

Supplementary Materials

Pre- and Posttest Procedures

Proximal Measures

Each science unit (air, sound, light) had its own science test adapted from FOSS I-checks to minimize the need for complex language in the prompts and to allow for children to respond either verbally or non-verbally. Each science unit test had ten questions that assessed the understanding of concepts taught in the lessons, for a total of 30 questions across all three science units. One point was awarded for each correct answer. Questions were rephrased to simplify the language and avoid the taught grammar and vocabulary targets while still requiring content knowledge. To further reduce language demands, we limited responses to single word labeling or multiple choice. For example, a prompt in the original FOSS I-Check associated with understanding that air takes up space included showing a submerged test tube in a bucket of water that had been inserted vertically (Picture A) and then tipped to allow the air to come out as bubbles and the vial to fill with water (Picture B). In the original task, the prompt was *Water doesn't go into the vial in Picture A because air _____. When the vial is tipped in Picture B, _____ comes out, and _____ goes into the vial. Bubbles are filled with _____.* The item was rephrased to *What comes out? What goes in? Bubbles are filled with _____.* Allowable responses included any response that clearly indicated that child understands that air comes out, water goes in, and bubbles contain air including words, pointing, or gestures.

Complement clause production was assessed using 20 animated videos adapted from work by Steel et al. (2016). Following 3 practice items, participants watched a brief

animated scene while the clinician provided a live voice over. They were then prompted to tell a little duck on the screen what had happened using a complement clause. For example, while watching a video about Kim waking up and coming into a kitchen, the examiner might say, "*Kim wakes up. She is hungry. It's not Kim's turn to cook breakfast. Kim wonders, "Whose turn is it? Dad or Mom?" You tell duck what happened. What did Kim do? Start with Kim. Kim...*" with an expected correct result of the child saying, "*Kim wonders who will cook breakfast.*" Participants received one point if they correctly and independently produced a main clause and a complement clause. If they responded off topic or with a partial response, the examiner may prompt a second time by starting the target utterance with, "Start with *Kim wondered...*" Children received half a point if they imitated the production of a noun and verb in the main clause of the sentence and then completed the sentence. Zero points were awarded for any other type of utterance production, repeated responses, or no response. Complement clause responses were originally scored by a member of the research team during live administration and then responses were later transcribed and recoded by a team member who was masked to the treatment condition and time point of testing (pre/post) to be scored for reliability. Initial agreement was 86%. Disagreements were discussed by the reliability coder and a clinician, and an overall consensus of 99% was obtained.

The vocabulary test consisted of two practice items and 20 target vocabulary words that were tested via choosing a picture out of an array of three that matched the word spoken by the examiner. For example, the examiner might say "show me *collecting rocks*" and the child would choose from three pictures of children: 1) looking at rocks, 2) collecting rocks, and 3) climbing rocks. The pictures consisted of images of

real children and objects. Items were scored as correct (one point) or incorrect (zero) based on the child's response.

Distal Measures

A science retell task adapted from Mantzicopoulos and Patrick (2010) served as a distal measure of generalized science knowledge and language gains.

Mantzicopoulos, P., & Patrick, H. (2010). "The seesaw is a machine that goes up and down": Young children's narrative responses to science-related informational text. *Early Education and Development*, 21(3), 412-444. <https://doi.org/10.1080/10409281003701994>

The task was administered to children in all three conditions within three weeks before intervention and again within three weeks after withdrawing the language intervention. During the task, participants listened to the examiner tell six brief science-themed passages such as this one on sound:

Musical instruments make vibrations. When you play a guitar, the strings move back and forth really fast. The strings vibrate. The vibration makes the sound we hear.

Each short passage was accompanied by a relevant photo (in this case a guitar). After each passage, the child was asked to repeat the passage. Two members of the research team who were blind to treatment condition and administration time point used a rubric to score the extent to which the child included scientific themes in each passage retell with 0 = no related information; 1 = related but does not capture key themes; 2 = one theme or several partial themes; 3 = two themes; and 4 = three themes. For the sound passage, the target themes were 1) instruments make

vibrations, 2) guitar strings move, 3) strings vibrate, and 4) vibrations make sound/what we hear. For example, one child's retell was:

The guitar makes sounds and in the songs everybody can hear it that little things they can sounds.

This child received a score of 2 on the rubric because they included two partial themes (part of theme 2 and part of theme 4). Inter-rater agreement ranged from a low of 86% to a high of 92%. All disagreements were discussed, and the consensus score was assigned. The raters also tallied the number of different content words (nouns, verbs, adverbs and adjectives) from the model passages that were included in each retelling. In the sound passage, there are 15 possible content words to include (see underlining). The child above included four of those content words in their retell.

Target Passages with Content Word Types Underlined

Most light on Earth comes from the sun, our nearest star. The sun is our most important source of light and heat. Without sunlight, Earth would be a cold, dark place. Nothing could live here.

Many animals have legs. Legs help animals move on land. Legs help animals move in different ways. A frog's legs help it hop far. A cheetah's legs help it run fast.

Musical instruments make vibrations. When you play a guitar, the strings move back and forth really fast. The strings vibrate. The vibration makes the sound we hear.

At first, young dolphins live with their mothers. The mother will feed and protect the baby. Mothers teach the young dolphins many things. In a year or two, the young dolphins leave to join a new school.

Windy weather is when air moves around quickly. Windy weather can blow things all around. If you have an umbrella during windy weather, it could blow away. A little bit of wind can feel nice on a hot day.

A lever helps move heavy objects. When you push down on one side of a lever, the other side goes up. Levers can also be used to lift heavy objects such as a rock or furniture. A seesaw is an example of a lever.

Scoring

- 1) Transcribe the passage retells into Word
- 2) Count number of content word types (those underlined in the passages above) that the child included in each passage. Be sure to count types (only the first use of any given word) not tokens (no word repetitions are counted).
- 3) Determine the number of thematic units that the child included in each passage using the guidelines in Table S1. Follow these rules:
 - a. Each item separated by / means that the child must include one or the other but not both to count as a complete thematic unit.
 - b. The order in which the children presented the themes does not matter.

- c. Repetitions of the same themes are counted only once
- d. When expressing themes, the child does not have to use the exact words that were in the passage, but the meaning must be accurate.

Table S1 Guide for identifying themes	
Passage	Thematic units
1-Legs	<ol style="list-style-type: none"> 1. Animals have legs; 2. legs help move-land/different ways; 3. legs help cheetah-move quickly/frog hop.
2-Dolphins	<ol style="list-style-type: none"> 1. Young dolphins live w and mothers; 2. mothers-feed/protect/teach; 3. dolphins-leave/join/go to school
3-Light	<ol style="list-style-type: none"> 1. Light comes from sun; 2. sun nearest star; 3. sun source/gives/provides-light/heat; 4. without sun-cold/dark/no life
4-Sound	<ol style="list-style-type: none"> 1. Instruments make vibrations; 2. guitar-strings move back and forth/fast; 3. strings-vibrate; 4. vibrations-makes sound/we hear.
5-Wind	<ol style="list-style-type: none"> 1. Wind = air moves fast; 2. wind-blows things; 3. umbrella-blow away by wind; 4. wind-feels nice on hot day.
6-Levers	<ol style="list-style-type: none"> 1. Levers- move- heavy objects; 2. Pushing/moving/going one-side makes other lift/up and down; 3. levers move-rocks/furniture; 4. seesaw-type of lever

- 4) Assign Rubric score using the guidelines in Table S2, following these rules:

Table S2 Scoring Rubric			
Score	Definition	Example for light passage	Example for leg passage
0	<ul style="list-style-type: none"> • No response; or • Narrative does not include any text-relevant elements 	<p>space and aliens and the rocket ships live there. spaceship.</p> <p>Okay hmm I see that that X in here. This one. This one X in here.</p>	<p>Tiger</p> <p>Sky my puppet</p>

1	<ul style="list-style-type: none"> • Narrative includes one or more text-relevant but isolated words; or • Narrative is associated with the picture but not the text 	<p>once upon a time XXX <u>sun</u> is up all XX</p> <p>The moon is shining. The <u>sun</u> is shining. The <u>stars</u>.</p>	<p><u>Cheetah</u> and <u>frog</u> and penguin and chameleon. Chameleon's climb!</p> <p>The tiger <u>run</u> look at the grass I don't know</p>
2	<ul style="list-style-type: none"> • partial themes 	<p>The <u>closest to earth was the sun</u> side of a side to earth it keeps all the sunlight uh I think thats it</p> <p><u>the sun shines on the earth</u> what we live in.</p>	<p><u>Cheetah goes fast and the frog hops fast</u> and the cheetah goes so fast fast fast and fast like 100 fast</p> <p><u>Cheetah running on land cheetahs go really fast</u></p>
3	<ul style="list-style-type: none"> • 1 complete theme 	<p>the sun makes a <u>sun is also it makes light for us</u> to X be sadder be dark and sadder</p> <p>I see all thousand stars and the earth goes and the earth can move around from the sun and i see <u>the sunlight can make warm</u> and the earth goes around the sun</p>	<p><u>cheetah's legs make it go fast</u> and frogs' make it jump and cheetah make it walk fast</p> <p>So Mom she said <u>cheetah has many legs and she runs really fast</u>. Faster than me.</p>
4	<ul style="list-style-type: none"> • Two complete themes 	<p><u>The sun gives us light</u> and the sun is our biggest star and it's our biggest <u>without it we would not have anything on Earth</u></p> <p><u>The sun makes light for the Earth</u> and <u>if it was not here it would not be there cause it's a dark world</u></p>	<p><u>Different animal have legs</u> a cheetah a frog have two legs for jumping <u>cheetahs have four legs to run</u> elephants have four legs</p> <p><u>Many animals have legs. The frogs legs can make it hop far and the cheetah's legs can make it run fast</u></p>
5	<ul style="list-style-type: none"> • Three or four complete themes 		

Table S3. Sample lesson plans for science condition.

Lesson Plan	Step	Action	Script	Additional Information	Scored Science Elements
Air 3 (bubbles in the air)	Begin the search for moving air.	Before using the bubbles and wands, have adult turn the fan on and so students can feel the air on their faces and hands. Have them predict where the bubbles will fly.	We'll observe the wind. Can we see it? We can feel it. Feel the wind on your face.... your hands. What do you feel? Where will the bubbles fly? What do you think? Let's open our bags and find out!	MC asks for predictions re: where bubbles will go. May or may not use the word <i>predict</i>. Example: Student: <i>Wind</i> MC: <i>I feel wind too. It makes my hair move!</i>	Asks for predictions re: where bubbles will go.
Light 1 (making shadows)	Activate prior knowledge.	Ask students what they think of when they hear the word light . Let them share some ideas.	Listen to this new word: light. What you think about light? What makes light? What does it do?	MC must read the bolded. MC must support discussion about light (visual) and redirect if students talk about light (opposite of heavy). New word: light Example: Student: <i>the sun</i> MC: <i>The sun makes light!</i>	MC must say “ Listen to this new word: light. What do you think about light? ” MC must support discussion about light (visual) and redirect if students talk about light (opposite of heavy).
Sounds 2 (making sounds)	Introduce vibration	With own materials, model plucking the rubber banded cup while explaining. Continue plucking so children can hear the vibratory sounds.	The kind of motion that we saw, heard, and felt was a fast, back-and-forth motion called vibration . Vibration moves so fast that it can be hard to see. It made our rubber bands look blurry as it moved. But we don't have to see vibration because a lot of times we can hear and feel it! Listen!	Must use bolded vocabulary words and state definition word for word. New word: back and forth motion New word: vibration	Say bolded words “ back and forth motion ” and “ vibration. ”

List of Books Used in E-Book Adjuvant

- Adler, D. (2018). *Light Waves*. Holiday House.
- Ajmera, M., Browning, D. (2016). *Every Breath We Take*. Charlesbridge.
- Bauer, M. (2003). *Wind - Ready To Read* (J. Wallace, Illus.). Aladdin Library.
- Branley, F. (1962). *Air Is All Around You* (J. O'Brien, Illus.). Harper Collins.
- Boothroyd, J. (2014). *Playing With Light And Shadows*. Lerner Publications.
- Boothroyd, J. (2014). *Sending Messages With Light And Sound*. Lerner Publications.
- Branley, F. (1998). *Day Light Night Light*. Harper Collins.
- Bulla, C. (1962). *What Makes A Shadow?* (J. Otani, Illus.). Harper Collins.
- Coan, S. (2014). *How Sound Moves*. Teacher Created Materials.
- Cobb, V. (2003). *I Face The Wind* (J. Gorton, Illus.). Harper Collins.
- Dorros, A. (1989). *Feel The Wind* (A. Dorros, Illus.). Harper Collins.
- Johnson, R. (2014). *How Does Sound Change?*. Crabtree.
- Johnson, R. (2014). *What Are Sound Waves?*. Crabtree Classics.
- Pfeffer, W. (1998). *Sounds All Around* (H. Keller, Illus.). Harper Collins.
- Pfeffer, W. (2014). *Light Is All Around Us* (P. Meisel, Illus.). Harper Collins.
- Rosinsky, N. (2002). *Light- Shadows, Mirrors, Rainbows* (S. Boyd, Illus.). Picture Window Books.
- Rosinsky, N. (2002). *Sound- Loud, Soft, High, Low* (M. John, Illus.). Picture Window Books.
- Royston, A. (2016). *All About Light - All About Science*. Heinemann-Raintree.
- Sherman, J. (2003). *Gusts and Gales*. Picture Window Books.
- Showers, P. (1961). *The Listening Walk* (Alike, Illus.). Harper Collins.

Stevenson, R. (1885). *My Shadow* (M. Félix, Illus.). Creative Editions.

Trumbauer, L. (2003). *All About Light - Read About Science*. Children's Press (CT).

Trumbauer, L. (2004). *All About Sound*. Children's Press.

Waring, G. (2006). *Oscar And The Bat*. Walker Childrens Hardbacks.

Waring, G. (2006). *Oscar And The Moth*. Candlewick Press.

Winterberg, J. (2015). *Sound Waves And Communication*. Teacher Created Materials.



CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	Title Page
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	1 Abstract
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	2-5
	2b	Specific objectives or hypotheses	4-top of 5
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	5
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	5
Participants	4a	Eligibility criteria for participants	5-6
	4b	Settings and locations where the data were collected	5
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Supplemental materials and pages 8-10
	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Supplemental materials and 6-7
Outcomes	6b	Any changes to trial outcomes after the trial commenced, with reasons	5
	7a	How sample size was determined	5
Sample size	7b	When applicable, explanation of any interim analyses and stopping guidelines	n/a
	8a	Method used to generate the random allocation sequence	7-8
Randomisation: Sequence generation	8b	Type of randomisation; details of any restriction (such as blocking and block size)	7-8
	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	7-8
Allocation concealment mechanism			
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	7-8

Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	n/a
	11b	If relevant, description of the similarity of interventions	8-10
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	11-12
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	11-12
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	Fig 1
	13b	For each group, losses and exclusions after randomisation, together with reasons	Fig 1
Recruitment	14a	Dates defining the periods of recruitment and follow-up	5
	14b	Why the trial ended or was stopped	5
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Table 1
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	Fig 1
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Fig 2, pages 12-14
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	1 1 4
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	Table 4-5 + supplemental tables
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	n/a
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	19-20
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	14-20
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	14-20
Other information			
Registration	23	Registration number and name of trial registry	Abstract, 5
Protocol	24	Where the full trial protocol can be accessed, if available	Abstract, 5
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	Abstract, 5

Citation: Schulz KF, Altman DG, Moher D, for the CONSORT Group. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. BMC Medicine. 2010;8:18.

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*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up-to-date references relevant to this checklist, see www.consort-statement.org.