young Autistic Children: A Systematic Review and Meta Analysis

Lauren H. Hampton

Measurement of Dosage in Caregiver Mediated Interventions to Improve Children's Language

Ann P. Kaiser & Kathryn M. Bailey

VANDERBILT Peabody College

# Measurement of Dosage in Caregiver Mediated Interventions to Improve Children's Language

Ann P. Kaiser & Kathryn M. Bailey

# Vanderbilt KidTalk


# Today's talk

- Variability in caregiver and child outcomes
- Dosage as a key variable impacting outcomes
- Other key factors
  - *Fidelity*
  - *Child contributions*
- New Horizons in caregiver-implemented NDBIs

# Heterogeneity in child outcomes

- Social communication outcomes vary by
  - Measurement context and type (Sandbank et al., 2020),
  - Agent (Hampton & Kaiser, 2016)
  - Intervention setting (Debodinance et al., 2017)

- Predictors of treatment outcomes are not always consistent across meta-analyses.
  - Interaction of child characteristics
  - Dosage individual children receive during CI-NDBI may be a factor

# A Simple View of Dosage

# Common  Measures of Dosage

- Number of sessions X time (minutes) in treatment = **total minutes**
  - 2x /week for 30 minutes for 18 week= 18 hours of intervention

- Frequency X calendar duration = **total sessions**
  - 2x /week for 18 weeks = 36 intervention sessions

- Number of trials within session X number of sessions  = **total trials**

# The Problem with Simple Dosage

- Current measures of dosage
  - Total time in / frequency of treatment
  - Don’t directly measure key events or components  of intervention

- **Inconsistently** linked to child outcomes

# Measurement of Dosage is Challenging

- Methodological standards emphasize fidelity, time
- CI-NDBI are complex, multicomponent interventions
- Difficult to get a comprehensive measure of dosage
- Naturalistic, child-driven interventions

# Key Point

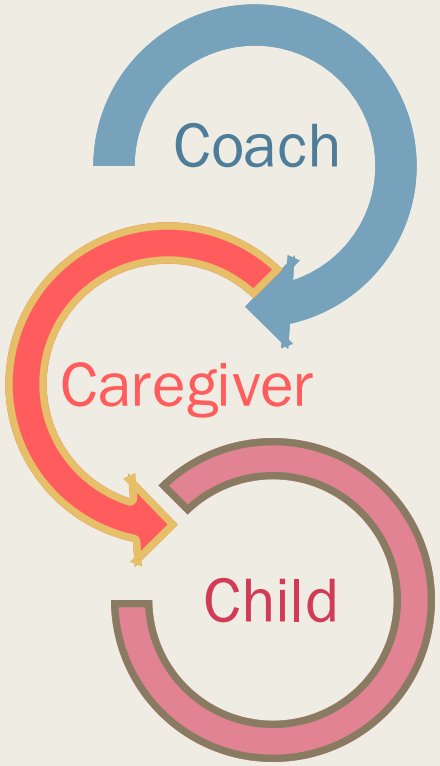
Consistency of positive effects on child social communication recommends CI-NDBI as an ***effective class of interventions***

AND

Mixed evidence for the relation between dosage and child social communication outcomes points to ***a need for further analysis prior to making clinical dosage recommendations***

# Enhanced Milieu Teaching (EMT)

- Conversation-based NDBI
  - *Child interests and initiations as opportunities to model and prompt language in everyday contexts*
- Use in everyday interactions
- Effective, evidence-based intervention with 20+ years of research
- Most often implemented by caregivers

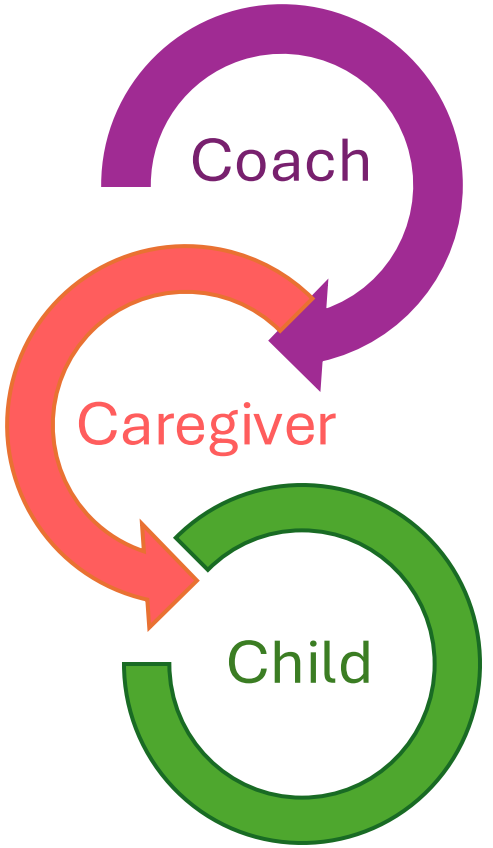



Kaiser & Hampton (2017) and Kaiser & Pak ( 2025, in press) provide an overview of procedures and evidence

# Dosage in Enhanced Milieu Teaching

- ***New task***: Directly count the usage of key strategies per session

- Which components of EMT drive child outcomes?
  - Target language within matched turns
    - Simple "Toy Talk" sentences
    - Contingency






(Bailey et al.,2024; Dillehay et al., in prep)

## Support Engagement

- Follow the child's lead
- Arrange the environment
- Imitate
- Give toys
- Respond & Pause
- Limit Directions

## Model and Expand Language

- Model single object labels
- Model "Toy Talk" sentences
- Expand and recast
- Point, show, and pantomime

## Support Play

- Establish a routine
- Bring new objects into play
- Model novel actions
- Re-start and extend successful routines

## Elicit Communication

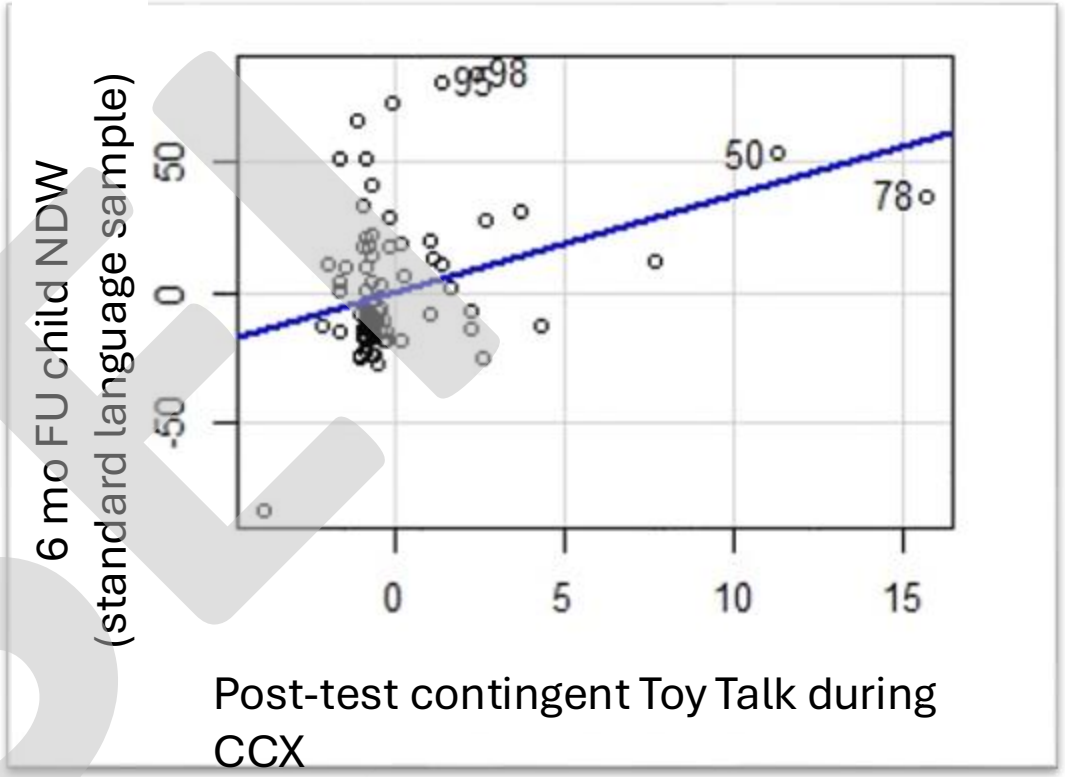
- Communication temptations
- Least-to-most prompting sequences

# Toy Talk Sentences

- Toy Talk sentences (Hadley et al., 2014)
  - Simple sentences
  - Active and declarative
  - Specific noun in the subject position
  - Include specific, diverse vocabulary: subject, verb, location, modifiers

"The **tower** *fell*!"

- Preliminary analyses across datasets suggested that contingent, simple Toy Talk sentences predict later growth in child language outcomes (NDW)
- Seemingly important to quantify in-sessions to track dosage of intervention




Data reanalyzed from Roberts et al, 2022
See also Bailey et al, 2024; Dillehay, 2023

# Dosage and Fidelity Analyses

**Dosage and fidelity vary across across caregiver-child dyads**

- **Single Case Design**
  - Bailey et al, 2024; Rodgers et al, 2025
  - 6 newly diagnosed toddlers with ASD and caregiver
  - EMT-Sentence Focused; delivered via Telehealth

**Dosage and fidelity increase over time in intervention**

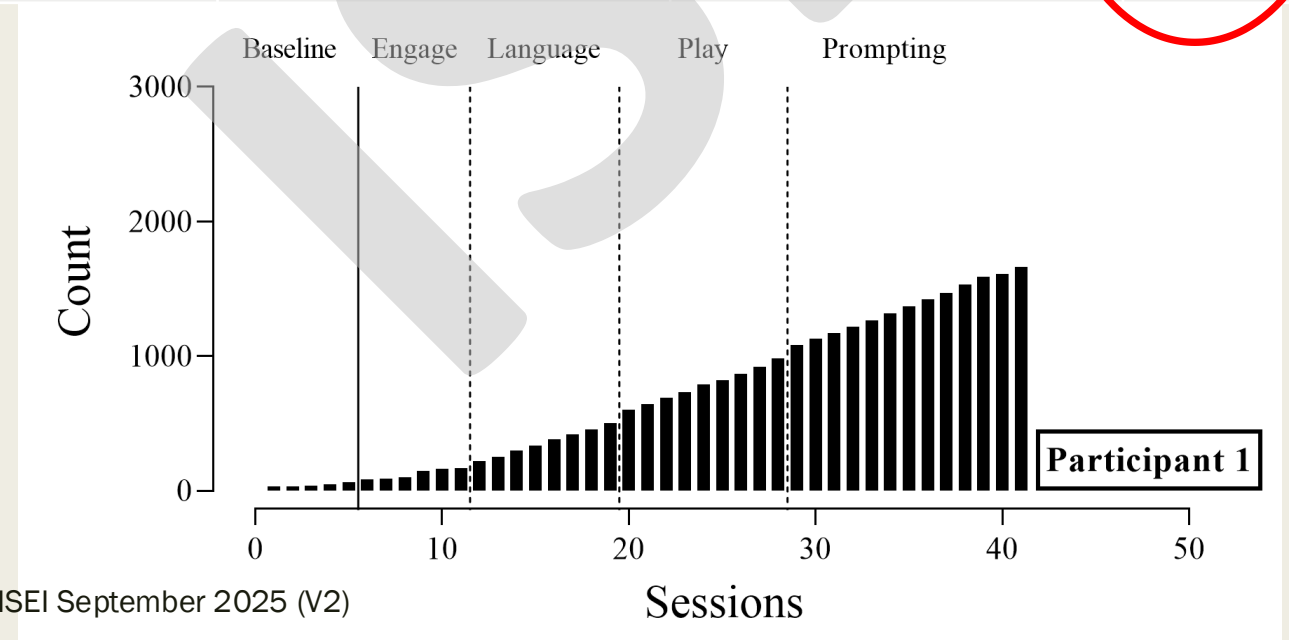
- **Single Case Design**
  - Bailey et al, 2024; Rodgers et al, 2025
  - 6 newly diagnosed toddlers with ASD and caregiver
  - EMT-Sentence Focused; delivered via Telehealth

**Dosage and fidelity predict child productive outcomes at post and followup**

- **Group Design**
  - Dillehay, 2023; Peredo et al, 2022
  - 21 language delayed bilingual toddlers and Spanish speaking caregiver
  - EMT en Espanol; delivered in vivo

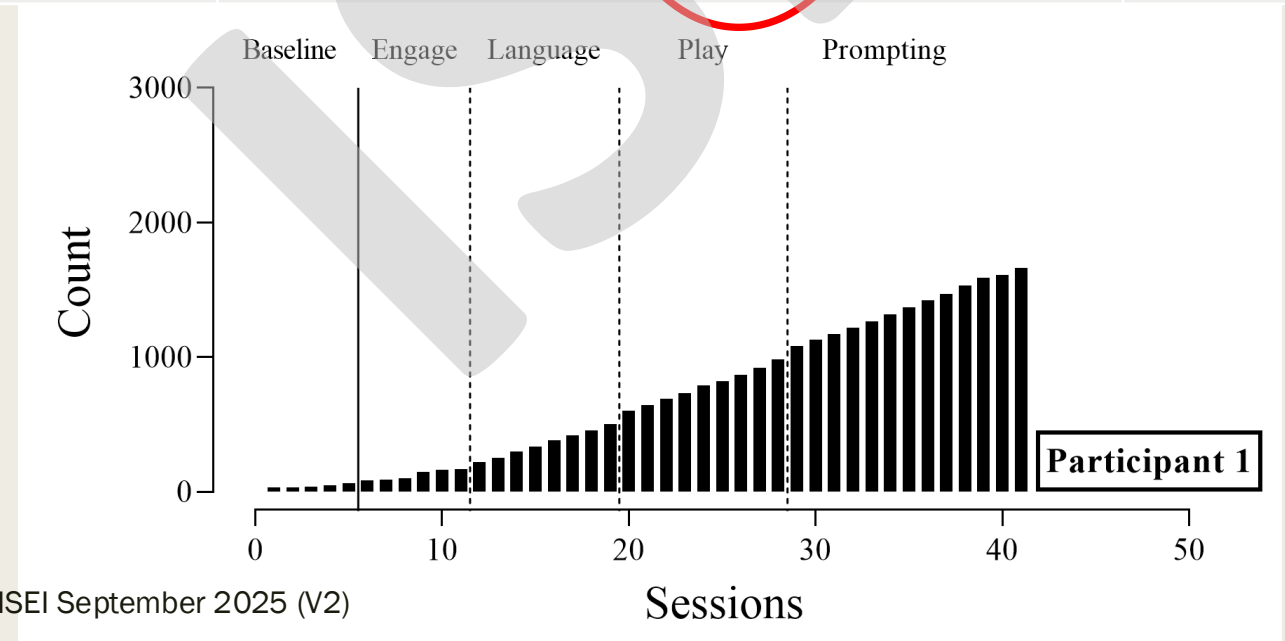
# Dosage Varies Across Participants (Count)

| Iteration | Dyad | # of Intervention Sessions | Dosage in Time | Dosage at Session 36 | Total Dosage |
|---|---|---|---|---|---|
| 1 | 1 | 41 | 6 hours | 1425 | 1666 |
| | 2 | 36 | 5.2 hours | 914 | 914 |
| | 3 | 50 | 7.5 hours | 1093 | 1684 |
| 2 | 4 | 61 | 9.3 hours | 1543 | 2950 |
| | 5 | 53 | 8 hours | 1404 | 2093 |
| | 6 | 38 | 5.5 hours | 1513 | 1578 |

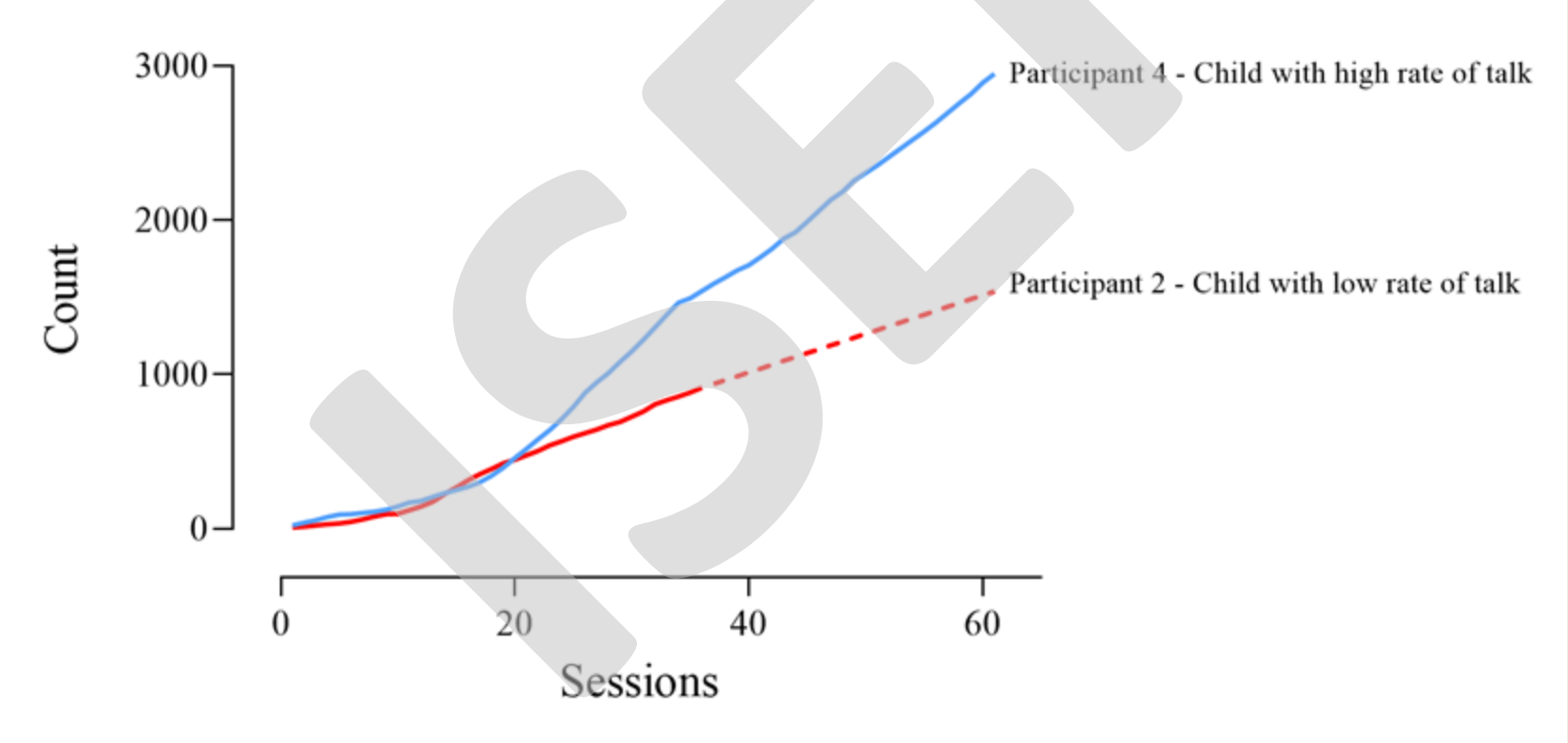


# Dosage Varies Across Participants (Count)

| Iteration | Dyad | # of Intervention Sessions | Dosage in Time | Dosage at Session 36 | Total Dosage |
|---|---|---|---|---|---|
| 1 | 1 | 41 | 6 hours | 1425 | 1666 |
| | 2 | 36 | 5.2 hours | 914 | 914 |
| | 3 | 50 | 7.5 hours | 1093 | 1684 |
| 2 | 4 | 61 | 9.3 hours | 1543 | 2950 |
| | 5 | 53 | 8 hours | 1404 | 2093 |
| | 6 | 38 | 5.5 hours | 1513 | 1578 |



# Differences in cumulative dosage

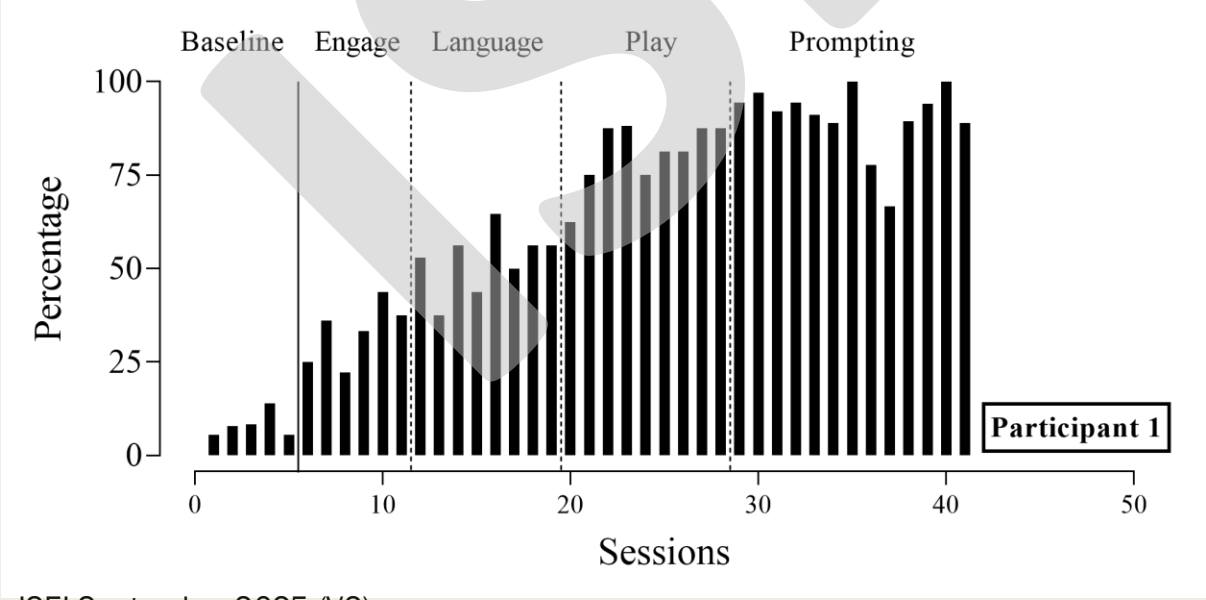



Bailey et al., 2024; Rodgers et al, 2025, in preparation

# Fidelity Also Varies Across Caregiver Participants

(Quality Rating from Checklist)

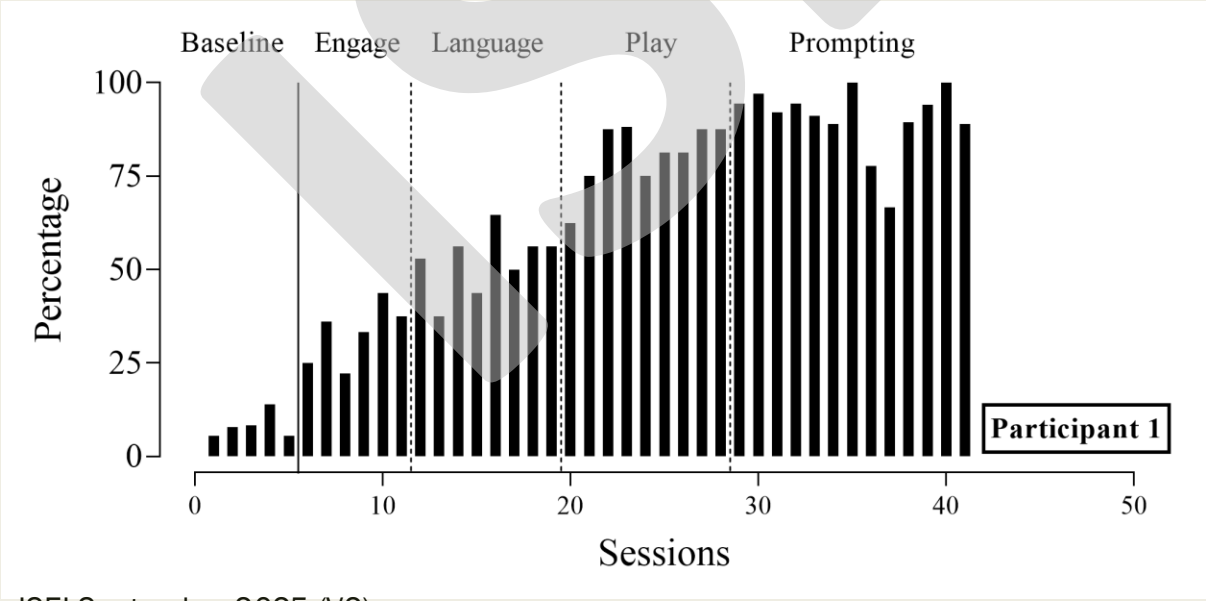
| Iteration | Participant | # Sessions at 80% Fidelity | Percent of Sessions at 80% Fidelity | Minutes of Intervention at 80% Fidelity* |
|---|---|---|---|---|
| 1 | 1 | 17 | 41.46% | 148 minutes |
| | 2 | 9 | 25.00% | 78 minutes |
| | 3 | 5 | 10.00% | 45 minutes |
| 2 | 4 | 11 | 18.03% | 100 minutes |
| | 5 | 13 | 24.53% | 118 minutes |
| | 6 | 16 | 42.11% | 139 minutes |



# Fidelity Varies Across Caregiver Participants

(Quality Rating from Checklist)

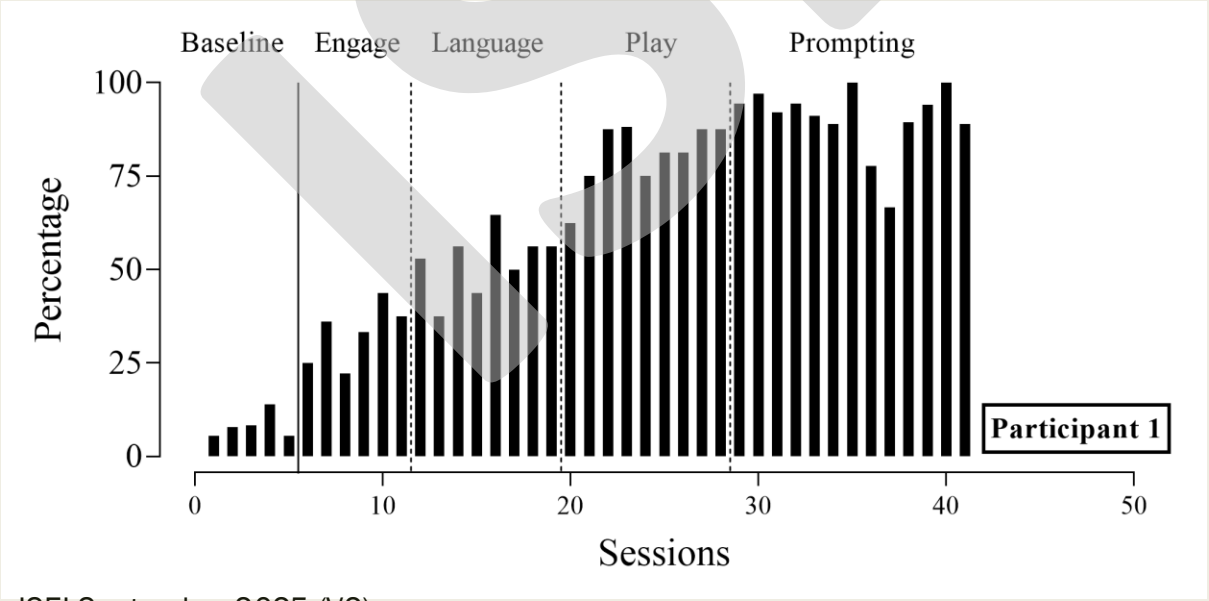
| Iteration | Participant | # Sessions at 80% Fidelity | Percent of Sessions at 80% Fidelity | Minutes of Intervention at 80% Fidelity* |
|---|---|---|---|---|
| 1 | 1 | 17 | 41.46% | 148 minutes |
| | 2 | 9 | 25.00% | 78 minutes |
| | 3 | 5 | 10.00% | 45 minutes |
| 2 | 4 | 11 | 18.03% | 100 minutes |
| | 5 | 13 | 24.53% | 118 minutes |
| | 6 | 16 | 42.11% | 139 minutes |



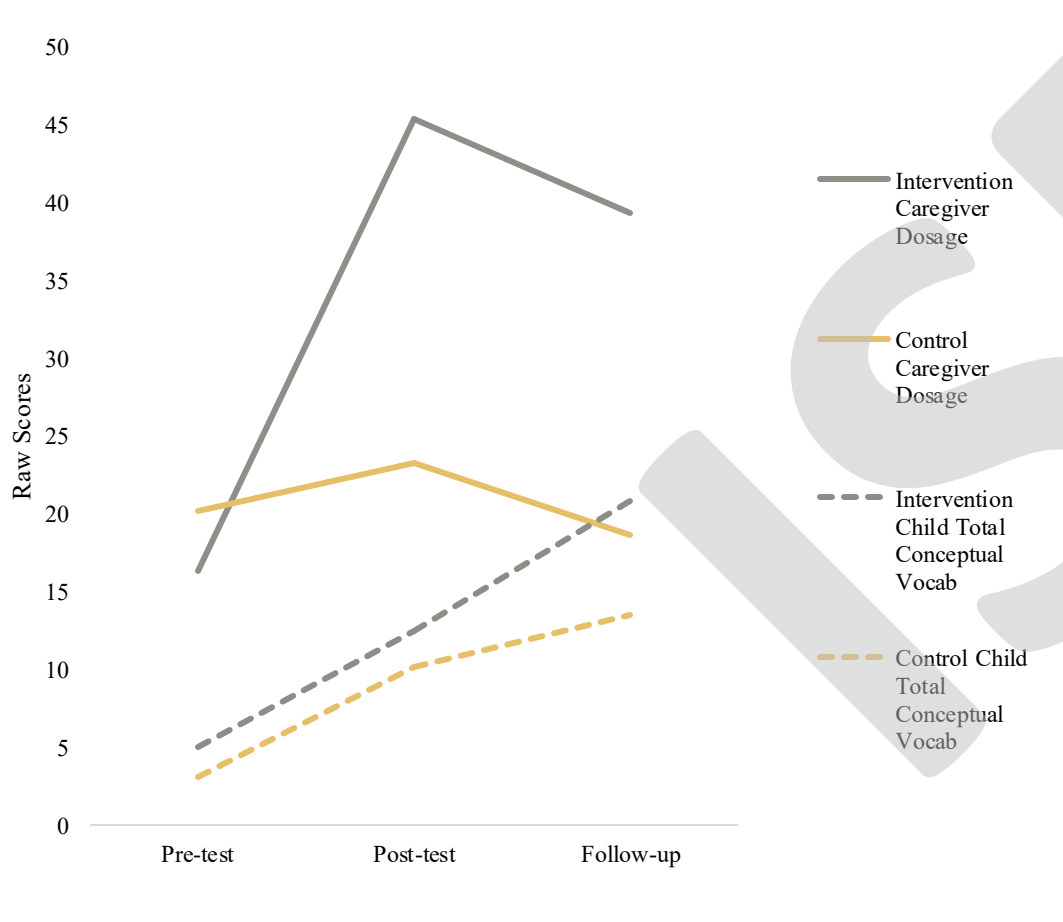
# Fidelity Varies Across Caregiver Participants

(Quality Rating from Checklist)

| Iteration | Participant | # Sessions at 80% Fidelity | Percent of Sessions at 80% Fidelity | Minutes of Intervention at 80% Fidelity* |
|---|---|---|---|---|
| 1 | 1 | 17 | 41.46% | 148 minutes |
| | 2 | 9 | 25.00% | 78 minutes |
| | 3 | 5 | 10.00% | 45 minutes |
| 2 | 4 | 11 | 18.03% | 100 minutes |
| | 5 | 13 | 24.53% | 118 minutes |
| | 6 | 16 | 42.11% | 139 minutes |

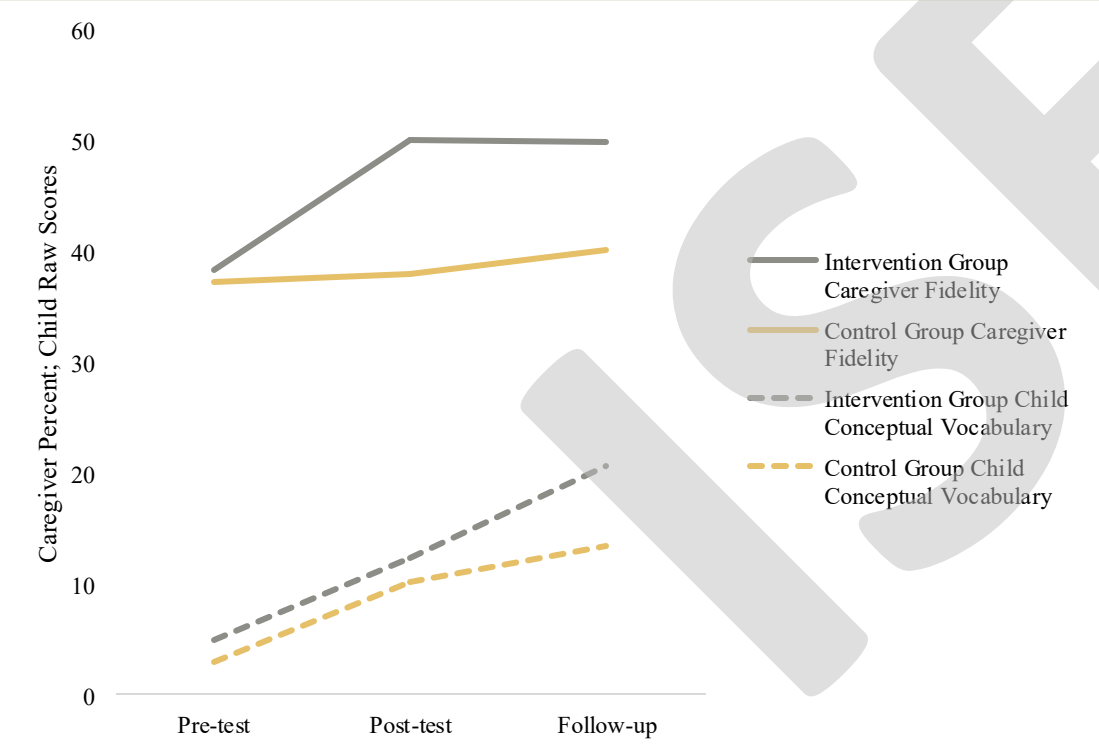


# Dosage and Child Language Outcomes at Post and Follow up are correlated




| Caregiver Timepoint | Follow-Up Child Outcome Measure | $R^2$ | B | SE | t | p |
|---|---|---|---|---|---|---|
| Post-test | Subject-Verb Combinations | 0.503 | 0.128 | 0.03 | 3.64 | 0.003 |
| | Conceptual Vocabulary | 0.317 | 0.495 | 0.19 | 2.49 | ❑ 0.026 |
| | Receptive Language | 0.014 | 0.016 | 0.11 | 0.13 | 0.894 |
| Follow-up | Subject-Verb Combinations | 0.670 | 0.170 | 0.033 | 5.21 | <.001 |
| | Conceptual Vocabulary | 0.565 | 0.769 | 0.183 | 4.21 | <.001 |
| | Receptive Language | 0.053 | 0.102 | 0.132 | 0.77 | 0.453 |

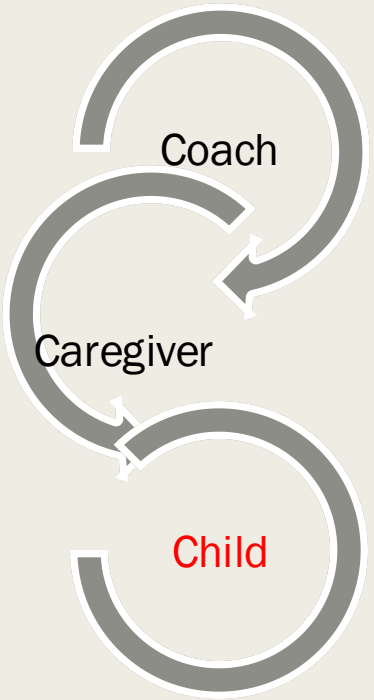
# Fidelity and Child Vocabulary at Post and Follow-up are correlated




| Caregiver Timepoint | Follow-Up Child Outcome Measure | $R^2$ | B | SE | t | p |
|---|---|---|---|---|---|---|
| Post-test | Subject-Verb Combinations | 0.208 | 17.528 | 9.928 | 1.766 | 0.09 |
| | **Conceptual Vocabulary** | **0.314** | **107.042** | **43.269** | **2.474** | **0.02** |
| | Receptive Language | 0.068 | 21.625 | 23.581 | 0.917 | 0.37 |
| Follow-up | Subject-Verb Combinations | 0.116 | 13.845 | 11.373 | 1.156 | 0.26 |
| | **Conceptual Vocabulary** | **0.636** | **0.370** | **0.077** | **4.827** | **<.00** |
| | Receptive Language | 0.084 | 34.918 | 33.353 | 1.047 | 0.31 |

Dillehay, 2023

# Dosage in Triadic NDBI interventions



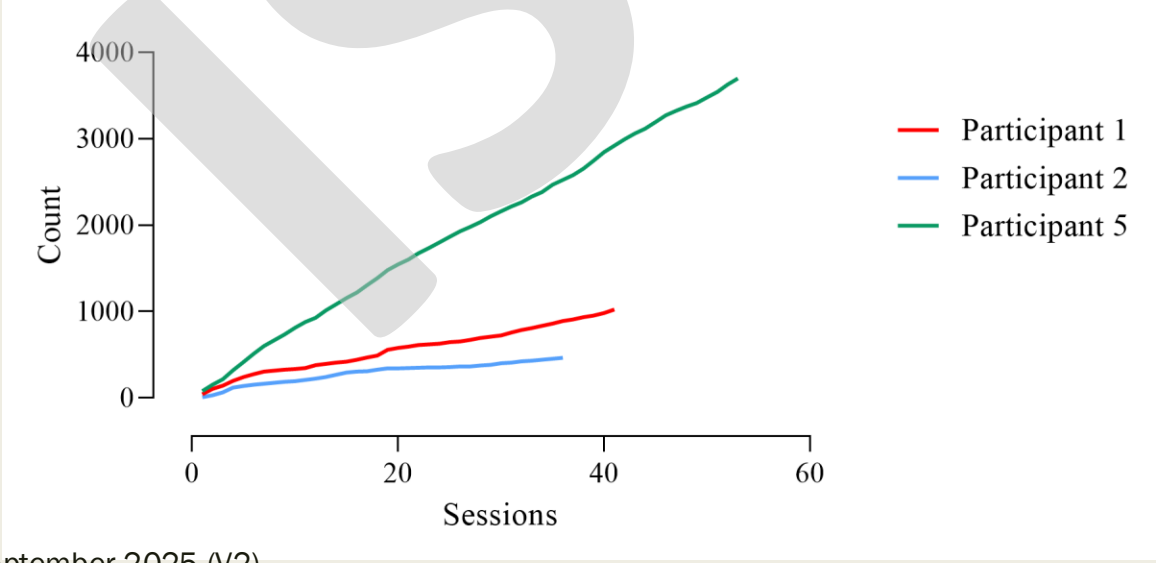

(Caregiver Training)(Caregiver Dosage + Fidelity)(Child Opportunities)

= Child Communication Outcomes

- Child opportunities for the caregiver use of the active ingredient moderate caregiver dosage + fidelity
- Child opportunities
  - *Total social communication utterances*
  - *Expandable utterances*

# Child Opportunities for Active Ingredients

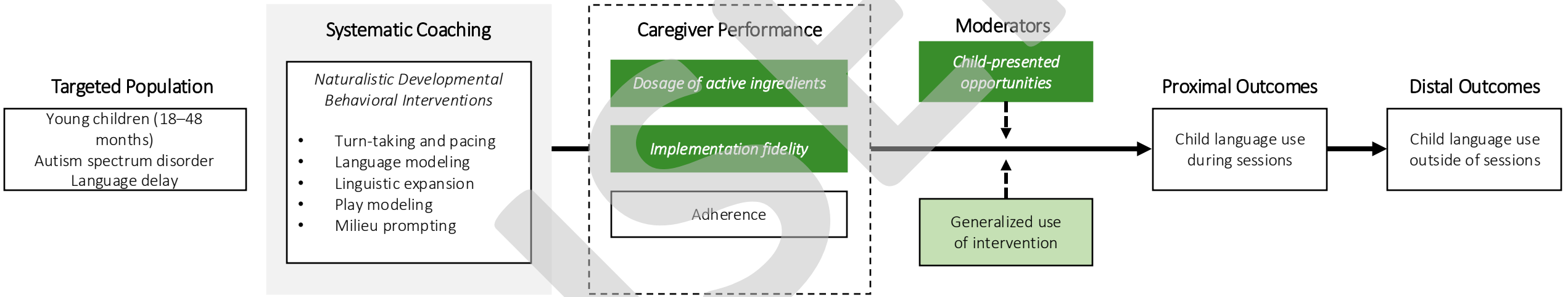
| Iteration | Participant | Total Expandable Utterances (High Qual) | | Total Social Communicative Utterances | TSCU Per Session | Total Dosage | Dosage per Session |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 175 | 4.8 | 1025 | 25 | 1666 | 41 |
| | 2 | 51 | 1.4 | 465 | 13 | 914 | 25 |
| | 3 | 144 | 2.9 | 1190 | 24 | 1684 | 34 |
| 2 | 4 | 2494 | 40.9 | 6470 | 106 | 2950 | 48 |
| | 5 | 1045 | 19.7 | 3699 | 70 | 2093 | 39 |
| | 6 | 609 | 16.0 | 1503 | 40 | 1578 | 42 |



# Child Opportunities for Active Ingredients

| Iteration | Participant | Total Expandable Utterances (High Qual) | | Total Social Communicative Utterances | TSCU Per Session | Total Dosage | Dosage per. Session |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 175 | 4.8 | 1025 | 25 | 1666 | 41 |
| | 2 | 51 | 1.4 | 465 | 13 | 914 | 25 |
| | 3 | 144 | 2.9 | 1190 | 24 | 1684 | 34 |
| 2 | 4 | 2494 | 40.9 | 6470 | 106 | 2950 | 48 |
| | 5 | 1045 | 19.7 | 3699 | 70 | 2093 | 39 |
| | 6 | 609 | 16.0 | 1503 | 40 | 1578 | 42 |
| **Range** | | | | 465-3699 | 13-106 | **914-2950** | **25-48** |

# Complex model of CI-NIDBIs



# Implications for practice

Identify key ingredients in the intervention that associated with child outcomes

Select or develop a method to monitor fidelity of intervention

Measure delivery of the key ingredients (dosage)

Monitor child progress as well as caregiver dosage and fidelity

Increasing child social communicative utterances is foundational to insuring adequate dosage

# Implications for research

- *Define and measure of active ingredients as indicators of dosage in specific CI-NDBIs*
- *Examine the relationship between child opportunity and dosage and fidelity*
  - individual differences in response to treatment
  - differential outcomes by population
- *Establish criterion levels and cumulative dosage typically associated with child changes in target language skills*
- *Test these relationships in randomized trials*


# Acknowledgments


- Parents and children who participate in our studies
- Vanderbilt KidTalk Research Team
  - *Tatiana Peredo, PhD , Ana Modero, Kelsey Dillehay, Natalie Pak, Lauren Booth, Rachel Asres, Tara Lynn, Rachel Frampton (EMT en Espanol)*
  - *Suzanne Thompson, Mary Rodgers, Kate Bailey, Natalie Pak, Eon-Joo Jang*
  - *Emily Quinn, Oregon Health Sciences Univ*
  - *Jenny Cunningham, Kathleen Artman Meeker, Univ of Wash*
  - *Megan Roberts, Northwestern Univ*
  - *Pamela Hadley, University of Illinois*
- Funding
  - *IES, NIDCD, NICHD*
  - *Vanderbilt Kennedy Center Hobbs Grants*
  - *Vanderbilt University Seeding Success*

# For more information:

Ann.Kaiser@vanderbilt.edu

This talk will be posted at

**http://kc.vanderbilt.edu/kidtalk/**


Good things
happen
when you talk!
- VANDERBILT COUNSELING