

Supplemental Material S3. Language treatment program details for included studies.

Study	Language target	Program description	Dosage summary	Time from pre- to post-testing
Aguilar et al. (2017)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> • Various learning activities (e.g., building a robot, going on a pirate treasure hunt) • Exposed to target words in a naturalistic and meaningful context 	8 novel words, average 12 minutes per activity, 1 activity per session, 3 sessions for 3 weeks	6 weeks
Anderson (2001)	Grammatical Morphemes (Artificial)	<ul style="list-style-type: none"> • Imitation group: directly asked to repeat given sentences. • Modeling group: asked to relay what they heard to a doll. 	13 verb forms, 52 opportunities, 1 session	N/A
Bishop & Hsu (2015)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> • Training session: presenting all the animals (target words) with the corresponding pictures twice. • Verbal vocabulary learning task: Listening to animals' names with corresponding pictures and selecting the picture that goes with what they heard. • Nonverbal paired associating learning task: replacing target words with non-speech sounds and the corresponding pictures. 	8 target words, 15-20 minutes per session, 4 sessions for 2 weeks	2 weeks
Botting et al. (2016)	General Language Enrichment (Real)	<ul style="list-style-type: none"> • All age groups: recalling group rule, turn-taking, speaking, and understanding activities. • 4- to 5-year-olds: focused on the names of animals • 5- to 6-year-olds: focused on matching animal pictures along with prepositions • 6- to 7-year-olds: focused on categorizing pictures into groups 	45 minutes per session, once a week for 6 weeks	6 weeks

Boyle et al. (2007)	Multiple targets (Real): Vocabulary/Word Learning, Grammatical Morphemes, Narratives	<ul style="list-style-type: none"> Activities varied: focused on comprehension, vocabulary, grammar, and narrative. 	30-40 minutes per session, 3 sessions per week over 15 weeks	Average 6.59 months
Calder et al. (2021)	Grammatical Morphemes (Real)	<ul style="list-style-type: none"> Explicit instructions on regular past tense verbs were embedded in age-appropriate and engaging activities. 	50 trials, 20-30 minutes per session, twice a week for 10 weeks	10 weeks
Clark (2006)	General Language Enrichment (Real)	<ul style="list-style-type: none"> Individual Language Intervention (ILI): story books to focus on semantics, syntax, narration, and phonological awareness. Computer Assisted Language Intervention (CALI): computerized games to target phonological awareness, recalling, and comprehension of complex sentences. Fast Forward Language (FFW-L): similar CALI's computerized games, but with the acoustic modifications. 	100 minutes per session, 5 sessions a week for 6 weeks	6 weeks
Durrleman & Delage (2020)	Linguistic Structure (Real)	<ul style="list-style-type: none"> Selected images show on iPads to present complement, and children repeat the complement for approximately 100 different items. 	30 minutes per session, 8-12 sessions	4-6 weeks
Ebert & Pham (2023)	Multiple targets (Real): Vocabulary/Word Learning; Grammatical Morphemes	<ul style="list-style-type: none"> A combination of interactive activities and computer programs for all conditions 	75 minutes per session, 4 sessions a week for 6 weeks	8 weeks

Finestack (2018)	Grammatical Morphemes (Artificial)	<ul style="list-style-type: none"> The space creature's language was presented on computer. Engage in cloze procedure tasks on computer with feedback. Explicit Intervention group received the rule of the novel morphemes throughout the activities. 	3 different novel morphemes, 16 models/prompts per target, 20 minutes per session, once a day for average 4 weeks	17 days
Finestack & Fey (2007)	Grammatical Morphemes (Artificial)	<ul style="list-style-type: none"> Introduced to an outer space creature, TiKi, and its language. Auditory bombardment activity where children watched and listened. Sentence completion activity while looking at the stimulus and pictures. Explicit Intervention group received the rule of the novel morphemes throughout the activities. Modeling and recasting were provided for all groups. 	20 models or recast prompts for targeted morpheme, 4 sessions in 2 weeks	Average 9.19 days
Gray (2005)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> Play activity involving an adventure or camping scenarios to present and teach target words: modeling, imitation prompt, comprehension questions, phonological cue, and production trial. 	4 target words, 24 models per session, 30 minutes per session, daily for 19 days with 4 days of break from day 10 to 13	5 days
Gray (2003)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> Play activities with playdough and western wagon set figurines to present and teach target words: modeling, imitation prompt, comprehension questions, and production trial. 	4 target words, 24 exposures per session, 30 minutes per session, a total of five sessions in average 8.9 days	Average 8.9 days
Gutiérrez-Clellen et al. (2012)	General Language Enrichment (Real)	<ul style="list-style-type: none"> Book reading and hands-on activities (e.g., pictures, manipulatives, etc.). Simple phrases, slow rate of speech, recasting, and paralinguistic cues were utilized throughout the intervention. 	45 minutes per session, 4 days a week for 12 weeks	12 weeks

Haebig et al. (2022)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> • Stimuli were presented by a computer presentation program. • Study trials: names, definitions, and associated pictures were presented. • Retrieval trials: names and definitions were asked while presenting referent pictures. 	12 novel words, 24 exposures, 25 minutes per session for 4 sessions	1 day
Hsu & Bishop (2014)	Multiple targets (Artificial): Sentence Complexity; Comprehension	<ul style="list-style-type: none"> • In a game-like format, target sentences were presented with corresponding pictures. • Asked to move pictures accordingly to presented sentences. • Visual cues were provided as needed. 	12 exposures per session, 5-7 minutes per session for 4 sessions within 4-6 days	2 weeks
Jackson et al. (2021)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> • Target nouns were presented via an online program along with animation. • Prompted to imitate and repeat the target words. • Recast was provided after the child's response. 	8 novel words, 20-30 minutes per session, a total of 3 sessions, 1 session per 1-3 days	4 days
Kapa et al. (2020)	Grammatical Morphemes (Real)	<ul style="list-style-type: none"> • Conversational recasts throughout a variety of activities (e.g., games, arts and crafts, books, pretend play, etc.) to promote high variability. • Establishing eye contact and grabbing child's attention before recast. 	30 minutes per session, 5 days per week for 5 weeks	5 weeks
Korat et al. (2019)	Vocabulary/Word Learning (Real)	<ul style="list-style-type: none"> • Using e-books with a dictionary help function. • Animations were presented while providing a definition of target words. • Definitions were provided in three formats: simple dictionary definition, short contextual example, and a combination of dictionary definition and contextual sentence. 	9 target words, 10 minutes per session, 1 session per 1-3 days for 5 sessions	N/A
Krzemien et al. (2021)	Grammatical Morphemes (Artificial)	<ul style="list-style-type: none"> • A video with an alien teaching its language. • High variability group: 8 unique sentences with no words in common were presented. 	15 minutes for one session	N/A

Leonard et al. (2019)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> Progressive alignment group: 2-5 sentences were replaced with words in common. Learning block: Watched a pre-recorded video and audio describing the novel words with corresponding pictures were presented on a laptop. Completed a cloze procedure task after the learning block. 	44 exposures for both sessions, 10 minutes per block session, 2 block sessions per day for a week	5-minute and 1 week
	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> Presented with nine cartoon characters representing target novel words in semi-standardized game tasks. Three characters were introduced with their names and the appropriate iconic gesture. Three characters were introduced with their names and arbitrary gestures. Three characters were introduced with their names only. 	12 exposures of 9 novel words per session, 45 minutes per session, a total of 3 sessions	4 weeks
Luke & Ritterfeld (2014)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> One of 4 sets of 12 target words along with unfamiliar referent pictures were presented on a computer screen. After presenting the target words with pictures, asked to answer yes/no questions. Direct Instruction: instructed to remember the names and corresponding pictures. Indirect Instruction: no specific instructions provided regarding learning the names and corresponding pictures. 	70 exposures, 12 novel target words, 60 minutes for one session	5-minute and 24-48 hours
Pomper et al. (2022)				
Restrepo et al. (2013)	Vocabulary/Word Learning (Real)	<ul style="list-style-type: none"> Placed in a small group. Focus vocabulary words were presented through book activities along with manipulatives. 	45 focus words, 45 minutes per session, 4 days per week for 12 weeks	12 weeks

		<ul style="list-style-type: none"> Engaged in various hands-on activities, story-retell, book making, acting, etc. English-only group: all instructions were presented in English. Spanish-English bilingual group: alternated instructions in Spanish or English every two weeks. 		
Rice et al. (1992)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> Watched two animated videos with the narration of target words at the sentence-final level in a story format. Pauses between the target words were added for the second and third sessions. 	10 target words, 30 exposures per session, 15 minutes per sessions, a total of four sessions	At least a day to no more than a week
Riches (2004)	Vocabulary/Word Learning (Artificial)	<ul style="list-style-type: none"> Engaged in performing and labeling target verbs with different objects in play activities. Experiment 1: four novel words Experiment 2: six novel words 	<ul style="list-style-type: none"> Over a 4-week period Experiment 1 & 2: <ul style="list-style-type: none"> Massed 12: 12 exposures in a day. Massed 18: 18 exposures in a day. Spaced 12: 12 exposures over 4 days. Spaced 18: 18 exposures over 4 days. 	Immediately after the intervention and a week after the last intervention session
Simon-Cereijido et al. (2013)	General Language Enrichment (Real)	<ul style="list-style-type: none"> Book reading and hands-on activities (e.g., pictures, manipulatives, etc.). Bilingual group: the language of instruction day was alternated each day. 	45 minutes per session, four days per week for 12 weeks	12 weeks
Smeets et al. (2014)	Vocabulary/Word Learning (Real)	<ul style="list-style-type: none"> Experiment 1: <ul style="list-style-type: none"> Engaged in four different electronic storybooks without adult's support: two video and two static formats. 	10 minutes per session, two sessions per week for four weeks	4 weeks

- The video format included additional effects: zoom-in on details of the pictures and background music or sound based on the story elements and mood.
- No written text was provided while listening to the storybooks.
- Experiment 2:
 - Engaged in same four different electronic storybooks as Experiment 1 but presented in four conditions.
 - 1) static books without background music/sound
 - 2) static books with background music/sound
 - 3) video books without background music/sound
 - 4) video books with background music/sound

Grammatical
Morphemes (Real)

- Engaged in whole-class and small-group activities.
- Three different activities in a small group varied from dress-up play, board games, to books.
- Model and general feedback were presented for both groups.
- Recasting group: when an error occurred, a correct answer was provided but the child does not have to reproduce it.
- Cueing group: when an error occurred, a hierarchy of cues was provided to elicit the correct respond from the child.

60 minutes per session, one session per week for eight weeks 8 weeks

Smith-Lock et
al. (2015)

Storkel et al. (2017)	Vocabulary/Word Learning (Real)	<ul style="list-style-type: none"> • Engaged in interactive book reading activities with a total of five books. • Pre-book reading: target words were presented with pictures, synonyms, and definitions. • Book reading: read the book together as a group. • Post-book reading: target words were presented with different pictures and in supportive context sentences. • Based on the intensity condition, children received different number of exposures for target words <ul style="list-style-type: none"> ○ 12 exposures, 24 exposures, 36 exposures, and 48 exposures 	<p>30 target words, 20-30 minutes per session; average 2-3 sessions per week</p> <p>12 exposures: 10 sessions in 4-5 weeks</p> <p>24 exposures and 36 exposures: 15 sessions in 5-8 weeks</p> <p>48 exposures: 20 sessions in 7-10 weeks</p>	5, 7, 8, or 10 weeks
Storkel et al. (2019)	Vocabulary/Word Learning (Real)	<ul style="list-style-type: none"> • Engaged in interactive book reading activities with a total of five books (see above for Storkel et al., 2017 on pre- to post-book reading activities) • 4 X 9 group: <ul style="list-style-type: none"> ○ Four exposures to a target word per book reading ○ Nine repeated readings of each book • 6 X 6 group: <ul style="list-style-type: none"> ○ Six exposures to a target word per book reading ○ Six repeated readings of each book • 9 X 4 group: <ul style="list-style-type: none"> ○ Nine exposures to a target word per book reading ○ Four repeated readings of each book 	<p>Average two sessions per week</p> <p>4 X 9 group: average 13 minutes per session, a total of 23 sessions in 12 weeks</p> <p>6 X 6 group: average 14 minutes per session, a total of 15 sessions in 8 weeks</p> <p>9 x 4 group: average 16 minutes per session, a total of 10 sessions in 5 weeks</p>	5, 8, or 12 weeks
