The Microdynamics of Early Childhood Learning APPENDIX*

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A The Balance of Initial Conditions

Enrollment age groups are treated as randomly assigned, which means that there is no selection (e.g., family investment and endowment) across different age groups. Parents' years of education and HOME-environment scores are commonly used as measures of family investment. In Table A.1, we test whether years of education and baseline HOME-environment scores differ across different enrollment age groups. We find no evidence of differences between years of education and baseline HOME-environment scores across enrollment age groups. The results in Table A.1 indicate that, before enrolling in the program, the family investment is the same across different age groups.

A.1 Tests of Baseline Years of Education and HOME-Environment Scores

Table A.1: Education and HOME Scores at Baseline

	Years of Education			HOME Score					
Age Group	Mother	Father	Grandmother	Warmth	Verbal Skills	Hostility	Learning Literacy	Outings	Total
				Enrollment Age (10-15) vs. (16-20)					
Mean (Age 10-15)	6.991	8.019	3.000	3.931	2.493	0.180	5.290	1.456	13.350
Mean (Age 16-20)	7.456	7.978	3.145	4.607	2.464	0.169	5.956	1.568	14.765
two sided step down p-value	0.663	0.986	0.986	**0.006**	0.986	0.986	0.122	0.818	0.058
step down p-value (Age 10-15 > Age 16-20)	1.000	0.946	0.988	1.000	0.930	0.946	1.000	0.996	1.000
N	393	394	389	400	400	400	400	400	400
				Enrollment Age (10-15) vs. (21-25)					
Mean (Age 10-15)	6.991	8.019	3.000	3.931	2.493	0.180	5.290	1.456	13.350
Mean (Age 21-25)	6.712	7.795	2.826	4.325	2.255	0.274	6.312	1.707	14.873
two sided step down p-value	0.790	0.790	0.790	0.311	0.150	0.311	**0.026**	0.218	0.122
step down p-value (Age 10-15 > Age 21-25)	0.741	0.760	0.760	1.000	0.096	0.998	1.000	1.000	1.000
N	369	369	365	374	374	374	374	374	374
				Enrollment Age (16-20) vs. (21-25)					
Mean (Age 16-20)	7.456	7.978	3.145	4.607	2.464	0.169	5.956	1.568	14.765
Mean (Age 21-25)	6.712	7.795	2.826	4.325	2.255	0.274	6.312	1.707	14.873
two sided step down p-value	0.220	0.709	0.709	0.693	0.321	0.327	0.709	0.709	0.890
step down p-value (Age 16-20 > Age 21-25)	0.116	0.749	0.617	0.467	0.172	0.978	0.978	0.978	0.852
N	336	337	334	340	340	340	340	340	340

1. Age (10–15) represents children whose monthly ages are between 10 and 15 at enrollment. Age (16–20) represents children whose monthly ages are between 16 and 20 at enrollment. Age (21–25) represents children whose monthly ages are between 21 and 25 at enrollment.

2. Step down p values are constructed by multiple hypotheses between the earlier enrolled group and later enrolled group based on Romano and Wolf (2005a,b).

3. Both step down p-values are conducted by 500 times of bootstrap.

A.2 Tests of Initial Conditions

None of the children received training in the program before entry, but they could acquire skills through other channels, such as imitation and maturation. Suppose that a child enters at level $\ell(s)$ of skill s at age $a^*(s, \ell)$. Some may be able to master the task from the outset due to maturation and exposure to rich environments, but many do not. We document that there is no selection on the endowments of the children when they enroll in the program across age groups. If some age-specific groups have significantly higher endowments, their task performance at enrollment may be better than the children with the same weekly ages but longer program exposure.

The probability of mastery of task ℓ of skill s at entry age $a^*(s, \ell)$ for new entrants is $\Pr\Big(D(s, \ell, a^*) = 1\Big)$.[1] It is a measure of learning from maturation and exposure without participating in the program. It is also a measure of raw ability. The impact of $a^*(s, \ell)$ on subsequent learning informs us about dynamic complementarity and the importance of critical and sensitive periods.

We analyze task performance by age. Specifically, we compare children at each monthly age who have been enrolled for different lengths of time. Figure A.1 shows the initial passing rate for language tasks by age (length of enrollment). For most tasks for this skill, the group that is enrolled for longer than one month performs significantly better than the new entrant groups.

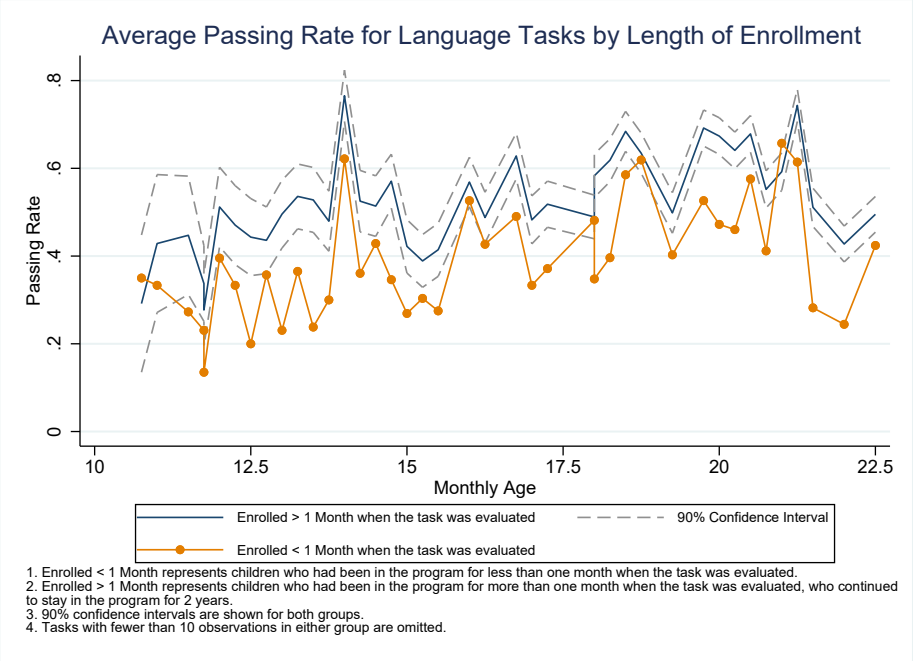
Figures A.2-A.4 show similar patterns of growth for other skills. Children who

[1] We define new entrants as children who enroll in the program and have less than one month of exposure to it.

enroll at younger ages have larger investments at younger ages and display greater knowledge at later ages.

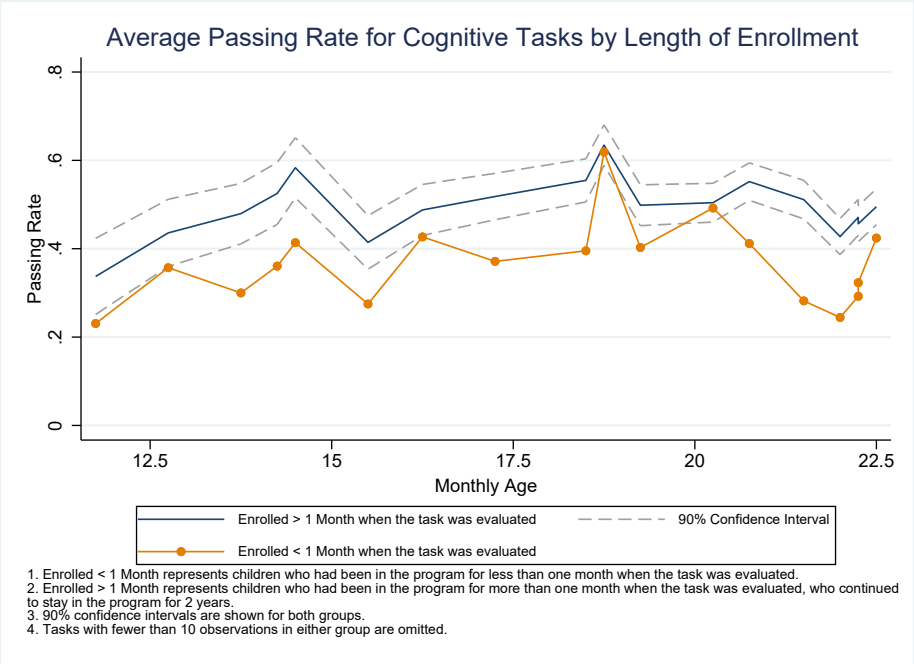
A.2.1 Language

Figure A.1: Language Tasks Performance Comparison by Length of Enrollment



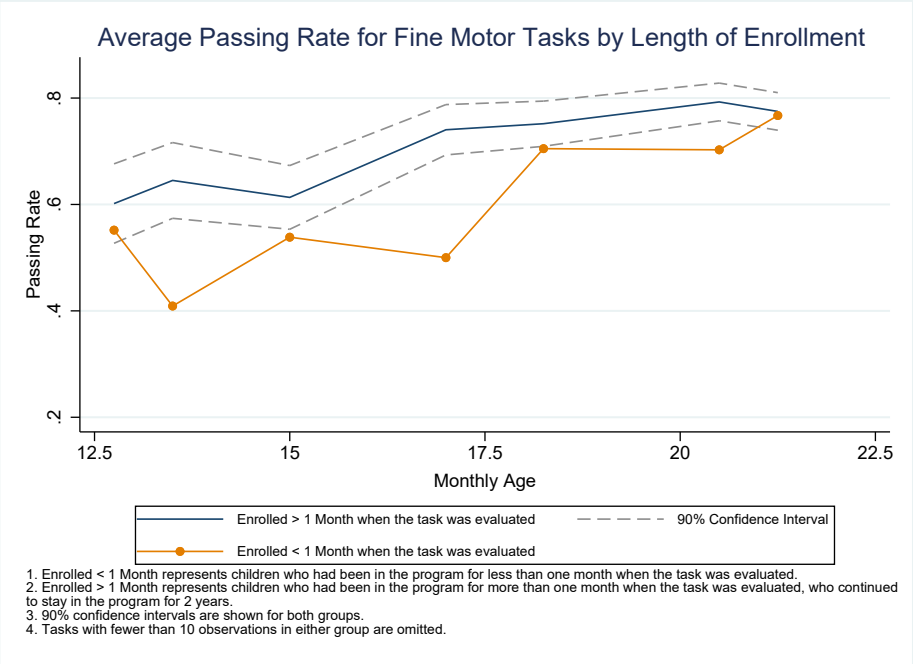
A.2.2 Cognitive

Figure A.2: Cognitive Tasks Performance Comparison by Length of Enrollment



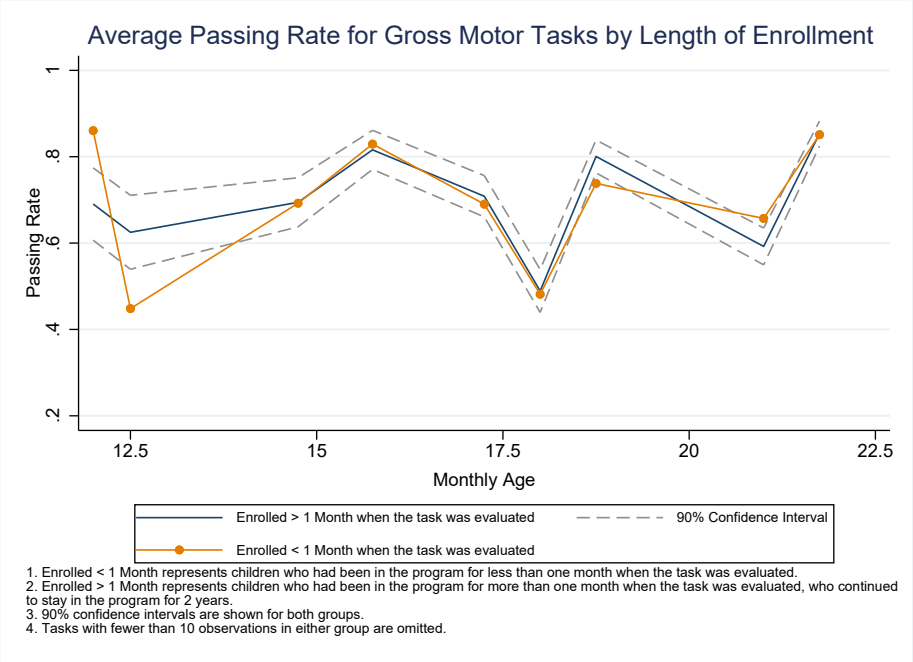
A.3 Fine Motor

Figure A.3: Fine Motor Tasks Performance Comparison by Length of Enrollment



A.4 Gross Motor

Figure A.4: Gross Motor Tasks Performance Comparison by Length of Enrollment



B Curriculum

The development of skills in young children has been extensively studied and theorized over the years (e.g., Uzgiris and Hunt (1975) and Palmer (1971) are major references). The China REACH program curriculum is adapted from the Jamaican Reach Up and Learn program, which is designed to focus on a child's ability to complete sequences of tasks ordered by progressing difficulty levels based on general child development patterns. In general, children's skill development depends on a number of factors such as caregiver involvement, cultural environment, nutrition, child endowment, etc. To better understand how the skills develop over time, it is necessary to analyze the measures used to evaluate children's multidimensional skills. Based on the main content of tasks, the tasks in the curriculum cover four domains of skills.[2] The categories help researchers understand how the main types of skills developed based on the measures in the curriculum. Next, we document all the tasks in the China REACH curriculum by four domains of skill types: fine motor, gross motor, language, and cognitive skills.

B.1 Skills Taught in the Curriculum

Fine motor, gross motor, language, and cognitive skills are taught. Within each skill group, skills are ordered by difficulty level following the patterns developed by Palmer (1971). For example, there are seven difficulty levels for fine motor drawing lessons

[2]We are aware that skills do not develop in isolation, fine motor skills require cognitive input and language skills develop in tandem with gross motor functions.

for.[3,4] In general, higher difficulty level of skills includes new content. For example, difficulty level 2 is to mimic circles. The skills at difficulty level 3 include drawing straight lines. We document how tasks in different difficulty levels are categorized.

Using Fine Motor Drawing lessons to explain in details: the lessons focus on a child's ability to use writing utensils with increasing skills. First, a child is asked to hold the utensil to make markings. Next, the child incorporate more and more cognitive skills to complete the tasks. They then begin by copying markings made by an adult. As skill levels progress, they are asked to make the marking after only a verbal command from the adults. Finally, the child progresses from abstract shapes to representative drawings (see Table B.1.).

Table B.1: Skill Levels for Fine Motor (Drawing) Lessons

Difficulty Level	**Task Content**
Level 1	Doodle using crayons
Level 2	Mimic draw circles
Level 3	Mimic circles and draw straight lines
Level 4	Draw a circle, vertical line, and horizontal line
Level 5	Draw circles, many lines, and crossed lines
Level 6	Draw a cross (or T), curves, and zigzag curves
Level 7	Draw caterpillars

In addition to tasks of different difficulty levels, the curriculum features multiple lessons and assessments at the same difficulty level l. The description of difficulty level categories is listed in this section. For example, there are six assessments at difficulty level 3 for fine motor drawing skills and only two assessments at difficulty

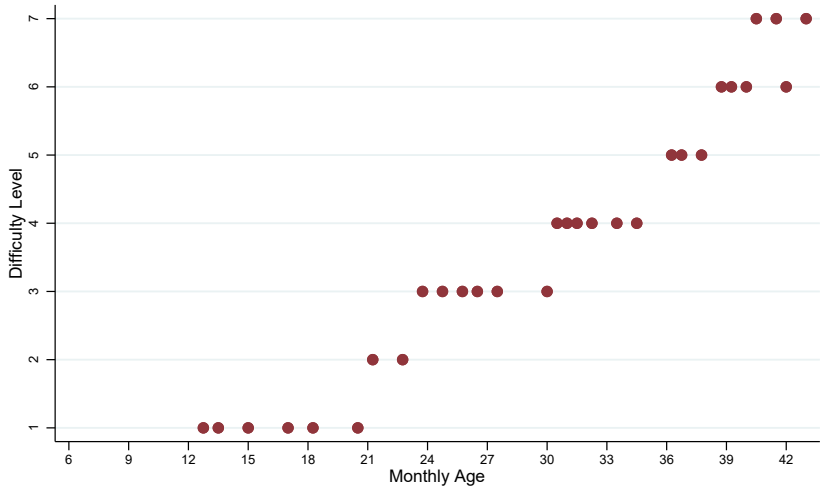
[3]The standard of generating the difficulty levels are based on the understanding of the content in the skills.

[4]The difficulty level in our content only has ordinal meaning, not cardinal meaning.

level 2.

Figure B.1 shows the timing of each fine motor drawing assessment in the curriculum design. For the designated skills, difficulty level 1 covers from 12 months and three weeks to 20 months and two weeks. This timing means that when the child is 12 months and three weeks old, the home visitor will teach her the first fine motor drawing skill. When she is 20 months and two weeks old, the home visitor will teach her the sixth lesson at difficulty level 1. In general, higher difficulty levels appear at later weekly ages. However, there can be some overlap across difficulty levels. For example, in Figure 2, by the time difficulty level 7 of fine motor lessons start, the last lesson of level 6 remains unfinished. In Figure B.1, when fine motor lessons at difficulty level 7 start, the student still receives lessons at difficulty level 6. Circling back is a strategy designed to solidify a child's understanding of a concept.

Figure B.1: The Timing of Fine Motor Skill (Drawing) Tasks across Difficulty Levels



Note: Level 1: Doodle using crayons; Level 7: Draw caterpillars.

Another example concerns cognitive skill categories. Cognitive skills have different dimensions. In the curriculum, the cognitive skills taught cover spatial, knowledge of objects and object functions, order and number, etc. Using knowing objects and object functions as an example: cognitive skill difficulty levels are defined based on the abstract concepts shown in Table B.2, such as the child's proficiency in understanding the objects. Seventy-four lessons are sorted into the listed 13 ordered difficulty levels.[5] It covers the process of how the child learns to know an object and understand the function of the object.

The lessons in the cognitive knowledge of objects unit progress from a simple understanding of the concept of pictures by acknowledging with vocalizations, to using receptive (heard) language to identify certain pictures. Receptive language is a skill developed prior to the expressive language where a child forms words to communicate. The child must use his or her expressive language to complete the following lessons, which increase with difficulty as they must develop more and more language to identify an increasing number of images. To progress through level 7 and beyond, the child must display an increasingly sophisticated understanding of the stories presented, first simply naming actions, then answering questions, then talking abstractly about a story. Levels 10, 11, 12, and 13 ask the child to take the information presented and build on it by discussing the uses of objects presented and making connections with other images.

Figure B.2 shows the timing of each cognitive (knowing objects and understanding the object's function) level in the curriculum. According to the curriculum content,

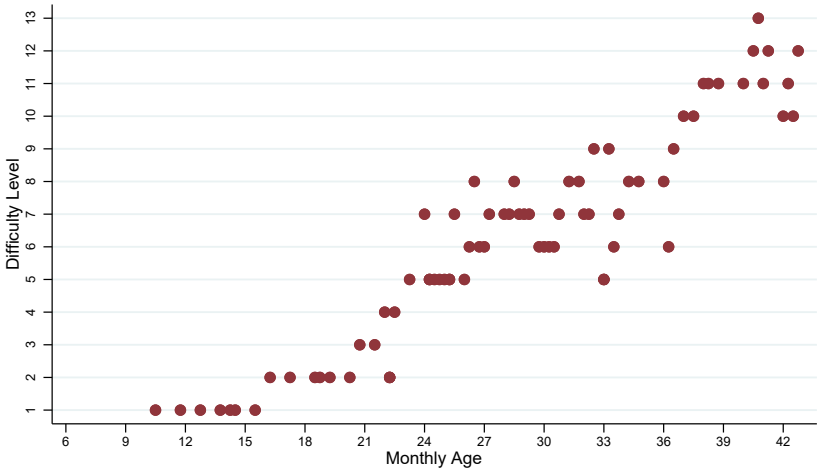
[5]The difficulty level in our content only has ordinal meaning, not cardinal meaning.

Table B.2: Difficulty Level List for the Cognitive Understanding Objects Tasks

Level 1	The child can look at the pictures and vocalize
Level 2	Name the objects and ask the child to point to the corresponding pictures
Level 3	The child can name the objects in one picture, and point to the named picture
Level 4	The child can name the objects in two or more pictures, and point to the named picture
Level 5	The child can point out named pictures, and say names of three or more
Level 6	The child can point out the picture mentioned and correctly name the name of six or more pictures
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)
Level 8	The child can follow the storyline, name actions, and answer question
Level 9	The child can understand stories and talk about the content in the pictures
Level 10	The child can keep up with the development of the story
Level 11	The child can say the name of each graphic, discuss the role of each item, and then link the graphics in the card together
Level 12	The child can name the things in the picture, link different pictures together, and discuss some of the activities in the pictures
Level 13	The child can name the things in the picture and talk about the function of objects

the number of lessons varies across difficulty levels. Table B.3 presents detailed information about the six lessons (and assessments) that are labeled as difficulty level 1 directed to ten-month to 15 month-old curriculum content. In Table B.3, all lessons relate to the activity of looking at the pictures or objects and vocalizing, which does not require the child to name or identify the object.

Figure B.2: The Timing of Cognitive Skill (Understanding Objects) Tasks across Difficulty Levels



Note: Level 1: Look at the pictures and vocalize; Level 13: The child can name the things in the picture and talk about the function of objects.

Table B.3: Cognitive Skill Task Content: Look at the Pictures and Vocalize (Level 1)

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 1	Look at the pictures and vocalize	10	2	Picture book A	Look at the pictures and vocalize: baby makes sound when looking at the pictures
Level 1	Look at the pictures and vocalize	11	3	Picture book B	Look at the pictures and vocalize: baby looks at the pictures and vocalize
Level 1	Look at the pictures and vocalize	12	3	Picture book A	Look at the pictures and vocalize: baby makes sound when looking at the pictures
Level 1	Look at the pictures and vocalize	13	3	Picture book B	Look at the pictures and vocalize: baby looks at the pictures and vocalize
Level 1	Look at the pictures and vocalize	14	1	Picture book A	Look at the pictures and vocalize: baby makes sound when looking at the pictures
Level 1	Look at the pictures and vocalize	14	2	Baby doll	Look at the pictures and vocalize: baby makes sound when holding a baby doll
Level 1	Look at the pictures and vocalize	15	2	Picture book B	Look at the pictures and vocalize: The child pronounces while looking at the pictures

In sum, the curriculum targets lessons for multiple levels of skill at each weekly age. For each type of skills, the difficulty levels are constructed by the content of the tasks and the guideline of Uzgiris and Hunt (1975) and Palmer (1971). The terms of the number of lessons within each difficulty level vary. We follow these scholars

and assume that each level is a quantum of understanding that is comparable across children. We use achievement at each level of skill as our measure of knowledge.

B.2 Fine Motor Skill

Fine motor skill involves finger movements, such as grasping, releasing and stitching, and drawing and writing skills. Here we consider two types of fine motor skills: (1) finger movements related to grasping, releasing, stitching; and (2) the movements related to drawing and writing ability. This task evaluates whether a child can grasp the writing instrument and make marks, scribbles, and shapes. It is not writing ability as in letters or words.

The first category is related to finger movements regarding grasping, releasing, stitching.[6] In Table B.4, tasks progress from basic activities like holding and moving an object that require limited precision with the fine muscles of the hands to manipulating the object with movements that need incrementally more dexterity (like rotating the object) to complex tasks requiring finer and finer finger control, like unscrewing the top. Finally, tasks that require the most hand dexterity, as well as hand-eye coordination, come last.

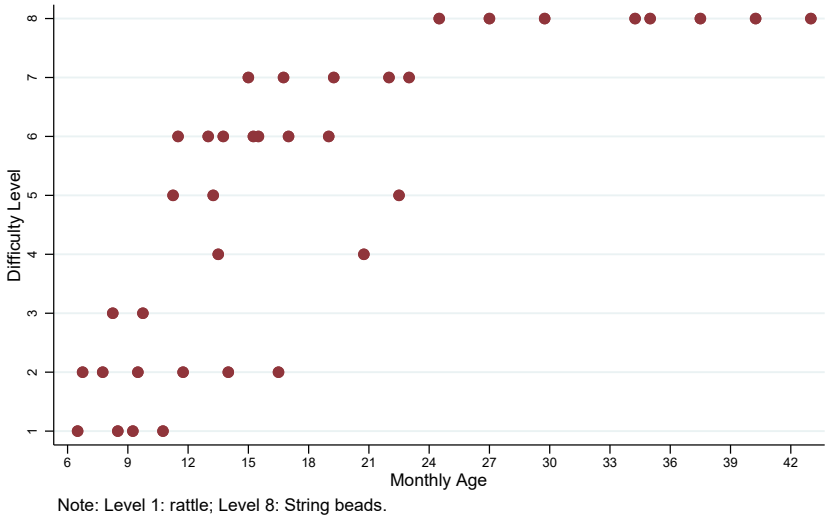
[6]These milestones are justified at https://www.chrichmond.org/therapy-services/occupational-therapy/developmental-milestones/fine-motor-skills-birth-to-2-years and http://www.kamloopschildrenstherapy.org/fine-motor-skills-infant-milestons.

Table B.4: Difficulty Level List for Fine Motor Finger Movement Tasks

Level 1	Rattle the bottle
Level 2	Shake and beat the drum with two hands
Level 3	Pull strings to get toys
Level 4	Rotate, push
Level 5	Place small objects into the bottle, shake it, and unscrew the lid
Level 6	Put a small container into a larger container
Level 7	Take the ring off and slip the ring onto the bottle
Level 8	String beads

Figure B.3 gives the timing of each finger movement tasks in the curriculum.

Figure B.3: The Timing of Fine Motor Skill (Grasping, Releasing Actions) Tasks across Difficulty Levels



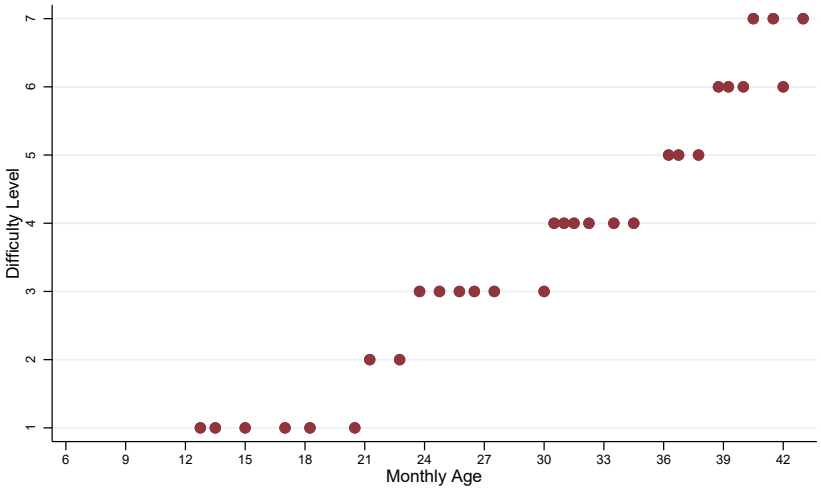
The second category is related to drawing and manual writing ability. The fine motor drawing tasks in Table B.5 focus on a child's ability to use a writing tool with increasing skills. First, a child must be able to hold the tool to make markings. Next, the child must incorporate increasingly complex cognitive skills to complete

the tasks. They start by imitating markings made by an adult. Then, when skill levels progress, they must make the marking after only a verbal command from the adult. Finally, the child progresses from abstract shapes to representative drawings.

Table B.5: Difficulty Level List for Fine Motor Drawing Tasks

Level 1	Doodle using crayons
Level 2	Mimic draw circles
Level 3	Mimic circles and draw straight lines
Level 4	Draw a circle, vertical line, and horizontal line
Level 5	Draw circles, many lines, and crossed lines
Level 6	Draw a cross (or T), curves, and zigzag curves
Level 7	Draw caterpillars

Figure B.4: The Timing of Fine Motor Skill (Drawing) Tasks across Difficulty Levels



Note: Level 1: Doodle using crayons; Level 7: Draw caterpillars.

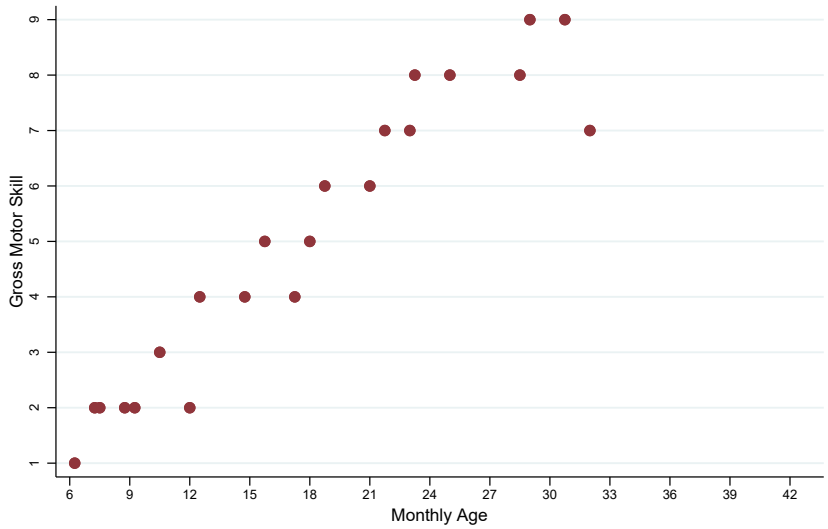
B.3 Gross Motor Skill

Gross motor skill is any skill that requires movement and precision of large body muscles. Crawling, creeping, walking, throwing, and dancing are all examples of gross motor skills. The designated gross motor tasks start with a relatively simple activity, touching the ball, requiring the child only to move one hand to the object. Next, the child must be able to move his or her entire body to interact with the toy. After mastery over those tasks, the child uses both gross motor skills and newly found cognitive ability to interact with the toy in increasingly complex ways. Pushing a toy requires coordination, standing, and walking skills. However, the child is still using the toy as a walking aid at this point. To progress to the next tasks, not only will the child have to master walking independently, but will also use the toy in a way that suggests intentionality (e.g., pulling, throwing). The final tasks require the child to integrate cognitive knowledge of direction, descriptive words, and gross motor mastery of balance.

Table B.6: Difficulty Level List for Gross Motor Tasks

Level 1	Let the child touch the ball
Level 2	The child moves (crawls) and follows the ball
Level 3	Roll the ball
Level 4	Push the toy when walking
Level 5	Pull the toy
Level 6	Pull and walk forward or backward
Level 7	Throw a ball backward, forward, upward and into a target
Level 8	Move forward or backward. Child can understand "upward," "downward," "inside of," "outside of," "stop," "go," "fast," and "slow."
Level 9	Hold the soft ball on his or her head stably while walking

Figure B.5: The Timing of Gross Motor Skill Tasks across Difficulty Levels



Note: Level 1: Let the child touch the ball, Level 9: Hold the soft cloth ball on his head stably while walking.

B.4 Cognitive Skill

Cognitive skill is broadly defined as a child's ability to apply what they have learned previously for new situations. This skill involves logic, problem-solving ability, memory, attention, and so on.

A.4.1 Spatial Skill

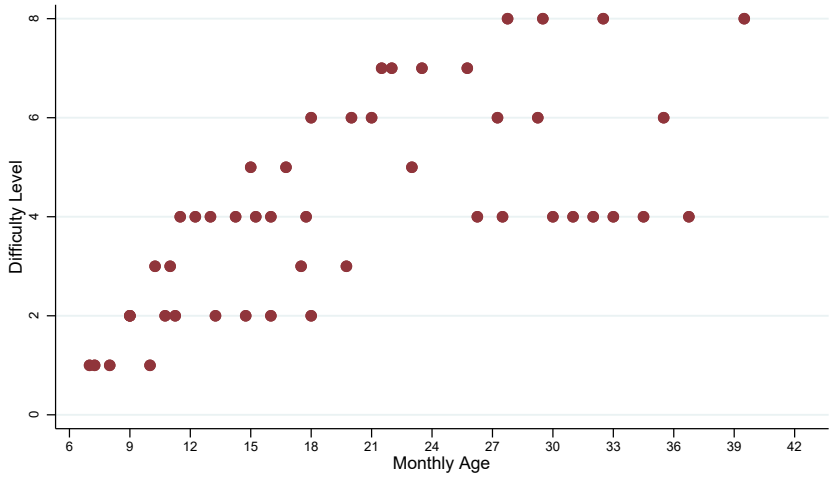
Spatial skill relies on a child's understanding of the three dimensional world. Comprehending concepts of relative positioning—"inside of," "around," and "next to" are the basics of this skill. The progression of these skills follows the child as he or she learns concepts that are more and more abstract. Beginning with "in" and

"out" and progressing to "underneath," "around," "up," "next to," and "close to." As the tasks become more difficult, the child is expected to manipulate objects to demonstrate knowledge and understanding of these concepts.

Table B.7: Difficulty Level List for Cognitive Skill (Spatial) Tasks

Level 1	Understand the concept of "getting out"
Level 2	Understand the meaning of "in" and "out"
Level 3	Understand the concepts of "go in," "come out," and "under"
Level 4	Understand "inside," "outside," "underneath," and "on top of"
Level 5	Understand the meanings of "put it around" and "take it off"
Level 6	Besides what was learned before, understand one more meaning of "up"
Level 7	Besides what was learned before, understand one more meaning of "next to"
Level 8	Besides what was learned before, understand the meanings of "close to," and "behind"

Figure B.6: The Timing of Cognitive Skill (Spatial) Tasks across Difficulty Levels



Note: Level 1: Underdtand the concept of "getting out", Level 8: Besides what learned before, understand the meanings of "close to", "behind."

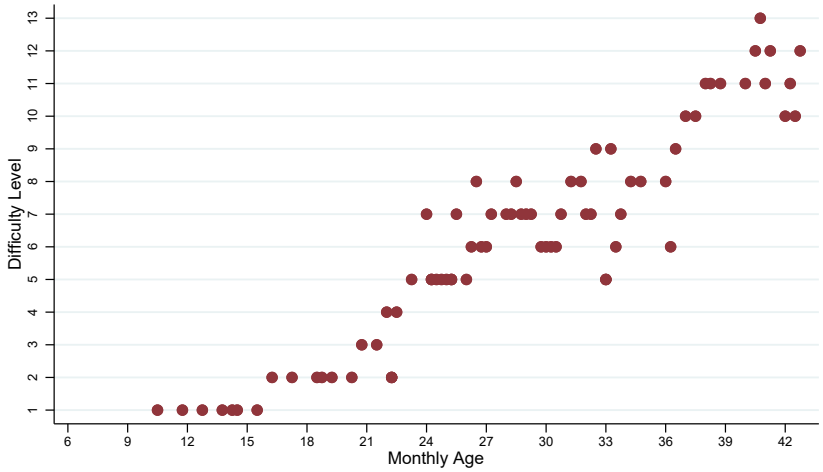
A.4.2 Knowing Objects and Objects' Functions

The knowing objects task set introduces preliteracy skills. It involves progressing interaction with pictures of objects and elements of storytelling. The tasks in the Cognitive Knowing Objects progress from a simple understanding of the concept of pictures by acknowledging with vocalizations, to using receptive (heard) language to identify certain pictures. Receptive language is a skill developed prior to an expressive language where a child forms words to communicate. The children must use their expressive language to complete the following tasks that increase with difficulty as they must develop more and more language to identify an increasing number of images. To progress through level 7 and beyond, the child must display an increasingly sophisticated understanding of the stories presented, first simply naming actions, then answering questions, then talking abstractly about the story. Levels 10, 11, 12, and 13 ask the child to take the information presented and build on it by discussing the uses of objects presented and making connections with other images.

Table B.8: Difficulty Level List for Cognitive (Understanding Objects) Tasks

Level 1	The child can look at the pictures and vocalize
Level 2	Name the objects and ask the child to point to the pictures accordingly
Level 3	The child can name the objects in one picture, and point to the named picture
Level 4	The child can name the objects in two or more pictures, and point to the named picture
Level 5	The child can point out named pictures, and say names of three or more
Level 6	The child can point out the picture mentioned, and correctly name the name of 6 or more pictures
Level 7	The child can talk about the pictures, answer questions, understand or names the verbs (eat, play, etc.)
Level 8	The child can follow the storyline, name actions and answer question
Level 9	The child can understand stories, and talk about the content in the pictures
Level 10	The child can keep up with the development of story
Level 11	The child can say the name of each graphic, discuss the role of each item, and then link the graphics in the card together
Level 12	The child can name the items in the picture, link the different pictures together, and discuss some of the activities in the pictures
Level 13	The child can name the things in the picture and talk about the function of objects

Figure B.7: The Timing of Cognitive Skill (Understanding Objects) Tasks across Difficulty Levels



Note: Level 1: Look at the pictures and vocalize; Level 13: The child can name the things in the picture and talk about the function of objects.

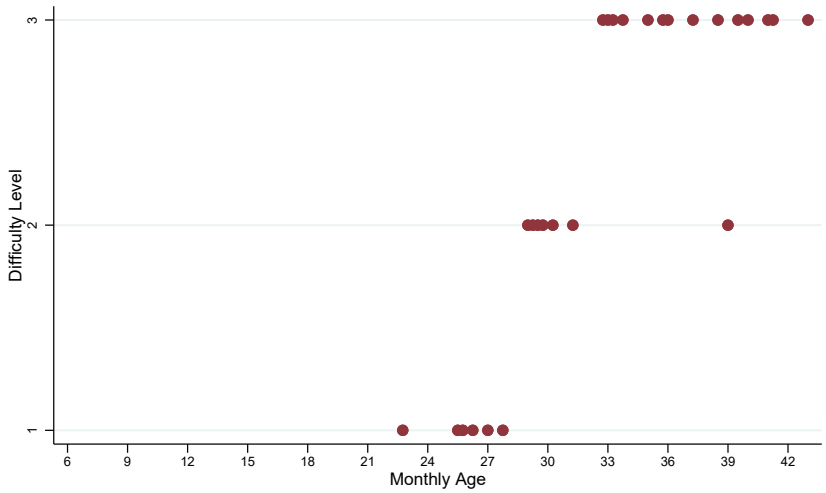
A.4.3 Color

In the color skill set, tasks progress from passive interactions (child hearing about color) to actively naming colors, to finally making connections with colors.

Table B.9: Difficulty Level List for Cognitive Skill (Color) Tasks

Level 1	Caregiver talks about the color
Level 2	The child can identify the color
Level 3	Understand color and match different colors

Figure B.8: The Timing of Cognitive Skill (Understanding Color) Tasks across Difficulty Levels



Note: Level 1: Caregiver talks about color; Level 3: Understand color and match color with objects.

Table B.10: Difficulty Level List for Cognitive Skill (Order: Understanding Upward, Forward, First, Some, All, Next, and Last) Tasks

Level 1	Child learns how to string beads and understands the meanings of "upward" and "downward"
Level 2	Understand the meanings of "upward," "downward," "first," and "then"
Level 3	Understand the concepts of "first," "finally," "in front of," and "behind"

Cognitive ability progresses into more abstract concepts of direction "upward" and "downward." Then, relative concepts of "first," "last," or "behind" are introduced.

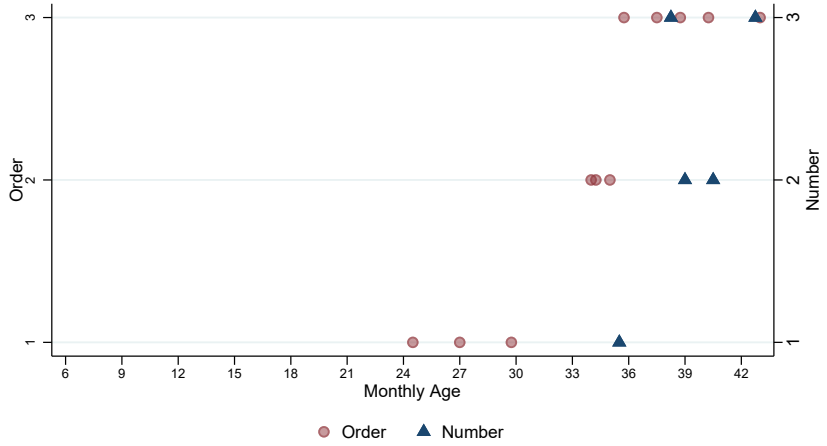
A.4.4 Number

Table B.11: Difficulty Level List for Cognitive Skill (Number) Tasks

Level 1	Child learns how to count, can count up to 4
Level 2	Counting from 1 to 4, and then count two objects: 1, 2
Level 3	Children can count from 1 to 4 and sort the card by the number of points on each card

Number tasks progress from the learning of numbers in order to understanding one-to-one relationships of numbers to objects when counting. Finally, the concept of number representation is introduced.

Figure B.9: The Timing of Cognitive Skill (Understanding Order and Numbers) Tasks across Difficulty Levels



Note: Order level 1: Understanding "upward and downward"; level 3: Understanding the concepts of "first, finally, in front of, and behind."
Number level 1: learn how to count; level 3: Sorting the card by the number of points on each card.

A.4.5 Match

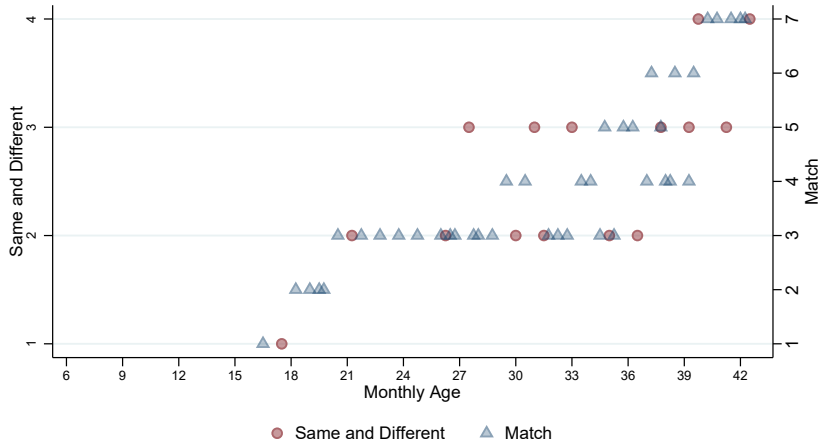
These tasks consist of matching different pieces from simple puzzles to complicated puzzles. This set of tasks builds on the child's spatial awareness skills. The

ability to fill in missing objects and understand how objects fit together is important in developing spatial awareness. The individual tasks progress from simply placing 1-2 puzzle pieces, completing the puzzle, making patterns, and using emerging language skills to describe pieces. As the children gain proficiency in these skills, they can complete puzzles of increasing complexity and restore the jumbled pieces to the original puzzle.

Table B.12: Difficulty Level List for Cognitive Skill (Match) Tasks

Level 1	Put one piece into the puzzle
Level 2	The child is able to put at least two pieces in the puzzle
Level 3	The child can complete the simple puzzle
Level 4	The child can complete the puzzle and name different pieces
Level 5	The child learns to put together puzzle pieces to form the complete pattern
Level 6	With the caregiver's help, the child can complete the puzzle with more pieces
Level 7	The child can restore the puzzle to the original

Figure B.10: The Timing of Cognitive Skill (Matching and Understanding) Tasks across Difficulty Levels



Note: Same and Different level 1: teaching the meaning of "same", level 4 the child understands the concept of "same" and "different."
Match level 1: teaching one shape puzzle; level 7: match different shape pieces.

B.5 Language Skill

Language skill is the ability of children to communicate their needs, thoughts, feelings and ideas in a way that the caregiver can understand. It includes vocalizations, gestures, spoken words, and other signals.

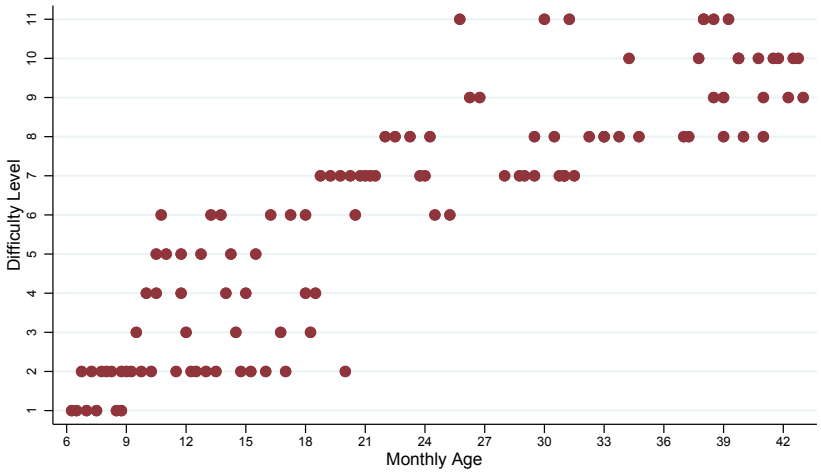
A.5.1 Learn words

Table B.13: Difficulty Level List for Language Skill (Knowing Objects and Understanding Their Functions) Tasks

Level 1	Caregiver and baby make sounds to each other to interact
Level 2	Caregiver tells baby the things she does in the house
Level 3	To teach baby to recognize people's names
Level 4	Baby learns movements that show intimacy: clapping, bye-bye, and thank you
Level 5	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures
Level 6	Baby is to recognize at least one body part
Level 7	The child identifies and/or names ordinary objects
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects
Level 9	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects
Level 10	The child points at 7 or more than 7 pictures and talk about them
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects

The language skill tasks increase in difficulty with the expectation that the child will learn to identify and use expressive language to indicate understanding. The tasks begin with the baby passively listening as the caregiver makes sounds and speaks. The child then plays a more active role, expected to indicate understanding (receptive language) and use simple gestures to indicate meaning. As understanding and vocabulary increase, the child will name more pictures and learn to describe them. Finally, the child will learn the names and uses of objects in the child's everyday environment.

Figure B.11: The Timing of Language Skill (Knowing Objects) Tasks across Difficulty Levels



Note: level 1: Teach some new sounds; level 11: The child can name, discuss objects and mimic their sounds.

A.5.2 Dialogue

In this set of tasks, the caregiver talks to the children.

Table B.14: Difficulty Level List for Language Skill (Dialogue) Tasks

Level 1	Caregiver talks to the baby when doing housework
Level 2	Use words that child learned to answer or create a new conversation

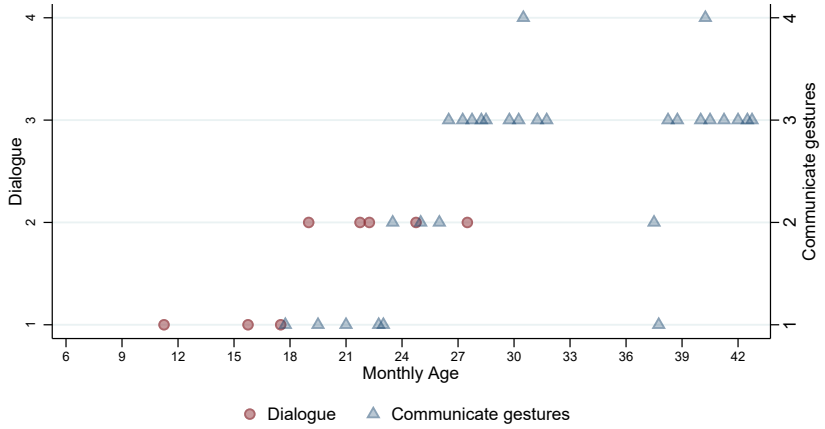
As the child grows, the caregiver progresses from simply narrating events to building on words the child has learned to scaffolding language development.

A.5.3 Communicate Gestures

Table B.15: Difficulty Level List for Language Skill (Communicate Gestures) Tasks

Level 1	The baby listens to simple instructions given by the caregiver
Level 2	Caregiver performs some activities with the child
Level 3	Let the child learn to talk about the pictures, act according to the pictures, answer questions, and name related actions

Figure B.12: The Timing of Language Skill (Communicate Gestures) Tasks across Difficulty Levels



Note: Dialogue level 1: Talking to the child; level 2: Using the words the child learned to create conversation.
Communicate gestures level 1: the child listens to simple instructions; and level 4: the child can act as other roles, e.g., father, mother.

C Task Content within Each Difficulty Level

C.1 Language Skill

Table C.1: Language Task Content (Learning Words) I

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 1	Caregiver and baby make sounds to each other to interact	6	1	Language repeat baby's sound	Caregiver and baby make sounds to each other to interact: Mother makes some sounds that the baby produces repeatedly and makes conversations with baby
Level 1	Caregiver and baby make sounds to each other to interact	6	2	Language repeat baby's sound	Caregiver and baby make sounds to each other to interact: Mother teaches baby some new sounds
Level 1	Caregiver and baby make sounds to each other to interact	6	4	Language repeat baby's sound	Caregiver and baby make sounds to each other to interact: Mother responds baby through vocalization or establishes new conversations
Level 1	Caregiver and baby make sounds to each other to interact	7	2	Language repeat baby's sound	Mother and baby make sounds to each other to interact
Level 1	Caregiver and baby make sounds to each other to interact	8	2	Language: new sound	Caregiver and baby make sounds to each other to interact: Mother helps baby imitate new sounds
Level 1	Caregiver and baby make sounds to each other to interact	8	3	Mirror game	Caregiver and baby make sounds to each other to interact: Mother and baby look into the mirror together, let baby touch the mirror image of him/herself and make sounds to the mirror.
Level 2	Caregiver tells baby the things she does in the house	6	3	language: talking with the child	Caregiver tells baby the things she does in the house: Mother tells baby the things she does in the house
Level 2	Caregiver tells baby the things she does in the house	7	1	Language: bathing	Caregiver tells baby the things she does in the house: Mother interacts with baby when bathing baby, and fills a container with water
Level 2	Caregiver tells baby the things she does in the house	7	3	language: dressing	Caregiver tells baby the things she does in the house: Mother talks to baby when dressing him
Level 2	Caregiver tells baby the things she does in the house	7	4	language: talking with the child	Caregiver tells baby the things she does in the house: Mother tells baby the things she does in the house

Table C.2: Language Task Content (Learning Words) II

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 2	Caregiver tells baby the things she does in the house	8	1	language: feeding	Caregiver tells baby the things she does in the house: Mother talks to baby when feeding him
Level 2	Caregiver tells baby the things she does in the house	8	3	Language: bathing	Caregiver tells baby the things she does in the house: Mother communicates with baby during bathing time, and fills an empty container with water.
Level 2	Caregiver tells baby the things she does in the house	8	4	language: talking with the child	Caregiver tells baby the things she does in the house: Mother tells baby what she is doing in the house
Level 2	Caregiver tells baby the things she does in the house	9	1	language: dressing	Caregiver tells baby the things she does in the house: Mother talks to baby when dressing him/her
Level 2	Caregiver tells baby the things she does in the house	9	3	language: talking with the child	Caregiver tells baby the things she does in the house: Mother tells baby what she is doing around the house
Level 2	Caregiver tells baby the things she does in the house	10	1	language: feeding	Caregiver tells baby the things she does in the house: Mother talks to baby when feeding him
Level 2	Caregiver tells baby the things she does in the house	11	2	language: talking with the child	Caregiver tells baby the things she does in the house: Mother talks to baby about what she is doing in the house
Level 2	Caregiver tells baby the things she does in the house	12	1	language: talking with the child	Caregiver tells baby the things she does in the house: Mother talks to the child about the things they do in the house
Level 2	Caregiver tells baby the things she does in the house	12	2	Language: bathing	Caregiver tells baby the things she does in the house: Mother talks to child while bathing the child
Level 2	Caregiver tells baby the things she does in the house	12	4	language: dressing	Caregiver tells baby the things she does in the house: Mother talks to the child when dressing him
Level 2	Caregiver tells baby the things she does in the house	13	2	language: talking with the child	Caregiver tells baby the things she does in the house: Mother talks to child about what they are doing in the house
Level 2	Caregiver tells baby the things she does in the house	14	3	language: feeding	Caregiver tells baby the things she does in the house: Mother talks to child when feeding him
Level 2	Caregiver tells baby the things she does in the house	15	1	language: talking with the child	Caregiver tells baby the things she does in the house: Mom tells the child their daily routine in family
Level 2	Caregiver tells baby the things she does in the house	15	4	Language: bathing	Caregiver tells baby the things she does in the house: Mom talks with the child at home
Level 2	Caregiver tells baby the things she does in the house	16	4	language: dressing	Caregiver tells baby the things she does in the house: Mother teaches the child to speak while dressing the child.
Level 2	Caregiver tells baby the things she does in the house	19	4	language: feeding	Caregiver tells baby the things she does in the house: Mother talks to child while feeding the child

Table C.3: Language Task Content (Learning Words) III

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 3	To teach baby to recognize people's names	9	2	Language – correct nouns:	To teach baby to recognize people's names: Mother teaches baby the names of family members
Level 3	To teach baby to recognize people's names	11	4	Language – correct nouns:	To teach baby to recognize people's names
Level 3	To teach baby to recognize people's names	14	2	Language – correct nouns:	To teach baby to recognize people's names: Mother teaches baby to say the names of the family members
Level 3	To teach baby to recognize people's names	16	3	Language – correct nouns:	To teach baby to recognize people's names: Mother teaches the child to identify the names of family members.
Level 3	To teach baby to recognize people's names	18	1	Language – correct nouns:	To teach baby to recognize people's names: Mother teaches the child AC:AC the names of family members.
Level 4	Baby learns movements that show intimacy: clapping, bye-bye, and thank you	9	4	language: movement wocabulary	Baby learns movements that show intimacy: clapping, bye-bye, and thank you
Level 4	Baby learns movements that show intimacy: clapping, bye-bye, and thank you	10	2	language: movement wocabulary	Baby learns movements that show intimacy: clapping, bye-bye, and thank you
Level 4	Baby learns movements that show intimacy: clapping, bye-bye, and thank you	11	3	language: movement wocabulary	Baby learns to imitate a move: no-no, up-up and lip games
Level 4	Baby learns movements that show intimacy: clapping, bye-bye, and thank you	13	4	language: movement wocabulary	Baby learns to imitate a move: no-no, up-up and lip games
Level 4	Baby learns movements that show intimacy: clapping, bye-bye, and thank you	14	4	language: movement wocabulary	Baby learns to imitate a move: no-no, up-up and lip games
Level 4	Baby learns movements that show intimacy: clapping, bye-bye, and thank you	17	4	language: movement wocabulary	Baby learns to imitate a move: no-no, up-up and lip games
Level 4	Baby learns movements that show intimacy: clapping, bye-bye, and thank you	18	2	language: movement wocabulary	Baby learns to imitate a move: no-no, up-up and lip games

Table C.4: Language Task Content (Learning Words) IV

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 5	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures	10	2	Picture book A	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures: Book: baby makes sound when looking at the pictures
Level 5	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures	10	4	Dialogue (walking):	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures: Mother takes baby outdoor, and tells baby the names of outdoor objects and introduces them
Level 5	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures	11	3	Picture book B	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures: Book: baby looks at the pictures and vocalize
Level 5	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures	12	3	Picture book A	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures: Child makes sound looking at the pictures
Level 5	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures	14	1	Picture book A	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures: mother and child look at the pictures together, and let the child vocalize and touch the pictures
Level 5	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures	15	2	Picture book B	Caregiver and child look at the pictures together, and let the child vocalize and touch the pictures: The child pronounces while looking at the pictures
Level 6	Baby is to recognize at least one body part	10	3	language: body part	Baby is to recognize at least one body part: Baby is to recognize at least one body part (not names) (language G)
Level 6	Baby is to recognize at least one body part	13	1	language: body part	Baby is to recognize at least one body part: Mother teaches child to know at least one facial organs (eye, nose, mouth), (language – introducing body parts)
Level 6	Baby is to recognize at least one body part	13	3	Picture book B	Baby is to recognize at least one body part: face
Level 6	Baby is to recognize at least one body part	16	1	picture book 1	Baby is to recognize at least one body part: the child points out in the book the object body part and make sound.

Table C.5: Language Task Content (Learning Words) V

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 6	Baby is to recognize at least one body part	17	1	picture book 2	Name the objects and ask the baby to point to the pictures accordingly. Ask the baby to help the mother turn the pages.
Level 6	Baby is to recognize at least one body part	17	4	language: commonly used noun	Mother helps the baby identify and/or point to the name of ordinary objects (language—Common Nouns)
Level 6	Baby is to recognize at least one body part	18	3	picture book 1	Baby is to recognize at least one body part: the child points out in the book the object body part and make sound.
Level 6	Baby is to recognize at least one body part	20	2	language: body part	Baby is to recognize at least one body part: The child can identify parts of the face and the body (Language—Body Parts)
Level 6	Baby is to recognize at least one body part	24	2	Picture Talk3	Baby is to recognize at least one body part: Mother imitates the actions in the pictures with the child, talks about the content of the pictures, and lets the child point to the corresponding pictures when hears the names of the objects
Level 6	Baby is to recognize at least one body part	25	1	language: clothes	Baby is to recognize at least one body part: The child can recognize/identify the body part and clothes he/she is wearing
Level 7	The child identifies and/or names ordinary objects	19	1	picture book 2	The child identifies and/or names ordinary objects: Mother and child read the book together, name the objects in the book, flip pages, act out the movements in the book, and to match the objects in the book to the object in reality.
Level 7	The child identifies and/or names ordinary objects	19	3	language: commonly used noun	Child identifies and/or name common objects (language-commonly used noun)
Level 7	The child identifies and/or names ordinary objects	20	1	language: commonly used noun	Child identifies and/or names ordinary objects (Language—Common Nouns)
Level 7	The child identifies and/or names ordinary objects	20	3	picture book 3	The child identifies and/or names ordinary objects: animal—chicken, goat, horse, dog, pig, cow
Level 7	The child identifies and/or names ordinary objects	20	4	Sock, Doll, Hat, and Little Car	The child identifies and/or names ordinary objects: mother and child talk about the doll and the car while playing with them; the child understands the meaning of inside, outside, come down, on, and go; the child can pull the car forward and backward while walking.
Level 7	The child identifies and/or names ordinary objects	21	1	language: commonly used noun	Child identifies/or names common objects

Table C.6: Language Task Content (Learning Words) VI

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	21	2	picture book 1	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: child points to the picture in the book (one or multiple), names the objects in the picture(s), makes noises, and associates the objects in the book to the object in reality.
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	23	3	language: clothes	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: Ask the child to recognize clothes he or she is wearing and to say the name of one or more of them. (Language- clothes)
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	23	4	Picture talk 2	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: child reads book with mother, says one or more objects in the picture.
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	27	4	Picture talk 2	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: mother asks child to point to a picture and name the object in the picture; mother then asks questions. Child names the object, discusses it, and answers the questions.
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	28	3	language: food names	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: The child can say names of food (language – food names)
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	28	4	Picture talk 3	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: mother talks about the picture, raises questions, brings up new topics, introduces color. Child talks about picture and names the object in the picture, answers the questions.

Table C.7: Language Task Content (Learning Words) VII

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	29	2	language: touches and names	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: Child touches one or more objects and names these objects.
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	30	3	Picture Talk4	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: Child names the picture and some small parts of the picture, talks about them and answers the questions.
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	30	4	Sorting and matching 3	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: child pair single card with the pattern on the board; child can name the picture and understand concepts of "on" and "same as".
Level 8	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects	30	4	language: Acting as Mother/Father	The child points to the pictures which are being named, names one or more pictures, mimic the sound of the objects: Ask the child to tell his/her name and age.
Level 9	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects	21	4	picture book 2	child names the objects in two or more pictures, points to the named pictures, and associates the pictures to the objects in reality.
Level 9	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects	22	2	Picture talk 1	the child points to the pictures which are being named, names two or more pictures, make the sound of the objects or animals in the pictures, and match the objects in the pictures with the actual ones.
Level 9	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects	23	1	picture book 3	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects: the child points out named pictures, says names of three or more animals, and imitates the sound of animals.
Level 9	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects	24	1	picture book 2	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects: Child can name the pictures (four or more), point to the corresponding pictures when hears the names of objects, imitate the sounds that the objects in the pictures can make, and connect with the material objects in real environment.

Table C.8: Language Task Content (Learning Words) VIII

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 9	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects	29	2	Puzzle4	The child points to the pictures which are being named, names two or more pictures, mimics the sound of the objects: Child can name different parts of the house
Level 9	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects	30	2	Puzzle7	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects: child can name eye, nose, ear, and mouth.
Level 9	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects	39	4	snake shape bottle cap ring	The child points to the pictures which are being named, names two or more pictures, mimic the sound of the objects: The child can put the cap in a circle on the cardboard according to colors, complete the caterpillar pattern and indicate or say the name of each color.
Level 10	The child points at 7 or more than 7 pictures and talk about them	26	1	Picture talk 5	The child points at 7 or more than 7 pictures and talk about them: mother and child talk about picture and colors in the picture. Child points at 7 or more than 7 pictures and talk about them.
Level 10	The child points at 7 or more than 7 pictures and talk about them	26	3	Picture talk 1	The child points at 7 or more than 7 pictures and talk about them: mother asks child to say the name of objects (7 or more) in the pictures and talks about the picture.
Level 10	The child points at 7 or more than 7 pictures and talk about them	38	2	language: clothes	The child points at 7 or more than 7 pictures and talk about them: The child can distinguish and say the different types of clothes.(7 or more)
Level 10	The child points at 7 or more than 7 pictures and talk about them	38	4	language: body part	The child points at 7 or more than 7 pictures and talk about them: The child can tell a relatively small part of the body, such as: toes, fingers, elbows, etc.(7 or more)
Level 10	The child points at 7 or more than 7 pictures and talk about them	40	4	picture talk 7	The child points at 7 or more than 7 pictures and talk about them: Mom and child talk about pictures. The child can name the name and color of the things in the picture. (7 or more)

Table C.9: Language Task Content (Learning Words) IX

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	25	3	language: name and usage	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects: Child names objects at home, and tells the usage of those objects.
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	29	4	language: name and usage	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects: Child learns to name the objects in the house. And let the mother tell how to use them.
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	31	1	Picture talk 2	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects: Child can name animals, discuss them, and mimic their sounds
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	34	1	Picture Talk4	Child can name the pictures and talk about them. Child can name the details and answer questions.
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	37	4	Blocks and Animal	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects: Children learn to usel blocks to build animal fences and bridges, tell the names of animals, and discuss What theanimals are doing and imitate the sound of the animal. Understand the concept of "wide" and "narrow", "all" and "partial".
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	37	4	picture talk 7	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects: The child can say put the name of each graphics, discuss the role of each item, and then linkthe graphics in the card together. Mom and the child discuss the picture and come up with something else to discuss.
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	38	2	Puzzle 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects: The child can complete the puzzle and discuss the truck with the mother.
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	39	1	language: name and usage	Child names objects at home, and tells the usage of those objects
Level 11	Teach the child some simple descriptive words and the child names objects at home, and tells the usage of those objects	39	3	language: descriptive words	Teach the child some simple descriptive words.

C.2 Cognitive Skill Tasks

Table C.10: Cognitive Task Content (Understanding Objects) I

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 1	Look at the pictures and vocalize	10	2	Picture book A	Look at the pictures and vocalize: baby makes sound when looking at the pictures
Level 1	Look at the pictures and vocalize	11	3	Picture book B	Look at the pictures and vocalize: baby looks at the pictures and vocalize
Level 1	Look at the pictures and vocalize	12	3	Picture book A	Look at the pictures and vocalize: baby makes sound when looking at the pictures
Level 1	Look at the pictures and vocalize	13	3	Picture book B	Look at the pictures and vocalize: baby looks at the pictures and vocalize
Level 1	Look at the pictures and vocalize	14	1	Picture book A	Look at the pictures and vocalize: baby makes sound when looking at the pictures
Level 1	Look at the pictures and vocalize	14	2	Baby doll	Look at the pictures and vocalize: baby makes sound when holding a baby doll
Level 1	Look at the pictures and vocalize	15	2	Picture book B	Look at the pictures and vocalize: The child pronounces while looking at the pictures
Level 2	Name the objects and ask the baby to point to the pictures accordingly	16	1	picture book 1	Name the objects and ask the baby to point to the pictures accordingly: Child points to the objects in the book that the family visitor named, and learns how to turn pages.
Level 2	Name the objects and ask the baby to point to the pictures accordingly	17	1	picture book 2	Name the objects and ask the baby to point to the pictures accordingly
Level 2	Name the objects and ask the baby to point to the pictures accordingly	18	3	picture book 1	Name the objects and ask the baby to point to the pictures accordingly: Child points to the objects in the book that the family visitor named, and learns how to turn pages.
Level 2	Name the objects and ask the baby to point to the pictures accordingly	19	1	picture book 2	Name the objects and ask the baby to point to the pictures accordingly

Table C.11: Cognitive Task Content (Understanding Objects) II

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 2	Name the objects and ask the baby to point to the pictures accordingly	20	1	Baby doll	Name the objects and ask the baby to point to the pictures accordingly:start naming body parts.
Level 2	Name the objects and ask the baby to point to the pictures accordingly	22	1	Baby doll	Name the objects and ask the baby to point to the pictures accordingly: name individual parts of its body
Level 2	Name the objects and ask the baby to point to the pictures accordingly	22	1	Baby doll	Name the objects and ask the baby to point to the pictures accordingly: name individual parts of its body
Level 3	The child can name the objects in one picture, and point to the named picture	20	3	picture book 3	Child can name the objects in one picture, and point to the named picture.
Level 3	The child can name the objects in one picture, and point to the named picture	21	2	picture book 1	Child points to the picture in the book (one or multiple), names the objects in the picture(s), makes noises, and associates the objects in the book to the object in reality.
Level 4	The child can name the objects in two or more pictures, and point to the named picture	21	4	picture book 2	Child names the objects in two or more pictures, points to the named picture make noises, and associates the pictures to the objects in reality.
Level 4	The child can name the objects in two or more pictures, and point to the named picture	22	2	Picture talk 1	Child points to the pictures which are being named, names two or more pictures, make the sound of the objects or animals in the pictures, and match the objects in the pictures with the actual ones.
Level 5	The child can point out named pictures, and say names of three or more	23	1	picture book 3	Child points out named pictures, says names of three or more animals, and imitates the sound of animals.
Level 5	The child can point out named pictures, and say names of three or more	24	1	Sorting and matching 1	Child to match pictures and names with material objects (3 or more), or point to the corresponding object when names.
Level 5	The child can point out named pictures, and say names of three or more	24	1	picture book 2	Child can name the pictures (four or more), point to the corresponding pictures when hears the names of objects, imitate the sounds that the objects in the pictures can make, and connect with the material objects in real environment.
Level 5	The child can point out named pictures, and say names of three or more	24	2	Picture Talk3	The child can point out named pictures, and say names of three or more: the child point to the corresponding pictures when hears the names of the objects (3 or more)

Table C.12: Cognitive Task Content (Understanding Objects) III

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 5	The child can point out named pictures, and say names of three or more	24	3	Puzzle4	The child can point out named pictures, and say names of three or more: Child names and points to each part of the house (3 or more)
Level 5	The child can point out named pictures, and say names of three or more	24	4	Picture Book 4	Child and the mother talk about the pictures in the picture book, perform the scenes and name the objects and details of the objects in those pictures.
Level 5	The child can point out named pictures, and say names of three or more	25	1	Cap House	The child can point out named pictures, and say names of three or more: let the child identify window, door, roof, and wall, and learn to name some of them if possible;
Level 5	The child can point out named pictures, and say names of three or more	25	1	language: clothes	The child can point out named pictures, and say names of three or more: The child can recognize/identify the clothes he/she is wearing (3 or more)
Level 5	The child can point out named pictures, and say names of three or more	25	4	Picture book 3	Picture Book: mother teaches the child to name every animal, talk about them, and imitate the sounds made by the animals
Level 5	The child can point out named pictures, and say names of three or more	32	4	lip flower	Child to match pictures and names with material objects (3 or more), or point to the corresponding object when names.
Level 5	The child can point out named pictures, and say names of three or more	32	4	Sorting and matching 4	Child to match pictures and names with material objects (3 or more), or point to the corresponding object when names.
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	26	1	Picture talk 5	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: mother and child talk about picture and colors in the picture. Child points at 7 or more than 7 pictures and talk about them.
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	26	3	Picture talk 1	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: Mother and child perform the content of the picture, talk about the picture, the child points out the picture mentioned, and correctly names the name of 6 or more pictures
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	26	4	Picture Talk3	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: Mother and child perform the content of the picture, talk about the picture, the child points out the picture mentioned, and correctly names the name of 6 or more pictures

Table C.13: Cognitive Task Content (Understanding Objects) IV

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	29	3	picture book 3	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: Child learns to identify and name the names of the animals in the book and makes the sounds of the animals. (6 or more)
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	29	4	Sorting and matching 5	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: Mother teaches the child to match each card with the picture in each picture card, and name and identify the animals. (6 or more)
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	30	1	Cap House	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: Child places caps into the circles on the drawing board; child matches caps with circles of the same color, and names different parts of the house.(6 or more)
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	30	2	Puzzle7	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: Child can piece the puzzle well and name different parts of a face (eyes, nose, mouth, and ears, etc) (6 or more)
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	33	2	Puzzle7	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: Child can piece the puzzle well and name different parts of a face (eyes, nose, mouth, and ears, etc) (6 or more)
Level 6	The child can point out the picture mentioned and correctly name the name of 6 or more pictures	36	1	Puzzle7	The child can point out the picture mentioned and correctly name the name of 6 or more pictures: Child can piece the puzzle well and name different parts of a face (eyes, nose, mouth, and ears, etc) (6 or more)

Table C.14: Cognitive Task Content (Understanding Objects) V

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	23	4	Picture talk 2	The child can talk about the pictures, answer questions, understand, or name the verbs: child reads book with mother, says objects in the picture, turns page, imitates actions in the picture and match object in the picture with object in real world.
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	25	2	Picture Talk4	The child can talk about the pictures, answer questions, understand, or name the verbs: child talks about the pictures, mimics behaviors in the pictures, answer questions, understands or names the verbs (eat, play, etc.).
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	27	1	picture book 4	The child can talk about the pictures, answer questions, understand, or name the verbs: child talks about the pictures, mimics behaviors in the pictures, answer questions, understands or names the verbs (eat, play, etc.).
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	27	4	Picture talk 2	The child can talk about the pictures, answer questions, understand, or name the verbs: child reads book with mother, says objects in the picture, turns page, imitates actions in the picture and match object in the picture with object in real world.
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	28	1	Doll, Clothes, Bed, Bed Sheet, Pillow	The child can talk about the pictures, answer questions, understand, or name the verbs: Child and mother play with the doll, talk about activity about doll, bed, and baby's clothes, with child and recognize or say the names of doll, bed and body parts.
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	28	4	Picture talk 3	The child can talk about the pictures, answer questions, understand, or name the verbs: Child talks about pictures and names the object in the picture, and answers the questions.
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	29	1	Picture Talk 5	The child can talk about the pictures, answer questions, understand, or name the verbs: Child can name the objects in pictures, talk about pictures, answer questions, and identify colors (red, orange).
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	30	3	Picture Talk4	The child can talk about the pictures, answer questions, understand, or name the verbs: The child can talk about the pictures, answer questions, understand, or name the verbs: Child talks about pictures and names the object in the picture, and answers the questions.
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	32	1	Picture talk 1	The child can talk about the pictures, answer questions, understand, or name the verbs: The child can name the pictures, talk with mother about the contents in the pictures, and answer questions.
Level 7	The child can talk about the pictures, answer questions, understand, or name the verbs (eat, play, etc.)	33	3	Picture talk 3	The child can talk about the pictures, answer questions, understand, or name the verbs: Child talks about pictures and names the object in the picture, and answers the questions.

Table C.15: Cognitive Task Content (Understanding Objects) VI

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 8	The child can follow the storyline, name actions, and answer question	26	2	language: recognize verbs	Child can follow the story line, name actions and answer question
Level 8	The child can follow the storyline, name actions, and answer question	28	2	picture book 5	Child can follow the story line, name actions and answer question
Level 8	The child can follow the storyline, name actions, and answer question	31	1	Picture talk 2	Child can name animals, discuss them, and mimic their sounds
Level 8	The child can follow the storyline, name actions, and answer question	31	3	picture book 5	Child can understand the story, answer questions, and name behaviors
Level 8	The child can follow the storyline, name actions, and answer question	34	1	Picture Talk4	Child can follow the storyline, name actions, and answer questions: Child can name the pictures and talk about them. Child can name the details and answer questions.
Level 8	The child can follow the storyline, name actions, and answer question	34	3	Picture Talk 6	Child name the pictures, talk about the pictures, connect the contents of the pictures with the real life, and raise questions.
Level 8	The child can follow the storyline, name actions, and answer question	35	4	Picture Talk 5	The child can follow the storyline, name actions, and answer question: Child is able to same the name of shapes and talks about them, is able to answer question.
Level 9	The child can understand stories, talk about the content in the pictures	32	2	Picture book 7	Child can understand stories, talk about the content in the pictures
Level 9	The child can understand stories, talk about the content in the pictures	33	1	Picture book 6	Child can understand stories, discuss the content of pictures, and the concept of wet, dry, clean, and dirty
Level 9	The child can understand stories, talk about the content in the pictures	36	2	Picture book 5	Child can understand the development of a story page by page

Table C.16: Cognitive Task Content (Understanding Objects) VII

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 10	The child can keep up with the development of the story	36	4	Picture book 8	The child can keep up with the development of the story: The child discusses and understand the main contents of the story
Level 10	The child can keep up with the development of the story	37	2	Picture book 8	Children can understand the story and answer questions. Mom and the child performed the story in the book and answered the questions.
Level 10	The child can keep up with the development of the story	41	4	picture talk : Clinic	The child can keep up with the development of the story: The child discusses and understand the main contents of the story
Level 10	The child can keep up with the development of the story	42	2	Picture book 6	The child can keep up with the development of story in each page during reading the book.
Level 11	The child can say the name of each graphics, discuss the role of each item and then link the graphics in the card together	37	4	Picture talk 7	The child can say put the name of each graphics, discuss the role of each item, and then linkthe graphics in the card together. Mom and the child discuss the picture and come up with something else to discuss.
Level 11	The child can say the name of each graphics, discuss the role of each item and then link the graphics in the card together	38	1	Picture book 6	The child can tell the things in each picture and discuss being at school and the teacher's work with children.
Level 11	The child can say the name of each graphics, discuss the role of each item and then link the graphics in the card together	38	3	Picture book 6	The child can tell the things in each picture and discuss being at school and the teacher's work with children.
Level 11	The child can say the name of each graphics, discuss the role of each item and then link the graphics in the card together	39	4	Picture talk: yard	Mom and the child discuss the picture together, what the people in the picture are doing and telling their names.
Level 11	The child can say the name of each graphics, discuss the role of each item and then link the graphics in the card together	40	4	Picture talk 7	The child can name the name and colors of the things in the picture. Encourage your child to concentrate on the picture and connect different pictures.
Level 11	The child can say the name of each graphics, discuss the role of each item and then link the graphics in the card together	42	1	2 socks doll, home and furniture	Discuss the usage of each different room with the child and place furniture according to the usage of each room. Play a house game with your child.

Table C.17: Cognitive Task Content (Understanding Objects) VIII

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 12	The child can name the things in the picture and link different pictures together and discuss some of the activities in the pictures	40	2	Picture book 8	Let the children talk about the book, and the mother asks the child some questions to help the child follow up the development of the story. Let the children talk about their experiences of buying things.
Level 12	The child can name the things in the picture and link different pictures together and discuss some of the activities in the pictures	41	1	Picture book 9	Children can understand and keep up with the development of the storyline in the book and answer simple questions.
Level 12	The child can name the things in the picture and link different pictures together and discuss some of the activities in the pictures	42	3	picture talk 6	The child can name the things in the picture and link the different pictures together. discuss some of the activities in the school.
Level 13	The child can name the things in the picture and talk about the function of objects	40	3	2 socks doll, home and furniture	The child placed the furniture and said the name of each furniture. Talk about the usage of each room, and what the doll does in each room.

C.3 Fine Motor Skills

Table C.18: Fine Motor Task Content (Drawing) I

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 1	Doodle using crayons	12	3	Crayon and paper	Child is to doodle on the paper
Level 1	Doodle using crayons	13	2	Crayon and paper	Child is to doodle on the paper
Level 1	Doodle using crayons	14	4	Crayon and paper	Child doodles on the paper.
Level 1	Doodle using crayons	16	4	Crayon and paper	Child doodles on the paper.
Level 1	Doodle using crayons	18	1	Crayon and paper	Child scribbles on the paper.
Level 1	Doodle using crayons	20	2	Crayon and paper	Child doodles on the paper.
Level 2	Mimic draw circles	21	1	Crayon and Paper	Drawing Circles: Child Imitating round and round.
Level 2	Mimic draw circles	22	3	Crayon and Paper	Drawing Circles: Child mimics to draw circles
Level 3	Mimic circles and draw straight lines	23	3	Crayon and Paper	Circles and straight line: Child to scribble on the paper, and to draw circles and perpendicular line
Level 3	Mimic circles and draw straight lines	24	3	Crayon and Paper	Circles and straight line: Child draws straight lines and circles.
Level 3	Mimic circles and draw straight lines	25	3	Crayon and Paper	Circles and straight line: let the child doodle on the paper and draw circles and straight lines from top to bottom and from left to right.
Level 3	Mimic circles and draw straight lines	26	2	Crayon and Paper	Circles and straight line: child randomly scribbles, drawing circle, and horizontal line.
Level 3	Mimic circles and draw straight lines	27	2	Crayon and Paper	Circles and straight line: child can draw circles, and horizontal lines.
Level 3	Mimic circles and draw straight lines	29	4	Crayon and Paper	Circles and straight line: Let the child draw horizontal, and color circles.

Table C.19: Fine Motor Task Content (Drawing) II

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 4	Draw circle, vertical line, and horizontal line	30	2	Crayon and Paper	vertical line and horizontal line and circle: let the child draw circle, vertical line, and horizontal line.
Level 4	Draw circle, vertical line, and horizontal line	30	4	Crayon and Paper	vertical line and horizontal line and circle:: ask the child to draw vertical lines, horizontal lines, and imitate to draw circles.
Level 4	Draw circle, vertical line, and horizontal line	31	2	Crayon and Paper	vertical line and horizontal line and circle
Level 4	Draw circle, vertical line, and horizontal line	32	1	Crayon and Paper	vertical line and horizontal line and circle
Level 4	Draw circle, vertical line, and horizontal line	33	2	Crayon and Paper	vertical line and horizontal line and circle
Level 4	Draw circle, vertical line, and horizontal line	34	2	Crayon and Paper	vertical line and horizontal line and circle: Child can doodle, and draw a circle and lines towards different directions.
Level 5	Draw circle, vertical line, and horizontal line	36	1	Crayon and Paper	Draw cicle, many lines, and cross lines: The child could draw circles, many lines (barricades or posts) and crossing lines
Level 5	Draw circle, vertical line, and horizontal line	36	3	Crayon and Paper	Draw cicle, many lines, and cross lines: The child could draw vertical lines (barricades or posts), circles or lamp posts
Level 5	Draw circle, vertical line, and horizontal line	37	3	Crayon and Paper	Draw cicle, many lines, and cross lines: The child can imitate drawing curves and zigzag curves.

Table C.20: Fine Motor Task Content (Drawing) III

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 6	Draw a cross (or T), curves and zigzag curves	38	3	Crayon and Paper	Draw a cross, curves, and zigzag curves: Children can draw cross shapes with horizontal and vertical lines Glyphs or T-shapes, draw curves and Z-line
Level 6	Draw a cross (or T), curves and zigzag curves	39	1	Crayon and Paper	Draw a cross, curves, and zigzag curves: Let the child draw a cross (or T) on the paper and draw a curve and a zigzag curve according to the picture.
Level 6	Draw a cross (or T), curves and zigzag curves	39	4	Crayon and Paper	Draw a cross, curves, and zigzag curves: The child can draw a cross (T-shaped), curve and Z-line on the paper.
Level 6	Draw a cross (or T), curves and zigzag curves	41	4	Crayon and Paper	Draw a cross, curves, and zigzag curves: Children can draw horizontal lines, vertical lines, and crosses, or T-shapes.
Level 7	Draw caterpillars	40	2	Crayon and Paper	Draw caterpillars: Children learn to draw caterpillars with heads.
Level 7	Draw caterpillars	41	2	Crayon and Paper	Draw caterpillars The child can draw caterpillars according to the picture.
Level 7	Draw caterpillars	42	4	Crayon and Paper	Draw caterpillars The child can draw caterpillars according to the picture.

C.4 Gross Motor

Table C.21: Gross Motor Task Content I

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 1	Let the child touch the ball	6	1	Soft cloth ball	Let baby touch the ball, entertain baby
Level 2	The child moves (crawls) and follows the ball	7	1	Soft cloth ball	The child moves (crawls) and follows the ball: when mother rolls the ball, let baby move and follow the ball to its side.
Level 2	The child moves (crawls) and follows the ball	7	2	Rolling water bottle	The child moves (crawls) and follows the ball: mother rolls the bottle and the baby crawls to follow
Level 2	The child moves (crawls) and follows the ball	8	3	Rolling water bottle	The child moves (crawls) and follows the ball: baby crawls to follow the bottle
Level 2	The child moves (crawls) and follows the ball	9	1	Soft cloth ball	The child moves (crawls) and follows the ball: Baby crawls to the ball by himself
Level 2	The child moves (crawls) and follows the ball	11	4	Soft cloth ball	The child moves (crawls) and follows the ball: Baby crawls to the ball by himself
Level 3	Roll the ball	10	2	Soft cloth ball	Roll the ball: baby draws pleasure through throwing and rolling the ball
Level 4	Push the toy when walking	12	2	Push the trolley	Push the toy when walking: a toy that the child can push while walking, to help the child to connect the movement and the word “push”
Level 4	Push the toy when walking	14	3	Push the trolley	Push the toy when walking: a toy that the child can push while walking, to help the child to connect the movement and the word “push”
Level 4	Push the toy when walking	17	1	Push the trolley	Push the toy when walking: the baby pushes the toy while walking. Help the baby connect the action with the word “push”.

Table C.22: Gross Motor Task Content II

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 5	Pull the toy	15	3	Pull a cart	Pull the toy: a toy that will follow when the child pulls. Help the child to connect the action with the word "pull"
Level 5	Pull the toy	17	4	Sock, Doll, Hat, and Little Car	Pull the toy:the baby pulls forward the little car.
Level 6	Pull and walk forward or backward	18	3	Pull a cart	Pull and walk forward or backward: The child can pull the toy while walking forwards or walking backwards.
Level 6	Pull and walk forward or backward	20	4	Sock, Doll, Hat, and Little Car	Pull and walk forward or backward: the child can pull the car forward and backward while walking.
Level 7	Throw ball backward, forward, upward and into a target	21	3	Soft cloth ball	Throw ball backward, forward, upward and into a target: child throws the ball backward or forward to the mother
Level 7	Throw ball backward, forward, upward and into a target	22	4	Soft cloth ball	Throw ball backward, forward, upward and into a target: Let the child throw up the soft ball, and throw it into the box, and understand the meaning of up and into
Level 7	Throw ball backward, forward, upward and into a target	31	4	Soft cloth ball	Throw ball backward, forward, upward and into a target: Child can throw the soft fabric ball under or on certain objects. Child can throw the soft fabric ball upwards

Table C.23: Gross Motor Task Content III

Difficulty Level	Difficulty Level Aim	Month	Week	Learning Materials	Task Aim and Content
Level 8	Move forward or backward. Child can understand "upward", "downward", "inside of", "outside of", "stop", "go", "fast", "slow."	23	1	Pull a cart	Move forward or backward. Child can understand "upward", "downward", "inside of", "outside of", "stop", "go", "fast", "slow." asks the child to pull bottle caps and understands the meaning of "stop" and "go".
Level 8	Move forward or backward. Child can understand "upward", "downward", "inside of", "outside of", "stop", "go", "fast", "slow."	24	4	Sock, Doll, Hat, and Little Car	Move forward or backward. Child can understand "upward", "downward", "inside of", "outside of", "stop", "go", "fast", "slow.": Sock doll, hat and toy car: Child can drag the toy car and move forward or backward. Child can understand "upward," "downward," "inside of," "outside of," "stop," "go," "fast," "slow."
Level 8	Move forward or backward. Child can understand "upward", "downward", "inside of", "outside of", "stop", "go", "fast", "slow."	28	2	Sock, Doll, Hat, and Little Car	Move forward or backward. Child can understand "upward", "downward", "inside of", "outside of", "stop", "go", "fast", "slow.": he baby can push forward or pull backward the little car while walking. Play the toy and understand the meanings of stop, go, fast, slow and next to.
Level 9	Hold the soft ball on his or her head stably while walking	28	4	Soft cloth ball	Hold the soft ball on his or her head stably while walking: child can hold the soft cloth ball on his head stably while walking; throw soft cloth ball, understand the meaning of up, under, across, on, high
Level 9	Hold the soft ball on his or her head stably while walking	30	3	Soft cloth ball	Hold the soft ball on his or her head stably while walking: child can hold the soft cloth ball on his head stably while walking; throw soft cloth ball, understand the meaning of on, under, across, on, high, and up.

D Measures of Interactions and Factor Model of Interactions

D.1 Measures of Interactions

China REACH collects weekly records of child performance on tasks that measure child development during the weekly home visits. The supervisors record home visitor, caregiver, and child interaction activities at least once per month, making it possible for us to examine their impacts. These measures are only recorded for the treatment group. We exploit variation within the treatment group, which, as we document below, is substantial.

We have detailed measures to evaluate the interaction quality between home visitors and caregivers and that between home visitors and the visited children during home visits. These observation-based measures were recorded by the program supervisors who randomly visited each household at least once per month at randomly selected times. During the home visit, the program supervisor evaluated the home visit's quality in three dimensions: the quality of the home visitor's teaching ability, the interaction quality between home visitor and caregiver, and the interaction quality between home visitor and child. The measures we use for the interaction quality are listed in Table D.1, and the measures we use for teaching quality are listed in Table D.2.

Table D.1: Observed Interactions

Between Home Visitor and Caregiver
Has the home visitor explained the task content and lesson target to the caregiver?
Has the home visitor shown the lessons and given examples to the caregiver?
Does the home visitor ask the caregiver to play the lessons with the child alone?
Does the caregiver ask the home visitor about lessons in the next week?
Has the home visitor listened to the caregiver?
Has the home visitor answered the caregiver's questions?
Has the home visitor asked for the caregiver's opinions?
Does the home visitor encourage and help the caregiver?
Is the relationship between the home visitor and the caregiver friendly, understandable, and cooperated?
Has the home visitor discussed with a caregiver or other persons about the content not related to the home visiting?
Between Home Visitor and Child
Has the home visitor shown the lessons and given examples to the child?
Has the home visitor explained the lesson to the child?
Does the home visitor listen to the child and respond to the child's voice or action?
Does the home visitor praise the child when the child tries to master one task?
Does the home visitor use language to communicate with the child when the child is completing the lessons?
Does the home visitor give the child enough time to explore the materials and finish the lessons?
Is the relationship between the home visitor, and the child friendly, understandable, and cooperative?

Note: The interaction quality measures are recorded by the supervisor of the program at least once per month.

Table D.2: Home Visitor's Teaching Quality during Home Visiting

Does the home visitor bring the curriculum to the household?
Does the home visitor properly use the curriculum?
Has the home visitor prepared for the home visit in advance?
Has the home visitor chosen the teaching materials and tasks which are suitable to the child's age?
Does the home visitor focus on language development?

Note: The interaction quality measures are recorded by the supervisor of the program at least once per month.

D.2 Factor Model for Summarizing Interactions

As documented above, we have detailed measures on the home visitors' teaching ability and the interaction measures between home visitor and caregiver (child). To summarize, we estimate the latent factors of home visitor's teaching ability and the interaction quality factors between home visitor and caregiver (child).

Denote $M_{ia}^{j,l}$ as the measure j at household i at the child's age a, and γ_{ia}^{l} is the latent factors l representing different factors (i.e., teaching ability, the interaction quality between home visitor and caregiver, and the interaction quality between home visitor and child).

$$M_{ia}^{j,l} = X_{ia}'\beta + \alpha^{j}\gamma_{ia}^{l} + \epsilon_{ia}^{j,l}. \tag{D.1}$$

Since the measure of M_{ia} is a categorical variable, we use an ordered probit model with latent factor γ and estimate the factor model by MLE assuming ϵ_{ia} is from normal distribution with zero mean.

We estimate the latent factor γ^{l} based using the Empirical Bayes method: the empirical conditional posterior distribution of the latent factor is given by

$$g(\gamma^{l}|M^{l}, X; \beta, \alpha) = \frac{\mu(M^{l}|X, \gamma^{l}; \beta, \alpha, \phi(\gamma^{l}))}{\int \mu(M^{l}|X, \gamma^{l}; \beta, \alpha, \phi(\gamma^{l}))d\gamma^{l}}. \tag{D.2}$$

Therefore, the latent factor estimate for latent factor l is given as $\hat{\gamma}^{l} = \int \gamma g(\gamma|M^{l}, X; \beta, \alpha)d\gamma^{l}$. The prior distribution of ϕ is based on estimated factor distribution. In Table D.3, we report the estimates of three factor distributions.

Table D.3: Prior Variances for Latent Factors

	Variance
Interaction between Home Visitor and Caregiver	0.685
	(0.046)
Interaction between Home Visitor and Child	2.914
	(0.200)
Teaching Ability	0.603
	(0.049)

Table D.4: Factor Model: Teaching Ability

	Measures Index				
	a6	a7	a8	a9	a10
Monthly Age	-0.008***	-0.034***	-0.021***	0.009***	-0.024***
	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)
Male	-0.148***	-0.043	-0.023	-0.274***	-0.213***
	(0.038)	(0.062)	(0.053)	(0.034)	(0.040)
Factor Loading	-1.000	-2.033***	-1.605***	-0.324***	-1.332***
	(0.000)	(0.147)	(0.102)	(0.034)	(0.072)
Cut 1	0.783**	1.217**	1.256**	1.221**	0.230**
	(0.068)	(0.118)	(0.098)	(0.061)	(0.072)
Cut 2	3.540**	4.867**	4.000**	3.512**	2.168**
	(0.139)	(0.278)	(0.176)	(0.147)	(0.087)
Cut 3		5.121**			4.023**
		(0.311)			(0.242)
Variance of the latent factor			0.603***		
(Teaching ability)			(0.049)		

1. Each variable represents a categorical variable evaluating Teaching ability. Each variable corresponds to the following questions. a6: Does the home visitor bring the curriculum to the household? a7: Does the home visitor properly use the curriculum? a8 : Has the home visitor prepared the home visit in advance? a9: Has the home visitor chosen the teaching materials and tasks which are suitable? and a10 : Does the home visitor focus on language development?
2. All the measures are categorical variables with four categories. In ordered probit model, we have three cut off intercepts. The four categories are: (1) well done (2) basically achieve (3) not enough (4) not achieve at all.
3. Since the smaller values mean the higher quality in all the measures, we normalize the loading of the first measure to -1, which makes the larger latent factor values mean better quality.
4. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.5: Factor Model: Interactions Quality between Home Visitor and Caregiver

	Measures Index									
	a18	a11	a12	a15	a16	a17	a19	a20	a21	a22
Monthly Age	0.013***	-0.014***	-0.023***	-0.024***	-0.014***	-0.009***	-0.032***	-0.002	-0.018***	-0.003
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Male	-0.253***	-0.138***	-0.017	-0.211***	-0.123***	-0.022	-0.368***	0.081**	-0.174***	-0.359***
	(0.038)	(0.041)	(0.049)	(0.041)	(0.037)	(0.030)	(0.057)	(0.033)	(0.048)	(0.059)
Factor Loading	-1.000	-1.073***	-1.489***	-1.268***	-1.008***	-0.781***	-1.791***	-0.944***	-1.521***	-1.896***
	(0.000)	(0.049)	(0.066)	(0.054)	(0.045)	(0.036)	(0.081)	(0.041)	(0.067)	(0.087)
Cut 1	1.289**	0.864**	0.979**	0.325**	0.582**	0.168**	0.959**	0.646**	0.872**	1.745**
	(0.069)	(0.073)	(0.088)	(0.073)	(0.066)	(0.055)	(0.100)	(0.060)	(0.085)	(0.110)
Cut 2	3.294**	2.577**	3.622**	2.080**	2.068**	1.616**	2.917**	1.773**	3.277**	4.983**
	(0.090)	(0.087)	(0.131)	(0.081)	(0.074)	(0.059)	(0.121)	(0.063)	(0.113)	(0.181)
Cut 3	4.486**	4.267**	4.678**	2.237**	2.959**	3.680**	4.390**	3.182**	4.611**	5.459**
	(0.163)	(0.293)	(0.248)	(0.082)	(0.093)	(0.155)	(0.189)	(0.085)	(0.222)	(0.221)
Variance of the latent factor	0.685***									
(Interaction: Home Visitor and Caregiver)	(0.046)									

1. The variables represent a categorical variable evaluating interaction quality. Each variable corresponds to the following questions:
a18: Has the home visitor listened to the caregiver? a11 : Has the home visitor explained the task content and task target to the caregiver?
a12: Has the home visitor shown the tasks and given an example to the caregiver? a15 : Does the home visitor ask the caregiver to play the tasks with the child alone?
a16: Does the caregiver answer the home visitor about what will play in the next week? a17: Has the home visitor discuss with a caregiver or other persons about the content?
a19: Has the home visitor answered caregiver's question? a20: Has the home visitor asked for the caregiver's opinions? a21: Does the home visitor encourage and help the caregiver? a22: Is the relationship between the home visitor and the caregiver friendly?
2. All the measures are categorical variables with four categories. In ordered probit model, we have three cut off intercepts. The four categories are:
(1) well done (2) basically achieve (3) not enough (4) not achieved at all.
3. Since the smaller values mean the higher quality in all the measures, we normalize the loading of the first measure to -1, which makes the larger latent factor values mean better quality.
4. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.6: Factor Model: Interactions Quality between Home Visitor and Child

	Measures Index						
	a23	a13	a14	a24	a25	a26	a27
Monthly Age	-0.021***	-0.019***	0.006**	-0.021***	0.027***	-0.005	-0.008**
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Male	-0.162***	-0.149***	-0.115***	-0.017	-0.205***	-0.149***	-0.255***
	(0.056)	(0.045)	(0.040)	(0.056)	(0.050)	(0.055)	(0.058)
Factor Loading:	-1.000	-0.685***	-0.664***	-1.099***	-0.918***	-1.053***	-0.992***
	(0.000)	(0.029)	(0.028)	(0.048)	(0.042)	(0.048)	(0.044)
Cut 1	1.249**	0.868**	1.105**	1.063**	2.130**	1.502**	1.743**
	(0.102)	(0.081)	(0.074)	(0.103)	(0.098)	(0.105)	(0.109)
Cut 2	3.061**	2.781**	3.184**	2.958**	3.686**	3.713**	3.731**
	(0.123)	(0.101)	(0.091)	(0.119)	(0.114)	(0.134)	(0.143)
Cut 3	3.570**	3.029**	3.550**	3.830**	4.575**	4.139**	3.856**
	(0.140)	(0.110)	(0.101)	(0.146)	(0.136)	(0.150)	(0.149)
Variance of the latent factor				2.914***			
(Interaction: Home Visitor and Child)				(0.200)			

1.Each variable represents a categorical variable evaluating interaction quality. Each variable corresponds to the following questions: a23 : Does the home visitor listen to the child and respond to the child's voice? a13: Has the home visitor shown the tasks and given an example to the child? a14: Has the home visitor explained the task to the child? a24: Does the home visitor praise the child when the child tries to finish one task? a25: Does the home visitor use language to communicate with the child when the child is completing tasks? a26: Does the home visitor give the child enough time to explore the materials? a27: Is the relationship between the home visitor and the child is friendly?

2. All the measures are categorical variables with four categories. In ordered probit model, we have three cut off intercepts. The four categories are: (1) well done (2) basically achieved (3) not enough (4) not achieved at all.

3. Since the smaller values mean the higher quality in all the measures, we normalize the loading of the first measure to -1, which makes the larger latent factor values mean better quality.

4. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E UHP Task Performance Persistence across Difficulty Levels

E.1 Persistence of Average Passing Rates across Levels

E.1.1 Average Passing Rates: Language

In this section, we show the persistence of the children's task performance across different difficulty levels within the same skill. We use the measures of passing rate and time to first mastery in this section. In Tables E.1-E.23, we find a consistent pattern: children's task performance is consistent across different difficulty levels within the same skill.

Table E.1: The Persistency of Language Task Passing Rates for Children in Top Quantile by Difficulty Levels

In Top Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels									
Difficulty Levels	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2		0.639	0.578	0.465	0.748	0.667	0.637	0.724	0.714	0.735
3	0.520		0.493	0.330	0.693	0.554	0.626	0.689	0.652	0.746
4	0.565	0.617		0.413	0.701	0.636	0.656	0.748	0.733	0.727
5	0.611	0.654	0.623		0.698	0.720	0.680	0.744	0.600	0.727
6	0.608	0.697	0.595	0.363		0.599	0.608	0.668	0.704	0.685
7	0.508	0.503	0.488	0.300	0.628		0.772	0.756	0.840	0.739
8	0.435	0.474	0.430	0.254	0.530	0.646		0.724	0.823	0.709
9	0.400	0.414	0.410	0.229	0.506	0.563	0.675		0.809	0.651
10	0.321	0.369	0.337	0.119	0.433	0.480	0.620	0.617		0.624
11	0.437	0.505	0.419	0.254	0.556	0.585	0.681	0.681	0.819	

Table E.2: The Persistency of Language Task Passing Rates for Children in Third Quantile by Difficulty Levels

In Third Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels									
Difficulty Levels	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2		0.341	0.400	0.348	0.302	0.405	0.333	0.194	0.183	0.244
3	0.368		0.434	0.290	0.474	0.360	0.360	0.203	0.167	0.357
4	0.309	0.303		0.289	0.375	0.383	0.393	0.196	0.155	0.280
5	0.348	0.286	0.364		0.318	0.397	0.333	0.140	0.143	0.237
6	0.213	0.333	0.378	0.259		0.400	0.349	0.258	0.078	0.352
7	0.238	0.203	0.301	0.275	0.308		0.428	0.264	0.151	0.317
8	0.183	0.211	0.309	0.219	0.262	0.428		0.255	0.201	0.318
9	0.165	0.194	0.257	0.159	0.320	0.415	0.385		0.176	0.385
10	0.234	0.195	0.268	0.222	0.120	0.333	0.417	0.232		0.333
11	0.179	0.272	0.280	0.192	0.356	0.417	0.411	0.321	0.206	

Table E.3: The Persistency of Language Task Passing Rates for Children in Second Quantile by Difficulty Levels

In Second Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels									
Difficulty Levels	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2		0.184	0.375	0.146	0.255	0.102	0.083	0.048	0.056	0.152
3	0.243		0.351	0.194	0.270	0.083	0.139	0.030	0.000	0.029
4	0.305	0.220		0.169	0.237	0.123	0.123	0.042	0.028	0.151
5	0.241	0.241	0.345		0.241	0.107	0.148	0.000	0.000	0.077
6	0.159	0.123	0.169	0.123		0.160	0.129	0.082	0.056	0.136
7	0.083	0.055	0.125	0.091	0.153		0.194	0.157	0.105	0.217
8	0.091	0.132	0.189	0.160	0.190	0.284		0.145	0.200	0.246
9	0.133	0.083	0.167	0.000	0.194	0.350	0.225		0.179	0.200
10	0.154	0.000	0.077	0.000	0.167	0.286	0.357	0.259		0.143
11	0.175	0.031	0.258	0.083	0.174	0.290	0.232	0.118	0.069	

Table E.4: The Persistency of Language Task Passing Rates for Children in Bottom Quantile by Difficulty Levels

In Bottom Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels									
Difficulty Levels	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2		0.606	0.485	0.774	0.294	0.192	0.078	0.194	0.150	0.150
3	0.658		0.483	0.791	0.298	0.207	0.102	0.211	0.136	0.118
4	0.688	0.615		0.882	0.337	0.202	0.083	0.261	0.132	0.141
5	0.558	0.427	0.360		0.248	0.152	0.032	0.178	0.174	0.105
6	0.797	0.755	0.647	0.865		0.330	0.196	0.366	0.169	0.278
7	0.750	0.862	0.645	0.864	0.557		0.344	0.433	0.255	0.517
8	0.571	0.750	0.444	0.444	0.556	0.564		0.467	0.273	0.719
9	0.500	0.500	0.451	0.594	0.362	0.263	0.143		0.171	0.250
10	0.400	0.355	0.273	0.577	0.277	0.255	0.128	0.350		0.239
11	0.688	0.542	0.520	0.600	0.466	0.492	0.365	0.429	0.234	

E.1.2 Average Passing Rates: Cognitive

Table E.5: The Persistency of Cognitive Task Passing Rates for Children in Top Quantile by Difficulty Levels

In Top Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels											
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1		0.443	0.642	0.519	0.825	0.782	0.679	0.741	0.643	0.706	0.400	0.750
2	0.300		0.794	0.752	0.847	0.873	0.854	0.813	0.853	0.738	0.729	0.897
3	0.288	0.529		0.646	0.838	0.844	0.738	0.807	0.774	0.800	0.704	0.686
4	0.275	0.538	0.677		0.745	0.823	0.750	0.769	0.799	0.792	0.625	0.804
5	0.269	0.365	0.524	0.453		0.816	0.629	0.710	0.721	0.625	0.612	0.752
6	0.231	0.346	0.483	0.459	0.740		0.671	0.730	0.744	0.694	0.622	0.770
7	0.264	0.429	0.548	0.524	0.752	0.858		0.840	0.826	0.764	0.720	0.762
8	0.252	0.355	0.504	0.478	0.710	0.797	0.715		0.822	0.794	0.739	0.767
9	0.194	0.314	0.381	0.437	0.607	0.694	0.595	0.695		0.764	0.638	0.755
10	0.190	0.251	0.368	0.409	0.541	0.660	0.560	0.670	0.793		0.715	0.762
11	0.182	0.316	0.463	0.430	0.658	0.711	0.627	0.735	0.798	0.822		0.829
12	0.240	0.245	0.289	0.414	0.656	0.699	0.491	0.619	0.745	0.717	0.682	

Table E.6: The Persistency of Cognitive Task Passing Rates for Children in Third Quantile by Difficulty Levels

In Second Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels											
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1		0.298	0.292	0.078	0.167	0.130	0.255	0.226	0.160	0.188	0.250	0.200
2	0.236		0.322	0.202	0.258	0.229	0.363	0.185	0.189	0.200	0.197	0.256
3	0.209	0.351		0.236	0.336	0.284	0.345	0.306	0.174	0.106	0.255	0.091
4	0.085	0.309	0.325		0.333	0.312	0.291	0.195	0.220	0.205	0.156	0.313
5	0.191	0.298	0.385	0.248		0.343	0.324	0.267	0.144	0.188	0.230	0.250
6	0.156	0.256	0.320	0.209	0.322		0.377	0.363	0.240	0.205	0.211	0.265
7	0.203	0.318	0.292	0.161	0.235	0.302		0.397	0.315	0.194	0.234	0.217
8	0.214	0.195	0.337	0.126	0.232	0.342	0.468		0.317	0.261	0.321	0.205
9	0.133	0.247	0.246	0.181	0.176	0.330	0.495	0.440		0.261	0.230	0.278
10	0.273	0.254	0.159	0.173	0.247	0.303	0.333	0.425	0.333		0.319	0.241
11	0.222	0.235	0.310	0.106	0.254	0.275	0.377	0.493	0.258	0.371		0.235
12	0.286	0.270	0.107	0.147	0.275	0.353	0.360	0.314	0.306	0.260	0.240	

Table E.7: The Persistency of Cognitive Task Passing Rates for Children in Second Quantile by Difficulty Levels

In Second Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels											
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1		0.256	0.000	0.000	0.057	0.000	0.114	0.118	0.000	0.000	0.125	0.000
2	0.147		0.000	0.000	0.116	0.095	0.153	0.075	0.000	0.000	0.278	0.029
3												
4												
5	0.087	0.271	0.000	0.000		0.209	0.294	0.134	0.000	0.060	0.217	0.133
6	0.000	0.256	0.000	0.000	0.233		0.450	0.267	0.000	0.122	0.119	0.091
7	0.125	0.270	0.000	0.000	0.230	0.310		0.287	0.000	0.016	0.192	0.050
8	0.200	0.167	0.000	0.000	0.150	0.271	0.417		0.000	0.167	0.342	0.154
9												
10	0.000	0.000	0.000	0.000	0.107	0.214	0.036	0.286	0.000		0.393	0.143
11	0.071	0.349	0.000	0.000	0.189	0.094	0.192	0.245	0.000	0.212		0.073
12	0.000	0.100	0.000	0.000	0.250	0.176	0.118	0.235	0.000	0.235	0.176	

Table E.8: The Persistency of Cognitive Task Passing Rates for Children in Bottom Quantile by Difficulty Levels

In Bottom Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels											
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1		0.282	0.353	0.414	0.133	0.052	0.109	0.115	0.247	0.339	0.306	0.200
2	0.686		0.701	0.780	0.244	0.100	0.163	0.166	0.270	0.207	0.214	0.178
3	0.592	0.508		0.762	0.188	0.083	0.178	0.177	0.286	0.252	0.248	0.167
4	0.462	0.468	0.630		0.169	0.070	0.151	0.149	0.250	0.244	0.212	0.188
5	0.762	0.750	0.778	0.808		0.225	0.472	0.338	0.500	0.434	0.415	0.452
6	0.545	0.667	0.714	0.810	0.533		0.625	0.563	0.650	0.368	0.412	0.417
7	0.650	0.565	0.733	0.844	0.523	0.328		0.567	0.565	0.378	0.395	0.344
8	0.684	0.591	0.762	0.837	0.414	0.305	0.586		0.659	0.368	0.500	0.480
9	0.583	0.515	0.667	0.734	0.354	0.160	0.321	0.354		0.370	0.435	0.361
10	0.667	0.446	0.667	0.778	0.365	0.111	0.274	0.222	0.370		0.410	0.421
11	0.652	0.468	0.667	0.744	0.309	0.127	0.273	0.309	0.435	0.314		0.516
12	0.667	0.591	0.632	0.900	0.467	0.167	0.367	0.400	0.591	0.320	0.571	

E.1.3 Average Passing Rate: Fine Motor

Table E.9: The Persistency of Fine Motor Task Passing Rates for Children in Top Quantile by Difficulty Levels

In Top Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels						
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1		0.800	0.659	0.844	0.657	0.614	0.611
2	0.638		0.668	0.849	0.695	0.686	0.670
3	0.599	0.776		0.915	0.731	0.772	0.619
4	0.585	0.721	0.661		0.679	0.706	0.628
5	0.597	0.737	0.622	0.855		0.820	0.617
6	0.590	0.741	0.641	0.870	0.789		0.686
7	0.647	0.768	0.517	0.815	0.603	0.723	

Table E.10: The Persistency of Fine Motor Task Passing Rates for Children in Third Quantile by Difficulty Levels

In Third Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels						
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1		0.135	0.273	0.105	0.222	0.061	0.200
2	0.167		0.247	0.133	0.204	0.268	0.185
3	0.273	0.177		0.152	0.359	0.159	0.164
4	0.220	0.229	0.355		0.261	0.263	0.182
5	0.207	0.147	0.363	0.119		0.207	0.147
6	0.065	0.282	0.275	0.189	0.340		0.268
7	0.188	0.179	0.267	0.133	0.256	0.250	

Table E.11: The Persistency of Fine Motor Task Passing Rates for Children in Second Quantile by Difficulty Levels

In Second Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels						
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1		0.000	0.028	0.057	0.063	0.067	0.143
2							
3	0.036	0.000		0.186	0.057	0.154	0.200
4	0.118	0.000	0.320		0.095	0.294	0.250
5	0.125	0.000	0.143	0.133		0.154	0.273
6	0.063	0.000	0.133	0.172	0.069		0.138
7	0.077	0.000	0.182	0.130	0.130	0.167	

Table E.12: The Persistency of Fine Motor Task Passing Rates for Children in Bottom Quantile by Difficulty Levels

In Bottom Quantile at Levels	Fraction of Children Stay in the Same Quantile across Levels						
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1		0.283	0.269	0.159	0.317	0.214	0.273
2	0.327		0.363	0.197	0.192	0.206	0.240
3	0.360	0.483		0.319	0.327	0.250	0.438
4	0.385	0.484	0.605		0.474	0.583	0.636
5	0.419	0.303	0.474	0.237		0.348	0.444
6	0.240	0.250	0.278	0.200	0.250		0.364
7	0.316	0.273	0.424	0.212	0.250	0.250	

E.2 Persistence of Time to First Mastery across Levels

E.2.1 Time to First Mastery - Language

Table E.13: The Persistency of First Time Mastery for Language Tasks by Difficulty Levels

First Time Mastery at 1st Task at Levels	Fraction of Children Maintained First Time Mastery at 1st Task Across Levels									
Difficulty Levels	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2		0.784	0.734	0.662	0.686	0.683	0.570	0.842	0.795	0.866
3	0.583		0.644	0.612	0.612	0.641	0.558	0.799	0.828	0.882
4	0.631	0.787		0.744	0.600	0.619	0.573	0.826	0.870	0.826
5	0.577	0.732	0.744		0.700	0.724	0.486	0.883	0.744	0.838
6	0.623	0.754	0.671	0.667		0.627	0.542	0.728	0.828	0.790
7	0.560	0.665	0.571	0.524	0.682		0.602	0.776	0.835	0.837
8	0.545	0.674	0.595	0.444	0.610	0.642		0.787	0.886	0.826
9	0.554	0.656	0.594	0.541	0.559	0.564	0.561		0.840	0.845
10	0.490	0.658	0.588	0.500	0.567	0.483	0.512	0.675		0.730
11	0.544	0.673	0.552	0.514	0.562	0.564	0.534	0.779	0.830	

Notes: 1. For each row, we only consider the children's first mastery of 1st task at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 1st task at the column level conditional on the children who pass the task on the first try at a given row level.

Table E.14: The Persistency of First Time Mastery for Language Tasks by Difficulty Levels

First Mastery at 2nd Task at Levels	Fraction of Children Maintained First Mastery at 2nd Task across Levels									
Difficulty Levels	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2		0.180	0.327	0.188	0.219	0.203	0.206	0.146	0.154	0.103
3	0.176		0.308	0.206	0.259	0.175	0.228	0.095	0.259	0.060
4	0.277	0.276		0.212	0.247	0.289	0.205	0.136	0.275	0.086
5	0.176	0.233	0.206		0.382	0.250	0.250	0.120	0.067	0.071
6	0.219	0.259	0.297	0.342		0.331	0.264	0.146	0.171	0.167
7	0.176	0.152	0.282	0.290	0.303		0.269	0.193	0.089	0.199
8	0.232	0.260	0.259	0.273	0.305	0.307		0.200	0.072	0.235
9	0.219	0.129	0.222	0.231	0.177	0.240	0.198		0.113	0.275
10	0.250	0.389	0.500	0.125	0.350	0.217	0.149	0.225		0.089
11	0.182	0.111	0.154	0.133	0.234	0.273	0.270	0.309	0.051	

Notes: 1. For each row, we only consider the children's first mastery of 2nd task at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 2nd task at the column level conditional on the children who pass the task on the second try at a given row level.

Table E.15: The Persistency of First Time Mastery for Language Tasks by Difficulty Levels

First Time Mastery at 3rd Task at Levels	Fraction of Children Maintained First Time Mastery at 3rd Task across Levels									
Difficulty Levels	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2		0.136	0.167	0.231	0.077	0.080	0.240	0.000	0.071	0.043
3	0.115		0.370	0.333	0.148	0.037	0.111	0.053	0.000	0.136
4	0.125	0.294		0.160	0.143	0.029	0.143	0.000	0.000	0.034
5	0.111	0.240	0.148		0.222	0.000	0.125	0.059	0.000	0.045
6	0.057	0.133	0.132	0.333		0.038	0.226	0.000	0.030	0.042
7	0.118	0.059	0.067	0.000	0.034		0.164	0.132	0.170	0.094
8	0.087	0.054	0.081	0.120	0.102	0.087		0.080	0.143	0.068
9	0.000	0.250	0.000	0.500	0.000	0.152	0.170		0.091	0.089
10	0.167	0.000	0.000	0.000	0.043	0.310	0.400	0.143		0.111
11	0.091	0.500	0.125	0.333	0.091	0.207	0.276	0.200	0.136	

Notes: 1. For each row, we only consider the children's first mastery of 3rd task at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 3rd task at the column level conditional on the children who pass the task on the third try at a given row level.

Table E.16: The Persistency of First Time Mastery for Language Tasks by Difficulty Levels

First Time Mastery at 4th Task or Beyond at Levels	Fraction of Children Maintained First Time Mastery at 4th Task or Beyond across Levels									
Difficulty Levels	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2		0.077	0.217	0.122	0.246	0.106	0.077	0.000	0.000	0.018
3	0.571		0.444	0.500	0.900	0.273	0.273	0.000	0.000	0.000
4	0.619	0.174		0.333	0.370	0.222	0.074	0.118	0.000	0.043
5	0.333	0.133	0.400		0.250	0.133	0.200	0.000	0.000	0.000
6	0.386	0.231	0.182	0.235		0.380	0.190	0.034	0.000	0.014
7	0.250	0.167	0.200	0.182	0.349		0.404	0.046	0.040	0.093
8	0.238	0.176	0.095	0.300	0.234	0.495		0.056	0.063	0.130
9	0.000	0.000	0.333	0.000	0.154	0.267	0.250		0.000	0.133
10	0.000	0.000			0.000	0.500	0.667	0.000		0.500
11	0.250	0.000	1.000	0.000	0.083	0.429	0.476	0.105	0.100	

Notes: 1. For each row, we only consider the children's first mastery of 4th task or beyond at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at the 4th task or beyond at the column level conditional on the children who pass the task on the fourth try or beyond at a given row level.

E.2.2 Time to First Mastery - Cognitive

Table E.17: The Persistency of First Time Mastery for Cognitive Tasks by Difficulty Levels

First Time Mastery at 1st Task at Levels	Fraction of Children Maintained First Time Mastery at 1st Task Across Levels											
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1		0.640	0.983	0.825	0.789	0.789	0.597	0.871	0.879	0.900	0.810	0.923
2	0.471		0.914	0.812	0.810	0.774	0.622	0.805	0.947	0.845	0.708	0.839
3	0.492	0.642		0.810	0.844	0.793	0.667	0.843	0.927	0.888	0.794	0.865
4	0.393	0.532	0.810		0.826	0.791	0.766	0.810	0.868	0.912	0.805	0.865
5	0.426	0.588	0.865	0.830		0.734	0.588	0.801	0.880	0.814	0.722	0.890
6	0.441	0.576	0.855	0.835	0.755		0.634	0.849	0.910	0.822	0.743	0.874
7	0.371	0.588	0.870	0.820	0.787	0.796		0.819	0.912	0.852	0.820	0.870
8	0.421	0.571	0.847	0.834	0.777	0.777	0.591		0.915	0.827	0.750	0.901
9	0.446	0.604	0.825	0.812	0.692	0.659	0.534	0.710		0.833	0.737	0.865
10	0.486	0.581	0.791	0.816	0.683	0.619	0.517	0.676	0.890		0.856	0.841
11	0.630	0.571	0.875	0.778	0.692	0.644	0.574	0.717	0.891	0.873		0.899
12	0.800	0.534	0.849	0.833	0.726	0.631	0.505	0.743	0.887	0.738	0.757	

Notes: 1. For each row, we only consider the children's first mastery of 1st task at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 1st task at the column level conditional on the children who pass the task on the first try at a given row level.

Table E.18: The Persistency of First Time Mastery for Cognitive Tasks by Difficulty Levels

First Time Mastery at 2nd Task at Levels	Fraction of Children Maintained First Time Mastery at 2nd Task Across Levels											
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1		0.176	0.207	0.269	0.054	0.171	0.158	0.147	0.000	0.125	0.000	0.000
2	0.194		0.231	0.130	0.216	0.122	0.256	0.159	0.120	0.156	0.150	0.185
3	0.462	0.267		0.111	0.216	0.224	0.260	0.160	0.206	0.000	0.154	0.111
4	0.333	0.133	0.111		0.236	0.240	0.173	0.200	0.094	0.154	0.125	0.231
5	0.100	0.264	0.268	0.351		0.171	0.241	0.255	0.067	0.169	0.102	0.200
6	0.231	0.159	0.239	0.300	0.196		0.202	0.288	0.104	0.104	0.175	0.130
7	0.240	0.224	0.224	0.225	0.182	0.150		0.127	0.187	0.116	0.260	0.185
8	0.313	0.213	0.216	0.256	0.289	0.319	0.189		0.120	0.103	0.145	0.175
9	0.000	0.231	0.412	0.136	0.111	0.174	0.362	0.191		0.054	0.303	0.200
10	0.500	0.333	0.000	0.444	0.324	0.189	0.324	0.219	0.071		0.200	0.308
11	0.000	0.207	0.143	0.188	0.140	0.256	0.455	0.190	0.278	0.206		0.267
12	0.000	0.313	0.143	0.300	0.281	0.171	0.323	0.219	0.208	0.267	0.250	

Notes: 1. For each row, we only consider the children's first mastery of 2nd task at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 2nd task at the column level conditional on the children who pass the task on the first try at a given row level.

Table E.19: The Persistency of First Time Mastery for Cognitive Tasks by Difficulty Levels

First Time Mastery at 3rd Task at Levels	Fraction of Children Maintained First Time Mastery at 3rd Task Across Levels											
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1		0.077	0.000	0.000	0.087	0.043	0.130	0.045	0.000	0.000	0.000	0.000
2	0.083		0.000	0.000	0.043	0.067	0.043	0.065	0.000	0.000	0.154	0.000
3												
4												
5	0.500	0.143	0.000	0.000		0.000	0.167	0.105	0.000	0.000	0.000	0.286
6	1.000	0.250	0.000	0.000	0.000		0.179	0.107	0.000	0.095	0.118	0.000
7	0.158	0.042	0.000	0.000	0.039	0.064		0.051	0.000	0.130	0.025	0.000
8	1.000	0.200	0.000	0.000	0.056	0.079	0.108		0.000	0.000	0.053	0.143
9												
10		0.000	0.000	0.000	0.000	0.105	0.353	0.000	0.000		0.000	0.000
11	0.000	0.222	0.000	0.000	0.000	0.111	0.059	0.056	0.000	0.000		0.000
12		0.000	0.000	0.000	0.333	0.000	0.000	0.286	0.000	0.000	0.000	

Notes: 1. For each row, we only consider the children's first mastery of 3rd task at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 3rd task at the column level conditional on the children who pass the task on the first try at a given row level.

Table E.20: The Persistency of First Time Mastery for Cognitive Tasks by Difficulty Levels

First Time Mastery at 4th Task or Beyond at Levels	Fraction of Children Maintained First Time Mastery at 4th Task or Beyond across Levels											
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1		0.135	0.000	0.000	0.105	0.028	0.053	0.000	0.000	0.000	0.000	
2	0.333		0.000	0.000	0.069	0.054	0.153	0.054	0.000	0.040	0.043	0.000
3												
4												
5	0.444	0.200	0.000	0.000		0.361	0.431	0.125	0.000	0.125	0.182	0.000
6	0.091	0.100	0.000	0.000	0.272		0.413	0.257	0.000	0.103	0.167	0.000
7	0.182	0.273	0.000	0.000	0.333	0.423		0.181	0.000	0.071	0.125	0.000
8	0.000	0.176	0.000	0.000	0.184	0.514	0.351		0.000	0.208	0.261	0.000
9												
10	0.000	0.143	0.000	0.000	0.278	0.333	0.167	0.313	0.000		0.133	0.000
11	0.000	0.067	0.000	0.000	0.207	0.233	0.185	0.222	0.000	0.083		0.000
12												

Notes: 1. For each row, we only consider the children's first mastery of 4th task or beyond at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 4th task or beyond at the column level conditional on the children who pass the task on the first try at a given row level.

E.2.3 First Time Mastery - Fine Motor

Table E.21: The Persistency of First Time Mastery for Fine Motor Tasks by Difficulty Levels

First Time Mastery at 1st Task at Levels	Fraction of Children Maintained First Time Mastery at 1st Task across Levels						
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1		0.911	0.641	0.904	0.951	0.696	0.836
2	0.717		0.629	0.877	0.941	0.713	0.882
3	0.706	0.879		0.899	0.936	0.837	0.889
4	0.732	0.890	0.648		0.947	0.796	0.887
5	0.738	0.912	0.609	0.870		0.757	0.873
6	0.763	0.870	0.650	0.878	0.951		0.946
7	0.789	0.915	0.559	0.818	0.900	0.783	

Notes: 1. For each row, we only consider the children's first mastery of 1st task at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 1st task at the column level conditional on the children who pass the task on the first try at a given row level.

Table E.22: The Persistency of First Time Mastery for Fine Motor Tasks by Difficulty Levels

First Time Mastery at 2nd Task at Levels	Fraction of Children Maintained First Time Mastery at 2nd Task across Levels						
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1		0.148	0.317	0.179	0.059	0.118	0.000
2	0.229		0.200	0.045	0.045	0.105	0.100
3	0.182	0.078		0.114	0.038	0.221	0.117
4	0.370	0.080	0.409		0.176	0.367	0.000
5	0.222	0.091	0.211	0.273		0.375	0.071
6	0.074	0.061	0.447	0.224	0.136		0.333
7	0.000	0.091	0.450	0.000	0.053	0.611	

Notes: 1. For each row, we only consider the children's first mastery of 2nd task at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 2nd task at the column level conditional on the children who pass the task on the first try at a given row level.

Table E.23: The Persistency of First Time Mastery for Fine Motor Tasks by Difficulty Levels

First Time Mastery at 3rd Task or Beyond at Levels	Fraction of Children Maintained First Time Mastery at 3rd Task or Beyond across Levels						
Difficulty Levels	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1		0.000	0.120	0.130	0.000	0.083	0.000
2							
3	0.222	0.000		0.064	0.029	0.143	0.063
4	0.316	0.000	0.111		0.143	0.111	0.143
5	0.000	0.000	0.333	0.600		0.000	0.250
6	0.091	0.000	0.143	0.091	0.000		0.050
7	0.000	0.000	0.250	0.500	0.250	0.250	

Notes: 1. For each row, we only consider the children's first mastery of 3rd task or beyond at a given difficulty level. 2. For each column, we show the fraction of children who keep the first mastery at 3rd task or beyond at the column level conditional on the children who pass the task on the first try at a given row level.

F UHP Task Passing Rate by Ability

Figure F.1: By Ability Group: Average Language Task Passing Rates

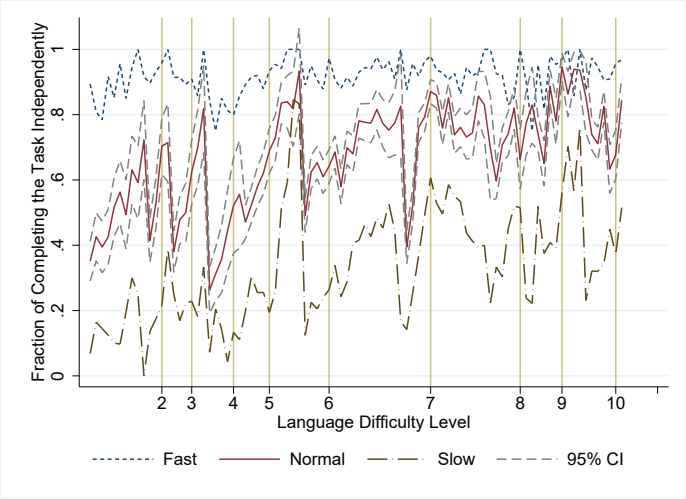


Figure F.2: By Ability Group: Average Cognitive Task Passing Rates

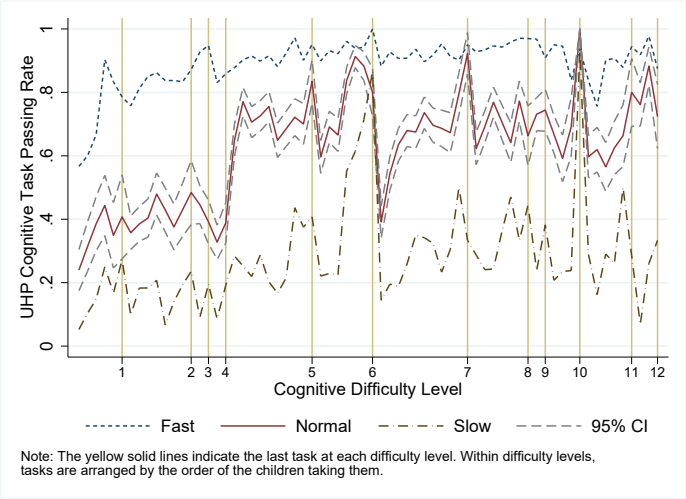


Figure F.3: By Ability Group: Average Fine Motor Task Passing Rates

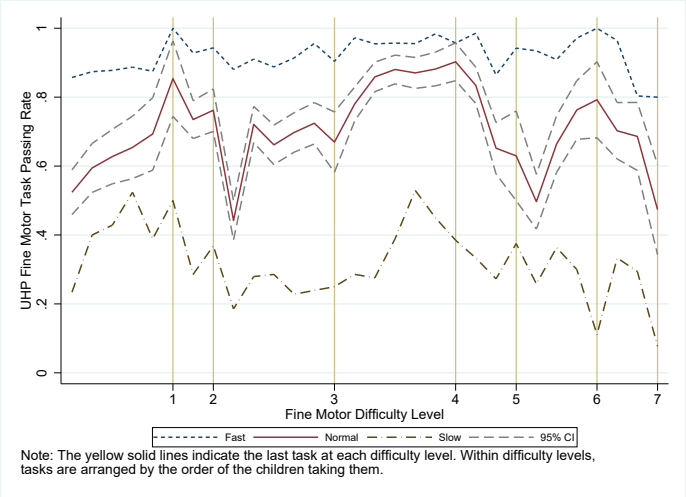
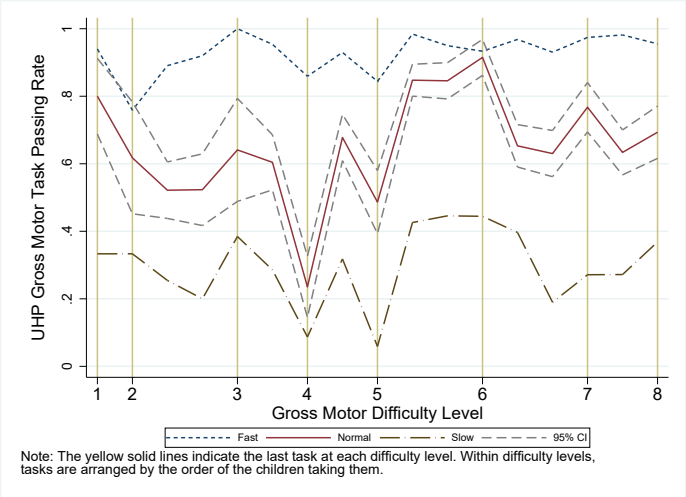


Figure F.4: By Ability Group: Average Gross Motor Task Passing Rates



G Comparing the Fit of Additive and Multiplicative Models

G.1 Definition of Additive Model

The additive learning technology is as following:

$$K(a) = K(a-1) + K(a-1)\delta(a)\eta + V(Q(a)) + \varepsilon(a) \tag{G.1}$$

where the shock term is i.i.d. within the level, so that

$$K(a) = K(0)\prod_{j=0}^{a-1}(1+\delta(a-j)\eta)+\sum_{k=0}^{a-1}V(Q(a-k))(1+\delta(a-k)\eta)^k+\sum_{k=0}^{a-1}\varepsilon(a-k)(1+\delta(a-k)\eta)^k \tag{G.2}$$

G.2 Comparing the Estimates between Additive and Multiplicative Models

Overall, both models' estimates fit the moments very well. The multiplicative model without common scale has better fit.

Table G.1: Goodness of Fit Summary

	χ^2	
	Additive Model	Multiplicative Model
With common scale	74.18	25.19
Without common scale	38.37	16.07

1. For all models, we cannot reject the model at the 0.0001 level.

H Identification

To simplify the notation, we suppress skill index s and analyze a model for a single skill. The same framework applies to all skills. Skill at level ℓ can be written as:

$$\begin{aligned}\ln K(\ell, a) =& \ln K(\ell, a-1) + \delta_\ell(a)\eta + V_\ell(Q(a)) + \varepsilon_\ell(a), \quad \underline{a}(\ell) \leq a \leq \bar{a}(\ell) \\ E(\varepsilon_\ell(a)) =& 0, \quad \mathrm{Var}(\varepsilon_\ell(a)) = \sigma^2_{\varepsilon(\ell)}. \end{aligned} \tag{H.1}$$

At the transition point from $\ell - 1$ to ℓ, under common scale the equation can be written, at the start of ℓ, as:

$$\begin{aligned}\ln K(\ell, \underline{a}(\ell)) =& \ln K(\ell-1, \bar{a}(\ell-1)) + \delta_\ell(\underline{a}(\ell))\eta + V_\ell(Q(\underline{a}(\ell))) + \varepsilon_\ell(\underline{a}(\ell)), \\ & \underline{a}(\ell) \leq a \leq \bar{a}(\ell). \end{aligned} \tag{H.2}$$

Define $\Delta_\ell(a) := \sum_{j=\underline{a}(\ell)}^{a} \delta_\ell(j)$; $\quad \Lambda_\ell(a) := \sum_{k=\underline{a}(\ell)}^{a} V_\ell(Q(k))$, $U_\ell(a) := \sum_{j=\underline{a}(\ell)}^{a} \varepsilon_\ell(j)$.

We assume $\delta_\ell(a) = \delta_\ell$ (for all a in ℓ) is constant for the same skill being taught at each level. We assume η (ability) is constant across all levels, and we parameterize the model such that

$$\eta\delta_\ell(a) = \bar{\beta}_\ell(X) + \omega_\ell$$

where X includes determinants of ability and learning such as family background and interaction measures. In this notation, $\eta\Delta_\ell(a) := (a - \underline{a}(\ell))(\bar{\beta}_\ell(X) + \omega_\ell)$. We assume that $\omega_\ell = \omega$ for all ℓ, $E(\omega) = 0$, $\mathrm{Var}(\omega) = \sigma^2_\omega$. We assume normal errors in making our estimates. Thus, we restrict attention to identification of means and

covariances.

H.1 Recursive Definition of the Skill Index

When $\underline{a}(1) = 0$, level 1 skill is as following:

$$\ln K(1,a) = \mu_1 + \mu_0(Z) + V(Q(a)) + \bar{\beta}_1(X)a + \underbrace{\left\{ a\omega + \sum_{j=1}^{a} \varepsilon_1(j) + \Upsilon \right\}}_{\Psi_1(a)}. \tag{H.3}$$

It is useful to collect the unobservables into

$$\Psi_1(a) = \{a\omega + U_1(a) + \Upsilon\}. \tag{H.4}$$

We assume (ω, Υ) are mutually independent, that $\varepsilon_1(a)$ is independent of $\varepsilon_1(a')$ and $(\omega, \Upsilon) \perp\!\!\!\perp \varepsilon_1(a)$ for all a. Furthermore, we assume that $\varepsilon_\ell(j)$ is independent of $\varepsilon_{\ell'}(j')$, $\ell' \neq \ell$, The shocks of $\varepsilon_\ell(j)$ are i.i.d. at each level ℓ.

$$\mathrm{Var}(\Psi_1(a)) = a^2\sigma_\omega^2 + a\sigma_{\varepsilon(1)}^2 + \sigma_\Upsilon^2 \tag{H.5}$$

and we define $\mathrm{Var}(\Psi_1(a)) := \sigma^2(1,a)$.

$$\mathrm{Cov}(\Psi_1(a), \Psi_1(a')) = aa'\sigma_\omega^2 + \min(a,a')\sigma_{\varepsilon(1)}^2 + \sigma_\Upsilon^2. \tag{H.6}$$

H.2 Identification of First Level Parameters

Under conditions presented in Matzkin (1993, 2007), we can identify up to scale $\sigma(1,1)$. This follows from standard results in the binary choice model, provided that at least one parameter is constant over the ℓ interval.

In estimation, we assume $\Lambda_\ell(a) := \sum_{j=0}^{J} \lambda_j a^j$ to capture aging and maturation effects, which we assume operates uniformly across ℓ. We assume $\lambda_j = 0, j > 2$. Although in principle we could identify ℓ-specific maturation effects, we do not do it here. Shocks are i.i.d. with mean zero (i.e., $E(\varepsilon_\ell(a)) = 0$) and with variance $\sigma^2_{\varepsilon(\ell)}$.

In each interval of ℓ, $\underline{a}(\ell) \leq \ell \leq \bar{a}(\ell)$.

$$\ln K(\ell, a) = \eta \Delta_\ell(a) + \Lambda_\ell(a) + U_\ell(a) + \ln K(\ell, \underline{a}(\ell)). \tag{H.7}$$

Define $\bar{K}_\ell$ as the minimum level of mastery of skill ℓ.

$$D(\ell, a) = \begin{cases} 1, & K(\ell, a) \geq \bar{K}_\ell \\ 0, & \text{otherwise.} \end{cases}$$

$$\Pr(D(\ell, a) = 1) = \Pr(\ln K(\ell, a) \geq \ln \bar{K}_\ell) = \Pr(\ln K(\ell, \underline{a}(\ell)) + \eta \Delta_\ell(a) + \Lambda_\ell(a) + U_\ell(a) \geq \ln \bar{K}_\ell).$$

The introduction of $\bar{K}_\ell$ in the estimation adds an intercept to the model that is the same for each a in ℓ, but in general differs across s.

For $\ell = 1$, we characterize the initial condition by $\ln K(1, \underline{a}(1)) = \mu_0(Z) + \Upsilon$, $E(\Upsilon) = 0$, $\text{Var}(\Upsilon) = \sigma^2_\Upsilon$, for the interval $[\underline{a}(1), \bar{a}(1)]$.

Thus, at $\underline{a}(1) = 1$, we can identify

$$\frac{\mu_1}{\sigma(1,1)}, \frac{\mu_0(Z)}{\sigma(1,1)}, \frac{\lambda_0}{\sigma(1,1)}, \frac{\lambda_1}{\sigma(1,1)}, \frac{\bar{\beta}_1(X)}{\sigma(1,1)}.$$

μ_1 is the intercept which includes $\bar{K}_1$. At the next age, we can identify

$$\frac{\mu_1}{\sigma(1,2)}, \frac{\mu_0(Z)}{\sigma(1,2)}, \frac{\lambda_0}{\sigma(1,2)}, \frac{\lambda_1}{\sigma(1,2)}, \frac{\bar{\beta}(X)}{\sigma(1,2)}.$$

Invoking the constancy of at least one parameter across age 1 and 2, we can identify

$$\frac{\sigma(1,2)}{\sigma(1,1)}$$

and using the same logic across ages for $\ell = 1$, we can identify

$$\frac{\sigma(1,j)}{\sigma(1,1)}, \qquad \underline{a}(1) \leq j \leq \bar{a}(1).$$

We can clearly identify $\bar{K}_\ell$, $\ell = 1, \ldots, L$ up to scale and an unknown constant if we assume intercepts are constant across levels.

H.3 Identification of Variance and Covariance Terms at the First Level

From (H.7), we can identify $\sigma^2_\omega, \sigma^2_{\varepsilon(1)}, \sigma^2_\Upsilon$ up to $\sigma^2(1,1)$ for $\underline{a}(1) \leq a \leq \bar{a}(1)$. Following Carneiro et al. (2003) and Heckman and Vytlacil (2007b) from the joint probabilities

$$\Pr(D(1,a) = d(a)), \quad \Pr(D(1,a') = d(a'))$$
$$d(a), d(a') \in \{0,1\}$$

we can identify

$$\text{Cov}\left(\frac{\Psi(1,a)}{\sigma(1,a)}, \frac{\Psi(1,a')}{\sigma(1,a')}\right) = \frac{(a-\underline{a}(1))(a'-\underline{a}(1))\sigma^2_\omega + \min((a-\underline{a}(1)),(a'-\underline{a}(1))\sigma^2_{\varepsilon(1)} + \sigma^2_\Upsilon}{\sigma(1,a)\sigma(1,a')}.$$

See Heckman and Vytlacil (2007a).

H.4 Identification of Higher Level Parameters

The same logic extends to higher levels of ℓ, $L \geq \ell > 1$, except here it is fruitful to distinguish two cases: with and without common scale. We first assume common scale over levels. We maintain common scale *within* the same level of skill.

<u>Under Common Scale Across Levels</u>

We can write $K(\ell, a)$ as

$$\begin{aligned}\ln K(\ell, a) =& \mu_0(Z) + \sum_{k=1}^{\ell-1} \bar{\beta}_k(X)(\bar{a}(k) - \underline{a}(k)) + \bar{\beta}_\ell(X)(a - \underline{a}(\ell)) + \sum_{k=1}^{\ell-1} \Delta_k(\bar{a}(k)) + \Delta_\ell(a) \\ &+ \sum_{k=1}^{\ell-1} \Lambda_k(\bar{a}(k)) + \Lambda_\ell(a) + \underbrace{\left\{ (a - \underline{a}(\ell))\omega + \sum_{k=1}^{\ell-1} U_k(\bar{a}(k)) + U_\ell(a) + \Upsilon \right\}}_{\Psi_\ell(a)}.\end{aligned}$$

For each a in each level ℓ, we acquire the threshold $\bar{K}_\ell$ as an intercept term in the sequence of observed indicators $D(\ell, a)$.

$$\mathrm{Var}\Psi_\ell(a) := \sigma^2(\ell, a) = (a - \underline{a}(\ell))^2 \sigma_\omega^2 + \sum_{k=1}^{\ell-1} \sigma_{\varepsilon(k)}^2 (\bar{a}(k) - \underline{a}(k)) + (a - \underline{a}(\ell))\sigma_{\varepsilon(\ell)}^2 + \sigma_\Upsilon^2$$

with covariance

$$\begin{aligned}\mathrm{Cov}(\Psi_\ell(a), \Psi_\ell(a')) = (a - \underline{a}(\ell))(a' - \underline{a}(\ell))\sigma_\omega^2 + \sum_{k=1}^{\ell-1} \sigma_{\varepsilon(k)}^2 (\bar{a}(k) - \underline{a}(k)) \\ + \min(a - \underline{a}(\ell), a' - \underline{a}(\ell))\sigma_{\varepsilon(\ell)}^2 + \sigma_\Upsilon^2.\end{aligned} \tag{H.8}$$

From each indicator variable, we can identify for each ℓ and a, the threshold variables $\frac{\bar{K}_\ell}{\sigma(\ell,a)}$ and $\frac{\mu_0(Z)}{\sigma(\ell,a)}$, $\frac{\bar{\beta}_\ell(X)}{\sigma(\ell,a)}$, $\frac{\Delta_\ell(a)}{\sigma(\ell,a)}$, $\frac{\Lambda_\ell(a)}{\sigma(\ell,a)}$. The other terms in the index $K(\ell, a)$ are identified by a recursive argument starting from $\ell = 1$ (previously discussed). In Equation (H.8), the only unknown parameter is $\sigma_{\varepsilon(\ell)}^2$, and so from it, we can identify the variance term $\sigma_{\varepsilon(\ell)}^2$. Therefore, we can identify the variance of the sum of shocks (i.e., $\mathrm{Var}\Psi_\ell(a)$) at level ℓ at age a.

From the above discussion, we can identify at all levels, $\ell \geq 2$, scales of variance $\text{Var}\Psi_\ell(a)$ without imposing additional normalizations. The only normalization we need is the scale of variance term $\sigma(1, j) = 1$ at level one.

<u>Without common scale</u>

To test the common scale assumption, we use an affine transformation as follows:

$$\ln K(\ell, \underline{a}(\ell)) = \gamma_{0,\ell} + \gamma_{1,\ell} \ln K(\ell - 1, \bar{a}(\ell - 1))$$

It is clearly impossible to separate $\gamma_{0,\ell}$ from the threshold parameter $\ln \bar{K}(\ell)$ so we normalize $\gamma_{0,\ell} = 0$ with the understanding that any estimated threshold parameter is net of $\gamma_{0,\ell}$ (i.e., $\bar{K}_\ell - \gamma_{0,\ell}$). To identify the parameter $\gamma_{1,\ell}$, we use additional moments. Using the definition of $\bar{\Psi}_\ell(a)$, we obtain:

$$\text{Cov}\big(\Psi_\ell(a), \Psi_{\ell-1}(a')\big) = \gamma_{1,\ell}\Bigg\{(a - \underline{a}(\ell))(a' - \underline{a}(\ell - 1))\sigma^2_\omega + \sigma^2_\Upsilon + \sum_{k=1}^{\ell-2}(\bar{a}(k) - \underline{a}(k))\sigma^2_{\varepsilon(k)} + (a' - \underline{a}(\ell - 1))\sigma^2_{\varepsilon(\ell-1)}\Bigg\}. \tag{H.9}$$

we can identify $\gamma_{1,\ell}$ based on this covariance term between level ℓ and $\ell - 1$. Using similar logic, we can identify the parameters $\gamma_{1,\ell}$ across difficulty levels. Thus, this aspect of common scale can be tested.

H.5 Beyond Normality

Drawing on the analysis of Heckman and Vytlacil (2007a) and Matzkin (1993, 2007), with sufficient variation in the regressors, we can not only identify the model under normality, but we can also identify the model under more general distributional assumptions based on Matzkin (1993).

To identify all the shock distributions, we first need to nonparametrically identify the distribution of the sum of all shocks (i.e.,$\bar{\Psi}_1(a)$). We need to impose assumptions on $\mu_1 + \mu_0(Z) + V(Q(a)) + \bar{\beta}_1(X)a$ and the shock terms. We need (a) the function is continuous; (b) there exists some x' and z' such that $\mu_1 + \mu_0(z') + V(Q(a)) + \bar{\beta}_1(x')a = R$ regardless of the specified coefficients (c) the shock term $\bar{\Psi}_1(a)$ and the observable covariates are independent. (d) the distributions of all shocks are continuous. These assumptions guarantee nonparametric identification of $\bar{\Psi}_1(a)$. Next, we discuss how to separately identify the distributions of ω, ε and Υ. We use characteristic functions.

Denote the characteristic function of $\bar{\Psi}_1(a)$ by $\varphi_{\Psi(a)}(t)$. Since we assume that all the shock terms are independent with each other, we have the following condition: $\varphi_{\Psi(a)}(t) = \varphi_\omega(at)\varphi_{U_1(a)}(t)\varphi_\Upsilon(t)$ Notice that $U_1(a) = \varepsilon_1(1) + \cdots + \varepsilon_1(a)$. Therefore, $\varphi_{U_1(a)}(t) = \varphi_{\varepsilon(1)}(t)^a$. Thus, we obtain the following equation:

$$\varphi_{\Psi(a)}(t) = \varphi_\omega(at)\varphi_{\varepsilon(1)}(t)^a\varphi_\Upsilon(t).$$

If we assume that ω is standard normal, we can identify

$$\varphi_\Upsilon(t) = \frac{\varphi_{\Psi(2)}(t)/\varphi_\omega(2t)}{\varphi_{\Psi(1)}(t)/\varphi_\omega(t)}$$

Collecting results, the characteristic function for ε_1 can be identified from

$$\varphi_{\varepsilon_{(1)}}(t) = \frac{\varphi_{\Psi(1)}(t)}{\varphi_{\omega}(t)\varphi_{\Upsilon}(t)}.$$

Since we can nonparametrically identify the shock distributions, we can easily get the moments of the first two levels. Identification of the remaining parameters follows from repeated application of the same logic.

I Simulation Procedure for Method of Moments Estimation

Our simulation procedures for both scalar and vector models are as follows. We parameterize each function and make the distributional assumptions noted below. We adopt a new subscript notation unique to this appendix to simplify the notation and distinguish person-specific variables. Thus, we write $\varepsilon_\ell(s,a)$ for person i as $\varepsilon_i(s,\ell,a)$ with similar notational changes for i-subscripted variables.

(A) We first simulate the initial conditions for latent skills: $\ln K(s,0) = Z_i'\beta_{0,s} + \Upsilon_{i,s}$ for each child i, where Z_i is a vector of variables for child i including family background measures and the monthly age of the child at enrollment. Family background information includes father's years of education, mother's years of education, and grandmother's years of education. $\Upsilon_{i,s}$ is a random term independent of all regressors and error terms at all levels. It follows the normal distribution $N(0, \sigma^2_\Upsilon(s))$.

(B) After drawing initial latent skills $K(s,0)$, child i skills evolve following the equation $(\ln K_i(s,\ell,a) = \ln K_i(s,\ell,a-1) + (\delta_\ell(s)\eta_i(s) + V(Q(a)) + \varepsilon_i(s,\ell,a)))$. In this equation, $\delta_\ell(s)$ is a level-specific lesson parameter for skill s. $\varepsilon_i(s,\ell,a)$ is an i.i.d. random term associated with the learning process drawn from a normal distribution $N(0, \sigma^2_{\varepsilon(\ell)}(s))$ for skill s, and $\eta_i(s)$ is an individual learning parameter with the specification: $\eta_i(s) = X'\beta_s + \omega_i$, where X includes the set of interaction measures; and ω_i is individual specific learning ability, which follows the normal distribution $N(0, \sigma^2_\omega(s))$.

Since $\delta_\ell(s)$ and $\eta_i(a)$ enter the model multiplicatively, we cannot separately identify them without some normalization. We normalize the first level $\delta(s,1) = 1$ to identify the coefficients of β_s. Since we assume that the β_s are the same across levels, we can identify $\delta(s,\ell)$ for $\ell > 1$. $\delta(s,\ell)\eta_i(a) = \delta(s,\ell)(X'(a)\beta_s + \omega_i)$ where the X includes determinants of ability and $\delta(s,\ell)$ captures lesson contents. We now give an example on how to simulate the latent skills within the same difficulty level ℓ:

1. Use the initial latent skill $\ln K_i(s,0)$ which is formed by $Z_i'\beta_{0,s} + \Upsilon_{i,s}$ and the random draw $\Upsilon_{i,s}$ from a normal distribution with mean zero and variance $\sigma^2_\Upsilon(s)$. Child ages sometimes differ at enrollment.

2. If child i starts the intervention at difficulty level ℓ, we randomly draw the task error term at difficulty level ℓ from the normal distribution with mean zero and variance $\sigma^2_{\varepsilon(\ell)}$. Then, we can construct the latent skill for the first task based on the following equation:
   $\ln K_i(s,\ell,1) = \ln K(s,0) + \delta(s,\ell)(X'(1)\beta_s + \omega_i) + \varepsilon_i(s,\ell,1)$

3. Similarly we randomly draw a shock $\varepsilon_i(s,\ell,2)$ for the 2nd task at level ℓ, and then, we construct the latent skill following:
   $\ln K_i(s,\ell,2) = \ln K_i(s,\ell,1) + \delta(s,\ell)(X'(2)\beta_s + \omega_i) + \varepsilon_i(s,\ell,2)$

4. Repeat step 3 until the last task of difficulty level ℓ at age $\bar{a}(s,\ell)$ to construct the latent skill:
   $\ln K_i(s,\ell,j) = \ln K_i(s,\ell,j-1) + \delta(s,\ell)(X'(j)\beta_s + \omega_i) + \varepsilon_i(s,\ell,j)$

(C) Under common scale, the latent skill across difficulty levels evolves as follows:

$$\ln K_i(s, \ell+1, \underline{a}(s, \ell+1)) = \ln K_i(s, \ell, \bar{a}(s, \ell)) + \delta(s, \ell+1)(X'(a)\beta_s + \omega_i) + \varepsilon_i(s, \ell+1, a(s, \ell+1)).$$

After the first task at that level, latent skills evolve as follows for $j > 1$:

$$\ln K_i(s, \ell+1, a) = \ln K_i(s, \ell+1, a-1) + \delta(s, \ell+1)(X'(a)\beta_s + \omega_i) + \varepsilon_i(s, \ell+1, j).$$

(D) For a model without common scale, the latent skill across difficulty levels develops as follows:
$\ln K_i(s, \ell+1, a(s, \ell, 1)) = \gamma_{0,\ell} + \gamma_{1,\ell}(\ln K_i(s, \ell)) + \delta(s, \ell+1)(X'(1)\beta_s + \omega_i) + \varepsilon_i(s, \ell+1, a(s, \ell+1))$.
After the first task, latent skill on other tasks at level $\ell+1$ are as follows:
$\ln K_i(s, \ell+1, a(s, \ell+1, j)) = \ln K_i(s, \ell+1, a(s, \ell+1, j-1)) + \delta(s, \ell+1)(X'(j)\beta_s + \omega_i) + \varepsilon_i(s, \ell+1, j))$, $j > 1$.

(E) Given estimates of the parameters $\bar{K}(s, \ell)$, we can calculate the simulated task performance based on the following equation:

$$D(s, \ell, a) = \begin{cases} 1 & K(s, \ell, a) \geq \bar{K}(s, \ell) \\ 0 & \text{otherwise.} \end{cases}$$

(F) We form moments based on series of simulated child task performance and

minimize the distance between the simulated and the data moments.

(G) The moments we consider in estimation include: (1)All task passing rates; (2) The passing rate on the first five tasks at each level; (3) The passing rate for each difficulty level; (4) The passing rate for newly enrolled children; (5) The passing rate for those who enroll in the program longer than one month; (6) The probability of passing the j'th task ($j \neq j'$) within each level, conditioning on the child passing the jth task; (7) The probability of passing the j'th task at level $\ell + 1$ across all difficulty levels, conditioning on the child passing the jth task at level ℓ; (8) The probability of passing the j'th task at level $\ell + 2$, conditioning on the child passing the jth task at level ℓ.

(G) After obtaining the point estimates, we bootstrap to calculate the standard errors of the estimates.

Table I.1: Assumptions on Random Shocks in the Model

Parameters	Level Specific or Not	Distribution
Initial Latent Skill Condition Shock ($\Upsilon_{i,s}$)	No	Normal$(0, \sigma^2_{\Upsilon}(s))$
Learning ability Shock ($\omega_i(s)$)	No	Normal$(0, \sigma^2_{\omega}(s))$
Task Performance Shock ($\varepsilon_i(s, \ell, a)$)	Yes	Normal$(0, \sigma^2_{\varepsilon(\ell)}(s))$

I.1 Bootstrap Procedure

Since our data are clustered, to conduct robust inference, we use the paired cluster bootstrap method in our paper. In the paper, the clustering is at the village level. We document the paired cluster bootstrap procedure below.

- From the original sample, we get point estimates β^*.
- We iterate the following bootstrap procedure 1000 times from a sample of G clusters $(y_1, \boldsymbol{X}_1), \cdots, (y_G, \boldsymbol{X}_G)$, resampling with replacement G times from the original sample of clusters. The unit of bootstrap is at cluster level. After we randomly draw G clusters, we construct one bootstrap sample.
- Based on the bootstrap sample k, we estimate the structural model based on the estimation procedure documented above and get the point estimates β_k^{bs} for the structural model.
- We conduct inference on each estimated parameter β^* based on the distribution of β^{bs}. After iterating the bootstrap 1000 times, we have the distribution of each parameter. We then calculate the confidence interval and standard error for each parameter.

J Estimation: Moment Fit (Scalar Model)

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Table J.1: Moments Used in Estimation

Moment	Number of Moments		
	Language	Cognitive	Fine Motor
All task passing rate	103	70	30
The first five task passing rates at each level	50	48	24
Each difficulty level task passing rate	10	13	7
Each task passing rate for newly enrolled children (≤ 1 month)	71	45	14
Each task passing rate for children enrolled in the program for > 1 month	96	70	30
Each difficulty level duration measure	10	13	7
Each difficulty level correlation between duration and interaction measures	30	36	21
Within each level, conditional on children who can pass the jth task, the probability of passing the j'th task ($j \neq j'$)	100	82	43
Across difficulty levels, conditional on children who can pass the jth task at level ℓ, the probability of passing the j'th task at level $\ell + 1$	225	177	84
Across difficulty levels, conditional on children who can pass the jth task at level ℓ, the probability of passing the j'th task at level $\ell + 2$	200	142	79
Total	895	696	339

In this section, we report the moment fit when we estimate the skill formation process independently across different types of skills. In summary, 80% of the simulated moments are in the 95% confidence intervals of data moments.

- Overall, our estimates fit the moments very well. The model without common scale has better fit.
- χ^2 test results are reported in column χ^2 of Table J.2.
- We also examine the model of fit by the following summary measure:

$$R = \frac{\sum_i (y_i^m - y_i^d)^2}{N_I}$$

where y_i^m is a predicted moment i for the model, and y_i^d is the empirical moment i. Values of R are reported in column R of Table J.2.

Table J.2: Goodness of Fit Summary (Scalar Model)

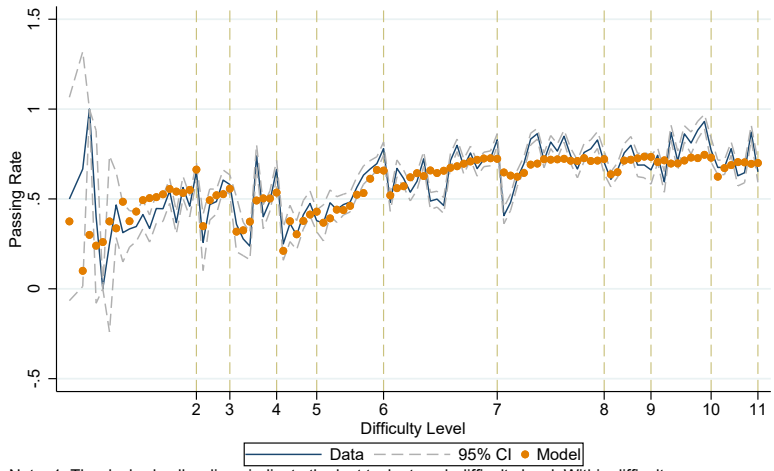
	Language		Cognitive		Fine Motor	
	χ^2	R	χ^2	R	χ^2	R
With common scale	32.71	133.05	16.84	93.5	5.59	29.09
Without common scale	21.27	121.39	14.31	81.63	5.23	24.73

1. $R = \frac{\sum_i (y_i^m - y_i^d)^2}{N_I}$, where y_i^m is the predicted moment i for the model, and y_i^d is the empirical moment.
2. For all models, we cannot reject the model at the 0.0001 level.

J.1 Language (Scalar Model)

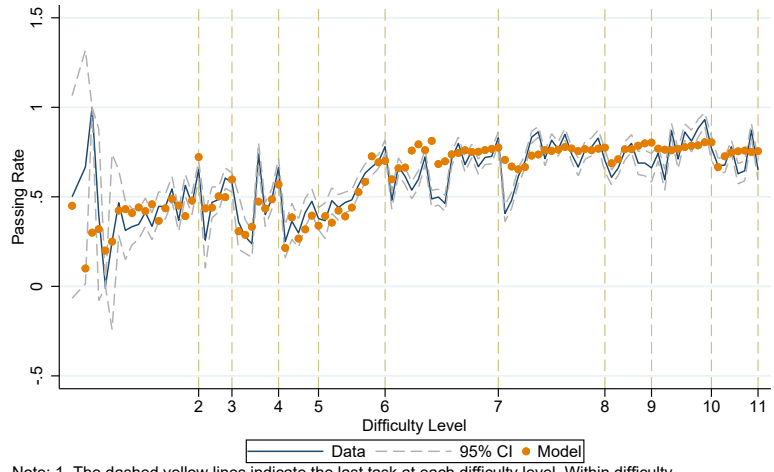
Figure J.1: Fit on All Language Tasks by Level (Scalar Model)

(a) common scale



Note: 1. The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.
2. All the children started from level 2 or above upon enrolling.

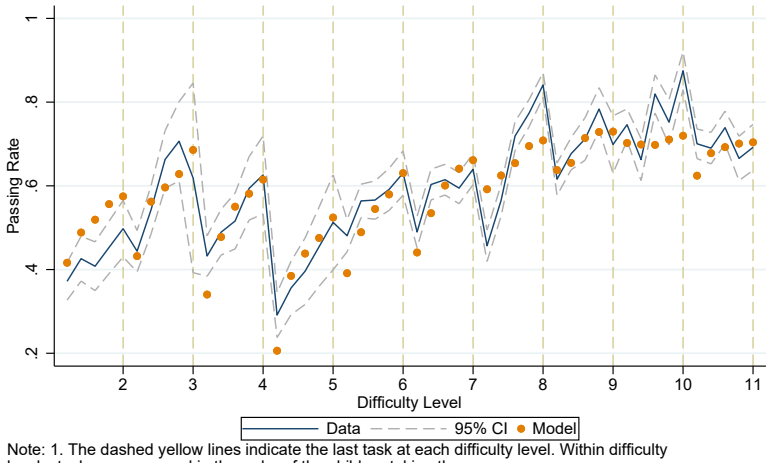
(b) w/o common scale



Note: 1. The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.
2. All the children started from level 2 or above upon enrolling.

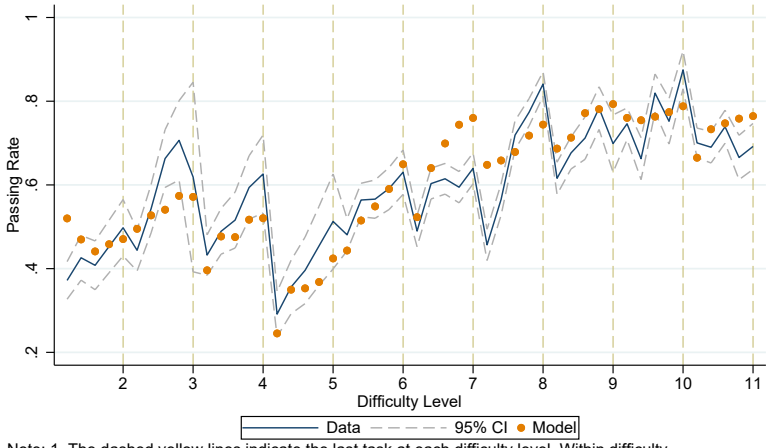
Figure J.2: Fit on the First Five Tasks in Each Level (Scalar Model)

(a) common scale



Note: 1. The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.
2. All the children started from level 2 or above upon enrolling.

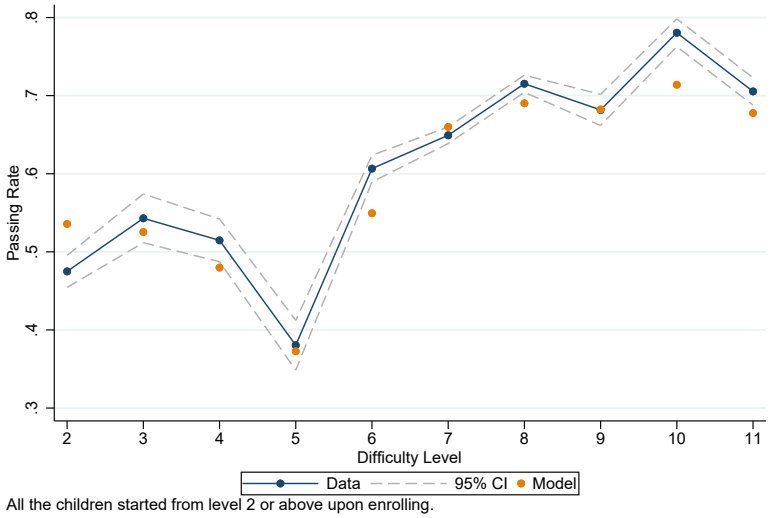
(b) w/o common scale



Note: 1. The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.
2. All the children started from level 2 or above upon enrolling.

Figure J.3: Fit on Average Language Passing Rate by Level (Scalar Model)

(a) common scale



(b) w/o common scale

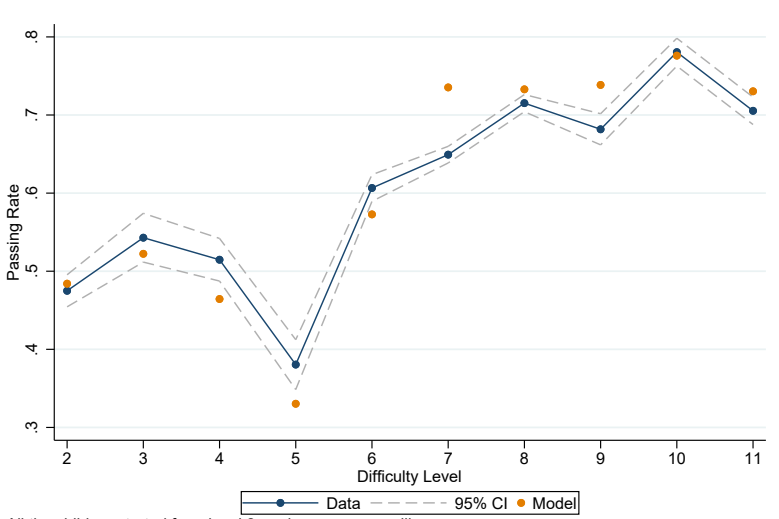
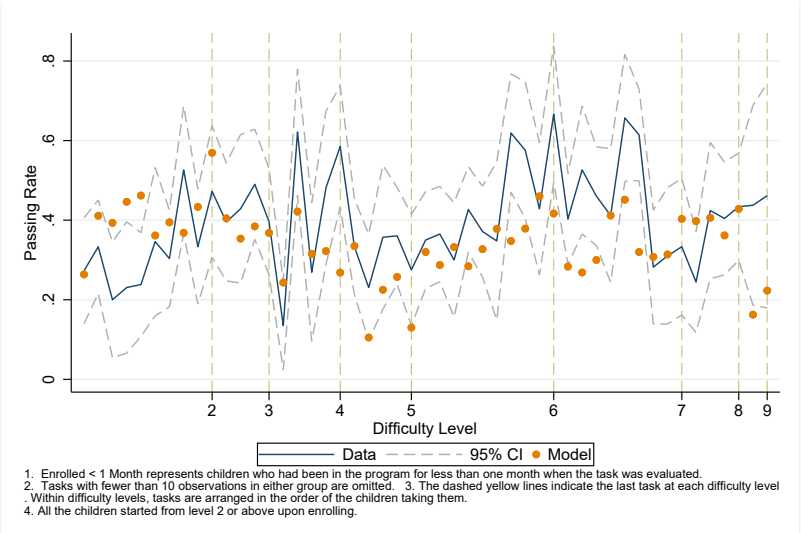


Figure J.4: Fit by Length of Enrollment: Newly Enrolled Group(Language Skill Scalar Model)

(a) common scale



(b) w/o common scale

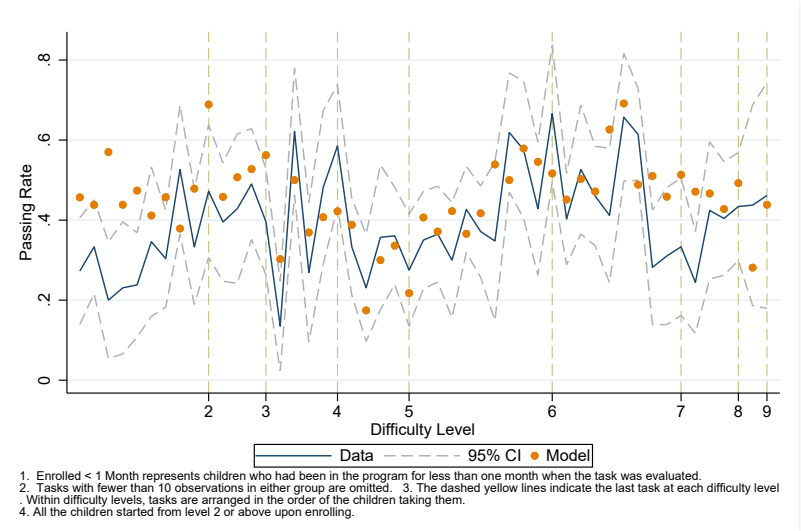
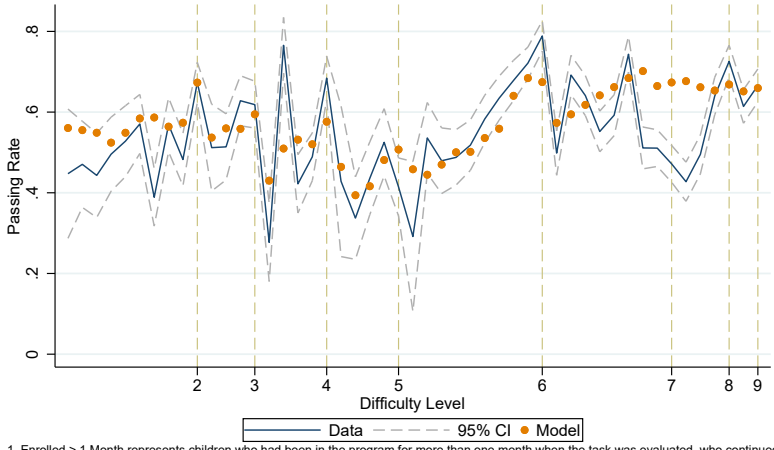


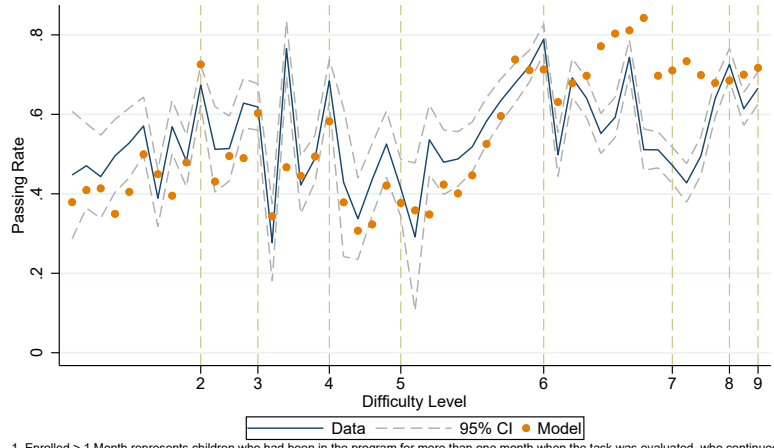
Figure J.5: Fit by Length of Enrollment: Group Enrolled > 1 Month (Language Skill (Scalar Model))

(a) common scale



1. Enrolled > 1 Month represents children who had been in the program for more than one month when the task was evaluated, who continued to stay in the program for 2 years. 2. Tasks with fewer than 10 observations in either group are omitted. 3. The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.
4. All the children started from level 2 or above upon enrolling.

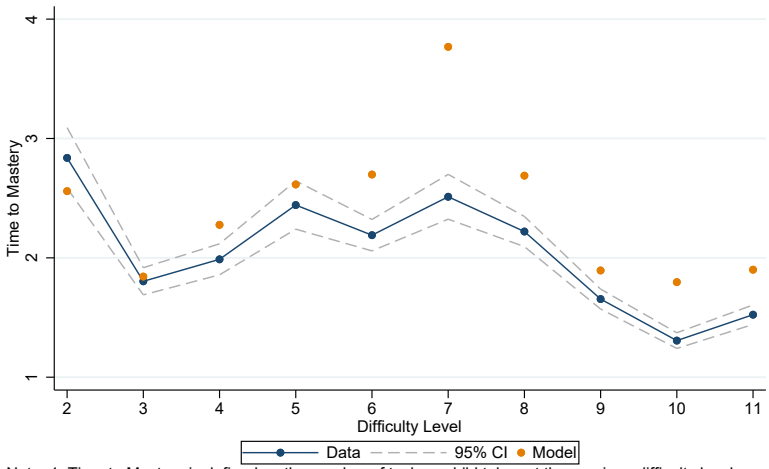
(b) w/o common scale



1. Enrolled > 1 Month represents children who had been in the program for more than one month when the task was evaluated, who continued to stay in the program for 2 years. 2. Tasks with fewer than 10 observations in either group are omitted. 3. The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.
4. All the children started from level 2 or above upon enrolling.

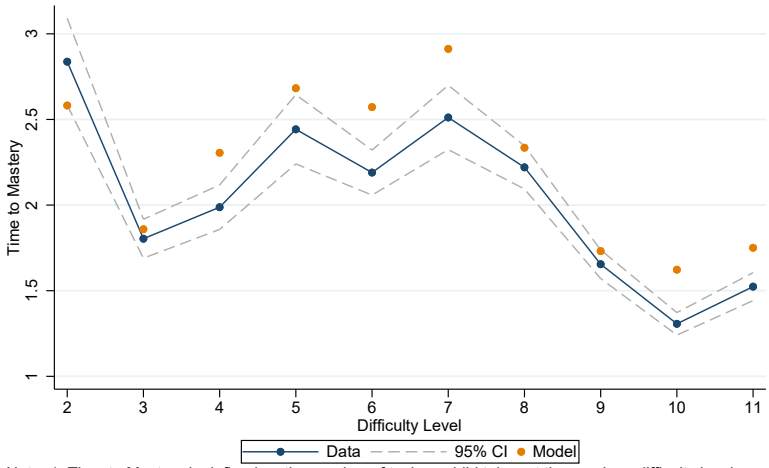
Figure J.6: Fit on Time to Mastery by Level (Language Skill Scalar Model)

(a) common scale



Note: 1. Time to Mastery is defined as the number of tasks a child takes at the previous difficulty level until the first success (inclusive).
2. All the children started from level 2 or above upon enrolling.

(b) w/o common scale

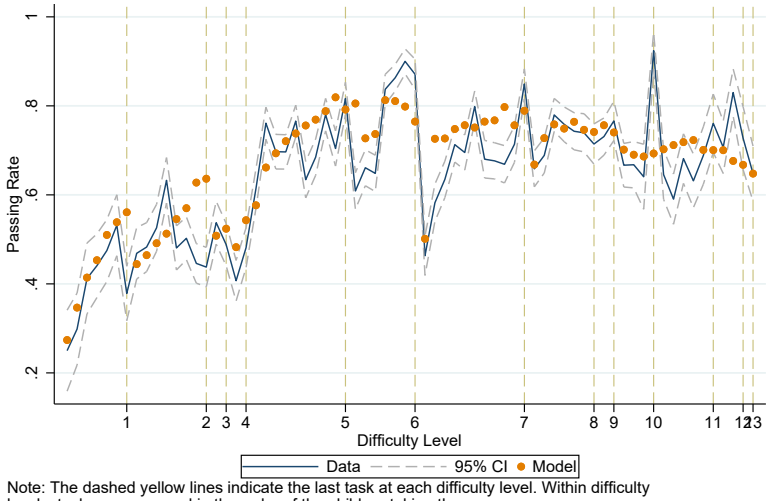


Note: 1. Time to Mastery is defined as the number of tasks a child takes at the previous difficulty level until the first success (inclusive).
2. All the children started from level 2 or above upon enrolling.

J.2 Cognition (Scalar Model)

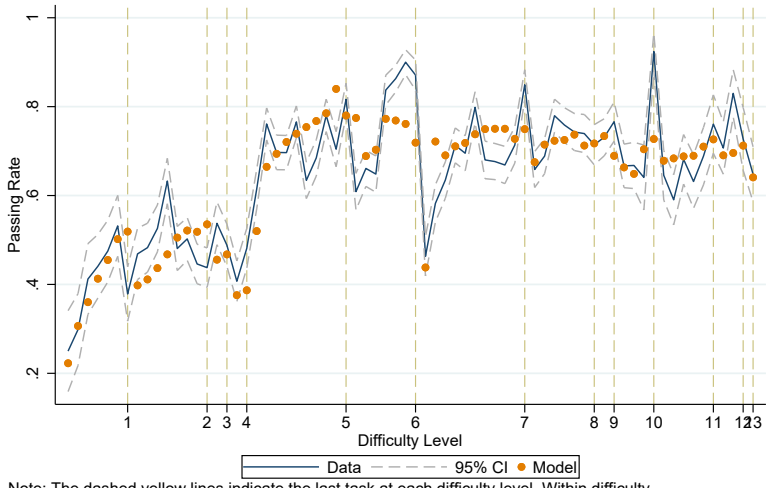
Figure J.7: Fit on All Cognitive Tasks by Level (Scalar Model)

(a) common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.

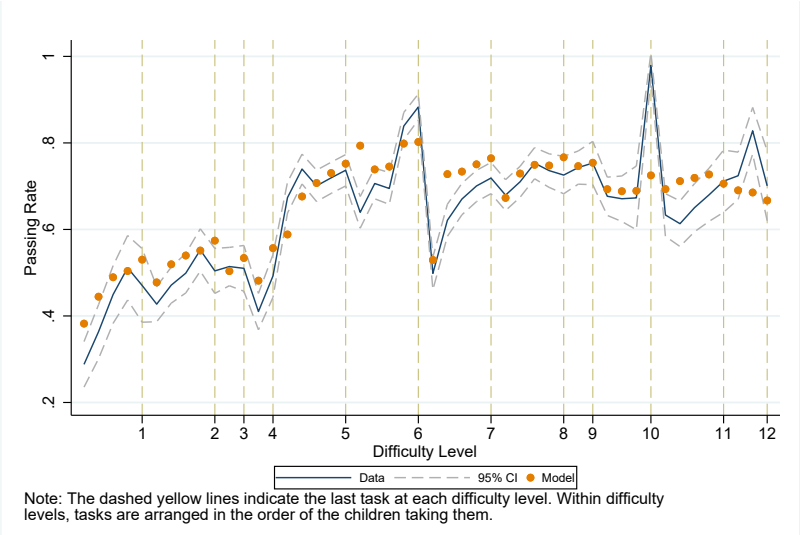
(b) w/o common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.

Figure J.8: Fit on the First Five Cognitive Tasks in Each Level (Scalar Model)

(a) common scale



(b) w/o common scale

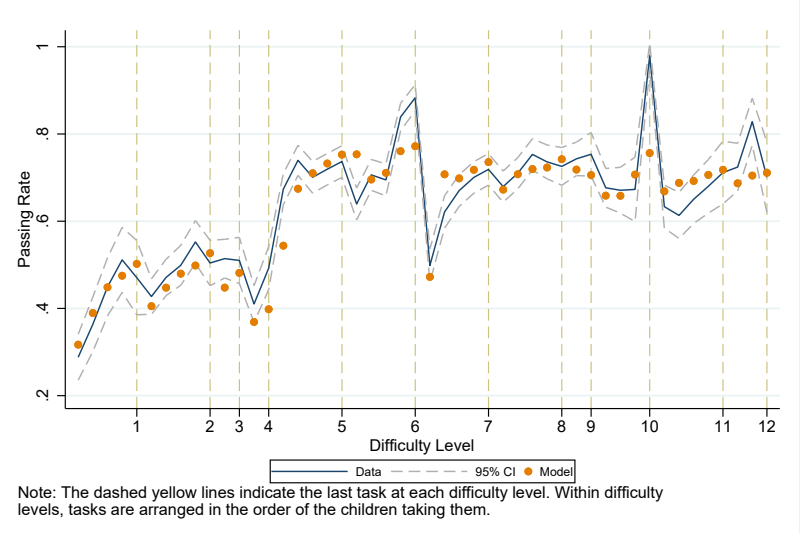
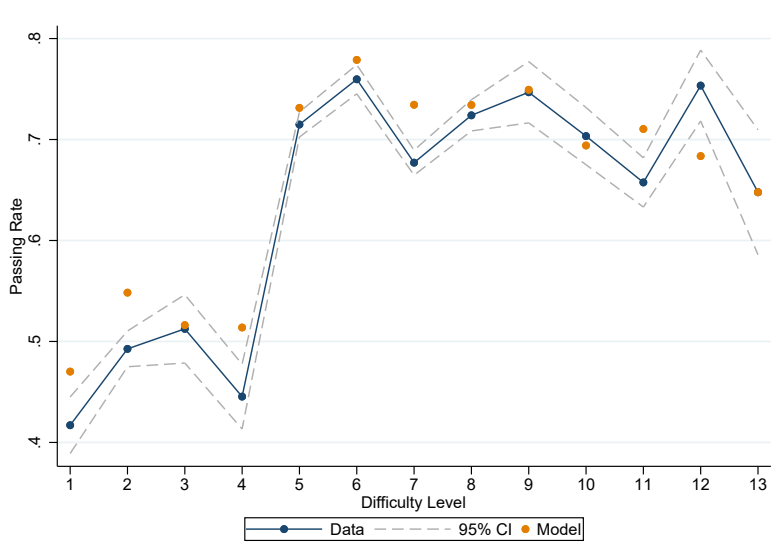


Figure J.9: Fit on Average Cognitive Passing Rate by Level (Scalar Model)

(a) common scale



(b) w/o common scale

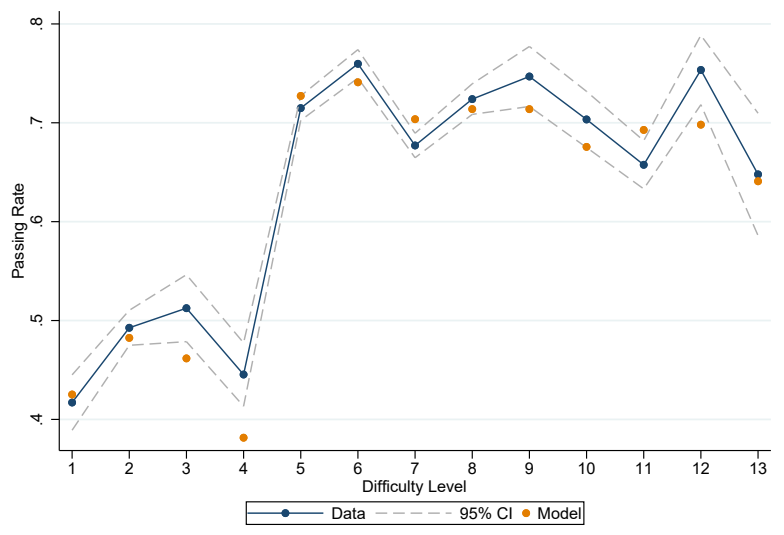
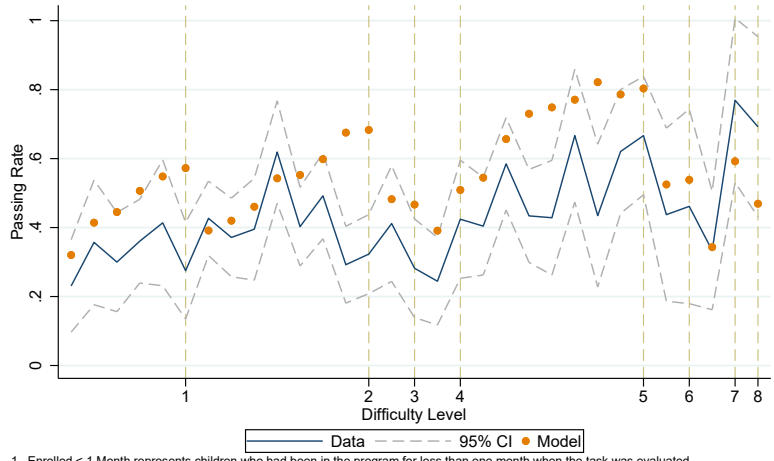


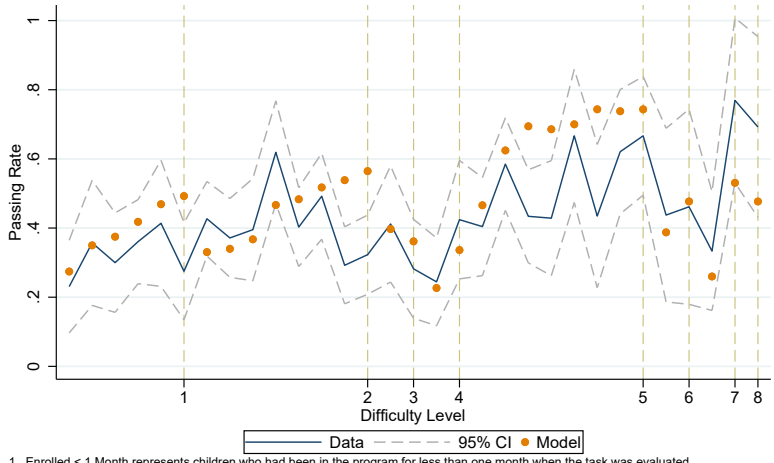
Figure J.10: Fit by Length of Enrollment: Newly Enrolled Group (Cognitive Skill (Scalar Model))

(a) common scale



1. Enrolled < 1 Month represents children who had been in the program for less than one month when the task was evaluated.
2. Tasks with fewer than 10 observations in either group are omitted. 3. The dashed yellow lines indicate the last task at each difficulty level
. Within difficulty levels, tasks are arranged in the order of the children taking them.

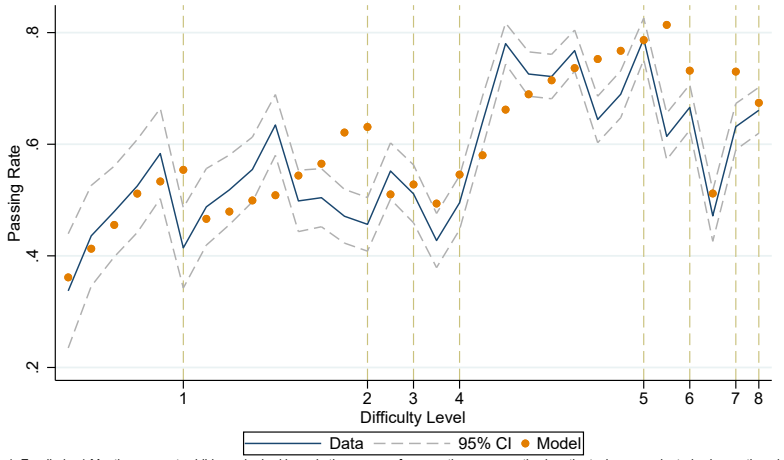
(b) w/o common scale



1. Enrolled < 1 Month represents children who had been in the program for less than one month when the task was evaluated.
2. Tasks with fewer than 10 observations in either group are omitted. 3. The dashed yellow lines indicate the last task at each difficulty level
. Within difficulty levels, tasks are arranged in the order of the children taking them.

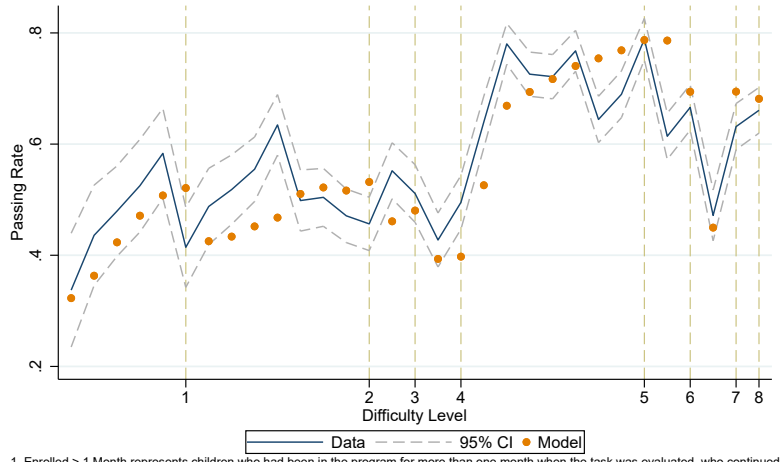
Figure J.11: Fit by Length of Enrollment: Group Enrolled > 1 Month (Cognitive Skill (Scalar Model))

(a) common scale



1. Enrolled > 1 Month represents children who had been in the program for more than one month when the task was evaluated, who continued to stay in the program for 2 years. 2. Tasks with fewer than 10 observations in either group are omitted. 3. The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.

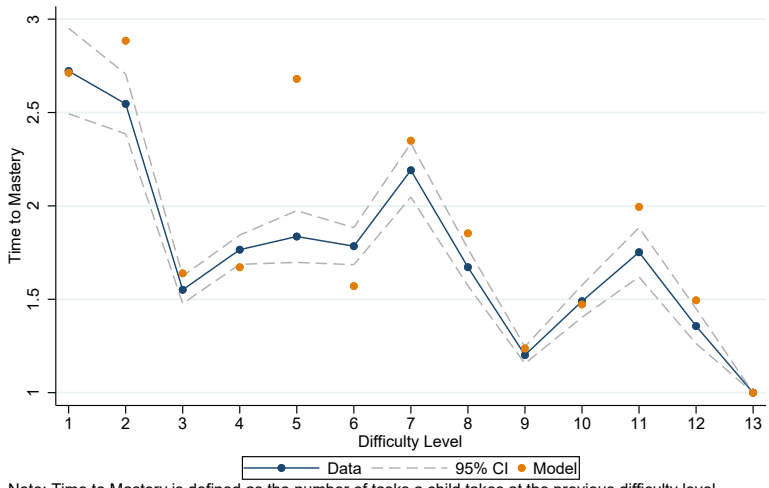
(b) w/o common scale



1. Enrolled > 1 Month represents children who had been in the program for more than one month when the task was evaluated, who continued to stay in the program for 2 years. 2. Tasks with fewer than 10 observations in either group are omitted. 3. The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.

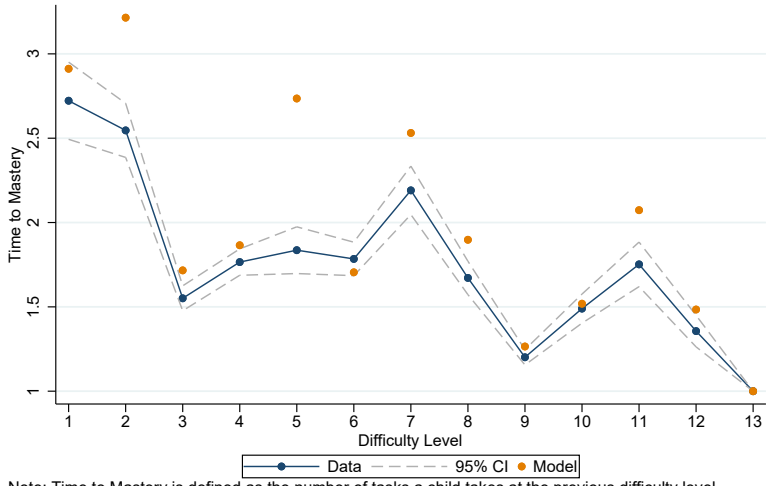
Figure J.12: Fit on Time to Mastery by Level (Cognitive Skill (Scalar Model))

(a) common scale



Note: Time to Mastery is defined as the number of tasks a child takes at the previous difficulty level until the first success (inclusive).

(b) w/o common scale

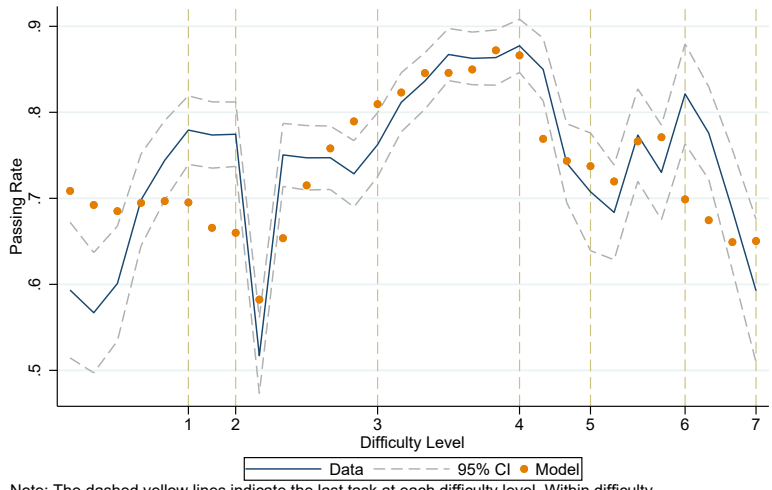


Note: Time to Mastery is defined as the number of tasks a child takes at the previous difficulty level until the first success (inclusive).

J.3 Fine Motor (Scalar Model)

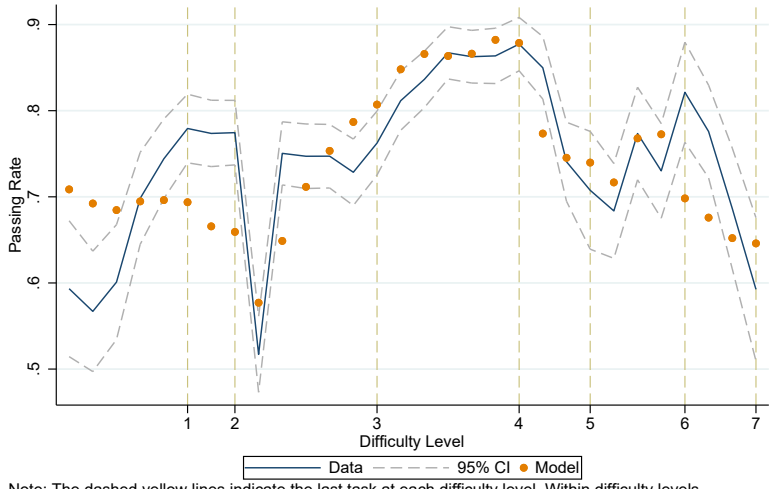
Figure J.13: Fit on All Fine Motor Tasks by Level (Scalar Model)

(a) common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.

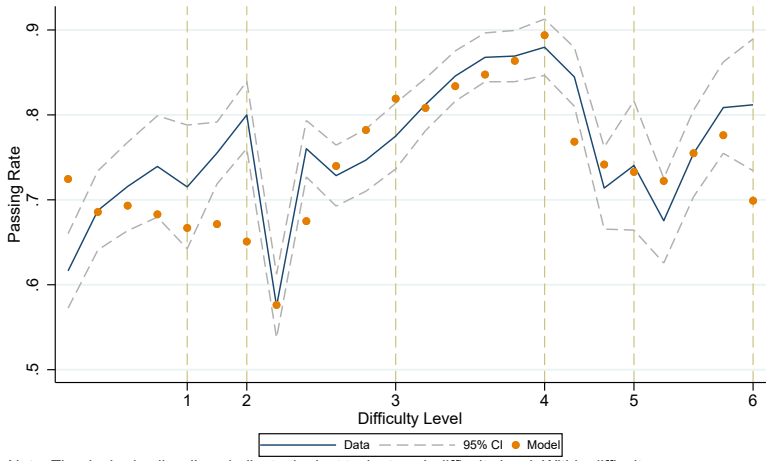
(b) w/o common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged by the order of the children taking them.

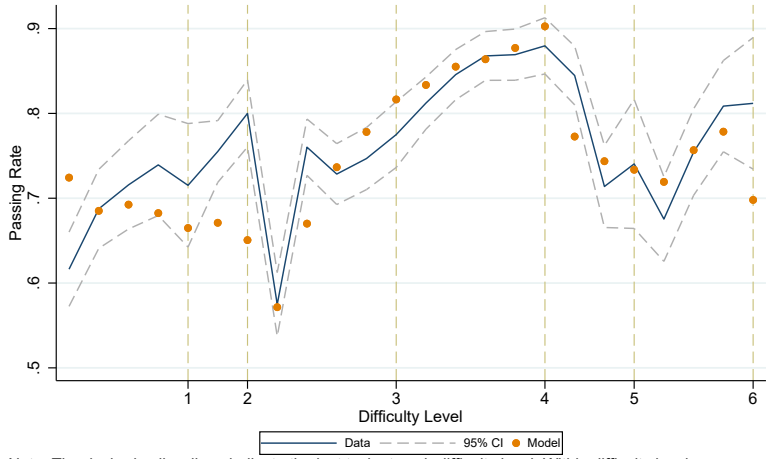
Figure J.14: Fit on the First Five Tasks in Each Level (Scalar Model)

(a) common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged in the order of the children taking them.

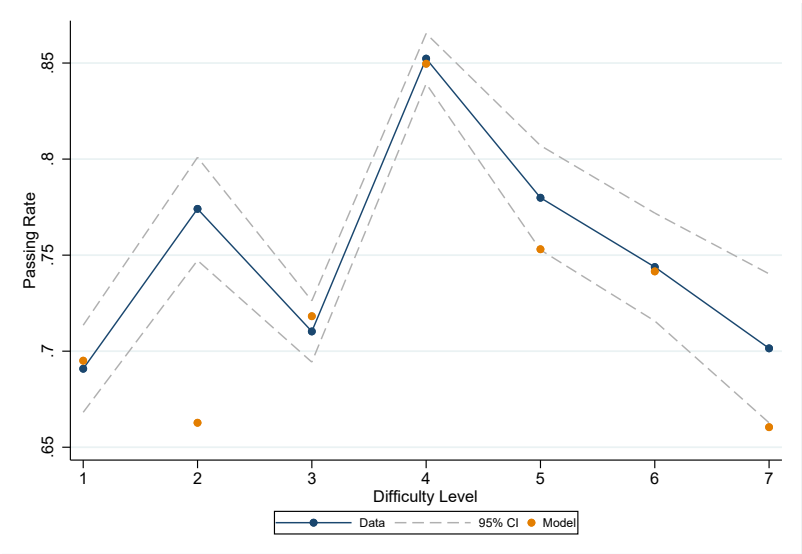
(b) w/o common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged by the order of the children taking them.

Figure J.15: Fit on Average Passing Rate by Level (Fine Motor Skill (Scalar Model))

(a) common scale



(b) w/o common scale

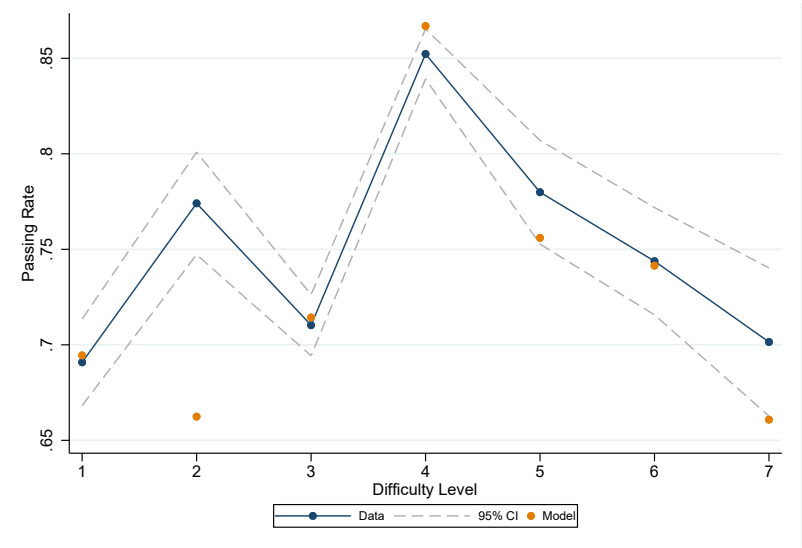
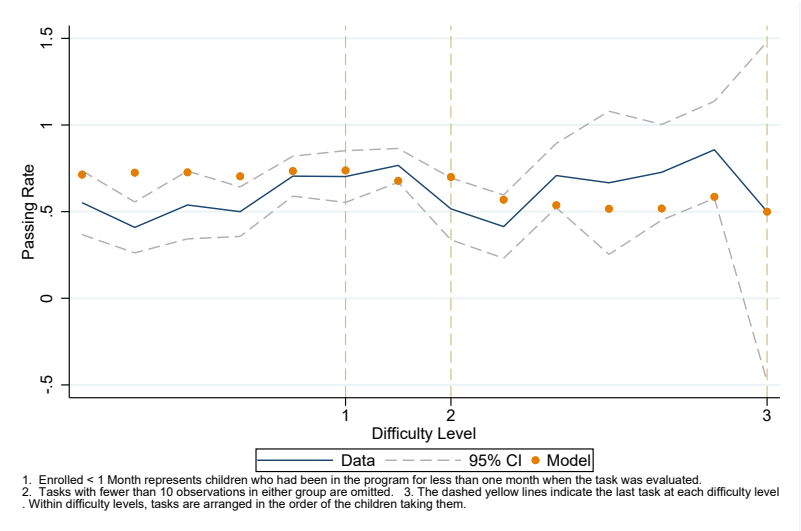


Figure J.16: Fit by Length of Enrollment: Newly Enrolled Group (Fine Motor Skill (Scalar Model))

(a) common scale



(b) w/o common scale

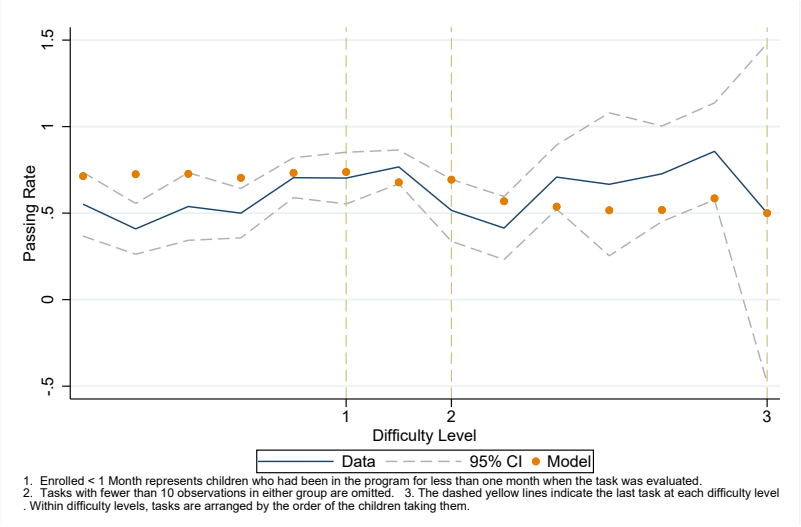
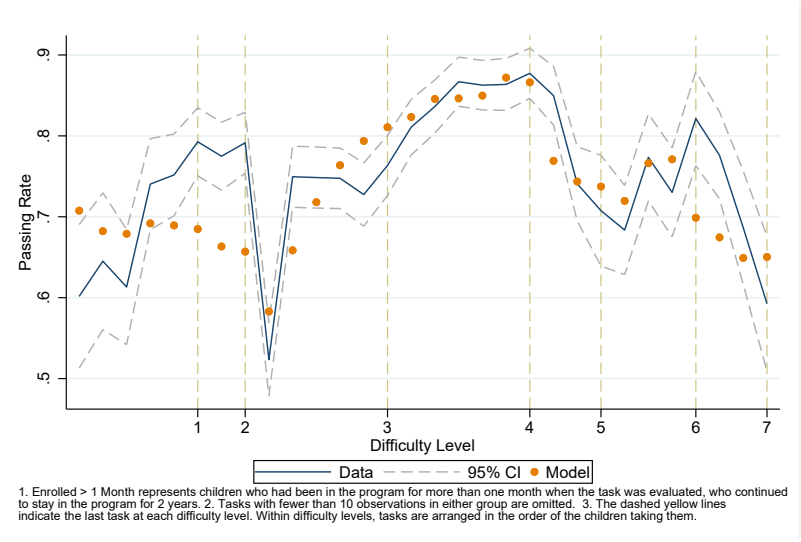


Figure J.17: Fit by Length of Enrollment: Group Enrolled > 1 Month (Fine Motor Skill (Scalar Model))

(a) common scale



(b) w/o common scale

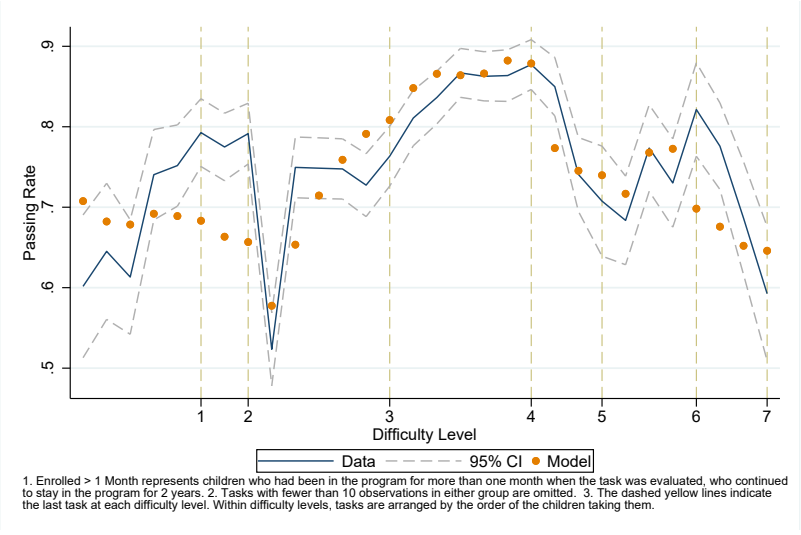
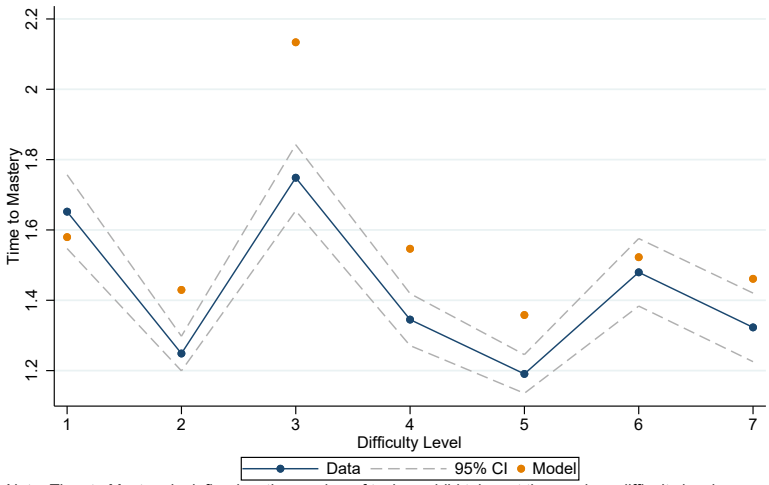


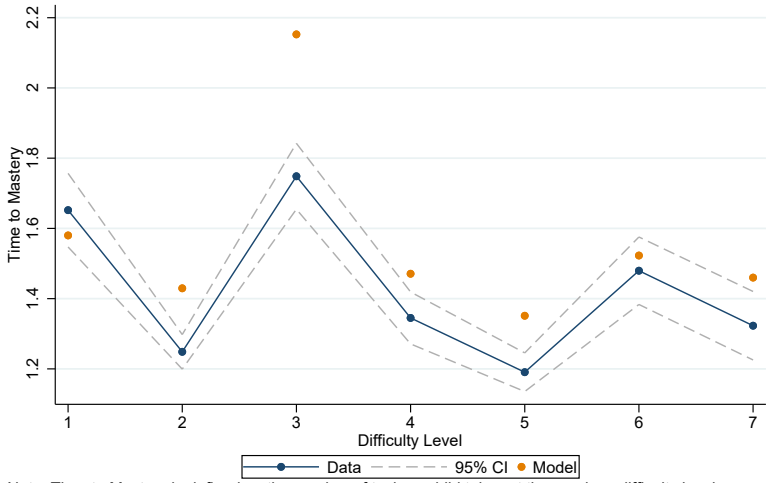
Figure J.18: Fit on Time to Mastery by Level (Fine Motor Skill (Scalar Model))

(a) common scale



Note: Time to Mastery is defined as the number of tasks a child takes at the previous difficulty level until the first success (inclusive).

(b) w/o common scale



Note: Time to Mastery is defined as the number of tasks a child takes at the previous difficulty level until the first success (inclusive).

K Point Estimates (Scalar Model)

K.1 Language Skills (Scalar Model)

K.1.1 Model with common scale

Table K.1: Determinants of Initial Conditions and Maturation Effects (Language Skill (Scalar Model))

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	–0.001
	Standard Error	(0.011)
Father's years of education	Point Estimate	0.061
	Standard Error	(0.001)
Mother's years of education	Point Estimate	0.056
	Standard Error	(0.001)
Grandmother's years of education	Point Estimate	0.050
	Standard Error	(1.00e-4)
Monthly age of enrollment to the program	Point Estimate	–0.003
	Standard Error	(0.004)
Constant	Point Estimate	–3.070
	Standard Error	(0.680)
Variance of Shock	Point Estimate	3.033
	Standard Error	(0.100)
Maturation Effects		
Child's Age: Month	Point Estimate	7.792e-5
	Standard Error	(2.238e-4)
Child's Age: Week	Point Estimate	–0.013
	Standard Error	(0.009)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. If the child is 8 months and 3 weeks old, the values for Child's Age: Month, and Child's Age: Week are 8 and 3, respectively.

Table K.2: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level (Language Skill (Scalar Model))

Level 3	Point Estimate	1.307	Level 8	Point Estimate	4.513
	Standard Error	(0.053)		Standard Error	(0.393)
Level 4	Point Estimate	2.225	Level 9	Point Estimate	5.527
	Standard Error	(0.324)		Standard Error	(0.405)
Level 5	Point Estimate	2.792	Level 10	Point Estimate	10.476
	Standard Error	(0.366)		Standard Error	(0.783)
Level 6	Point Estimate	3.155	Level 11	Point Estimate	11.844
	Standard Error	(0.373)		Standard Error	(0.782)
Level 7	Point Estimate	3.448			
	Standard Error	(0.378)			

1. Standard errors are calculated by 1000 iteration bootstrap.
2. All children started from level 2 or above upon enrolling.
3. Level 2 value is normalized to 1.

Table K.3: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level (Language Skill (Scalar Model))

Level 3	Point Estimate	0.993	Level 8	Point Estimate	21.882
	Standard Error	(0.004)		Standard Error	(19.434)
Level 4	Point Estimate	1.502	Level 9	Point Estimate	0.999
	Standard Error	(0.079)		Standard Error	(0.004)
Level 5	Point Estimate	0.990	Level 10	Point Estimate	0.997
	Standard Error	(0.004)		Standard Error	(0.004)
Level 6	Point Estimate	5.895	Level 11	Point Estimate	57.845
	Standard Error	(1.359)		Standard Error	(34.169)
Level 7	Point Estimate	0.998			
	Standard Error	(0.004)			

1. Standard errors are calculated by 1000 iteration bootstrap.
2. All children started from level 2 or above upon enrolling.
3. Level 2 variance is normalized to 1.

Table K.4: Learning Component ($\delta_k \eta(X)$)
(Language Skill (Scalar Model))

	η			δ_k		
Interaction quality:	Point Estimate	0.839	Level 3	3.053	Level 9	5.990
Home visitor and caregiver	Standard Error	(0.444)		(0.005)		(0.007)
Interaction quality:	Point Estimate	0.268	Level 4	3.049	Level 10	2.998
Home visitor and child	Standard Error	(0.188)		(0.006)		(0.002)
Teaching ability	Point Estimate	0.434	Level 5	0.033	Level 11	2.999
	Standard Error	(0.096)		(0.015)		(0.002)
Grandmother rearing	Point Estimate	–0.230	Level 6	3.111		
	Standard Error	(0.043)		(0.012)		
Male	Point Estimate	–0.073	Level 7	6.000		
	Standard Error	(0.014)		(0.006)		
Constant	Point Estimate	–6.722	Level 8	5.958		
	Standard Error	(0.768)		(0.012)		
Variance of learning ability shock (σ_ω^2)	Point Estimate	0.933				
	Standard Error	(0.008)				

1. Standard errors are calculated by 1000 iteration bootstrap.
2. All children started from level 2 or above upon enrolling. δ_2 at Level 2 is normalized to 1.
3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

K.1.2 Model without common scale

Table K.5: Determinants of Initial Conditions and Maturation Effects (Language Skill (Scalar Model))

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	–0.001
	Standard Error	(1.10e-4)
Father's years of education	Point Estimate	0.063
	Standard Error	(0.001)
Mother's years of education	Point Estimate	0.056
	Standard Error	(0.001)
Grandmother's years of education	Point Estimate	0.050
	Standard Error	(2.00e-4)
Monthly age of enrollment to the program	Point Estimate	–0.003
	Standard Error	(3.50e-4)
Constant	Point Estimate	–2.254
	Standard Error	(0.598)
Variance of Shock	Point Estimate	3.043
	Standard Error	(0.105)
Maturation Effects		
Child's Age: Month	Point Estimate	0.016
	Standard Error	(0.005)
Child's Age: Week	Point Estimate	0.002
	Standard Error	(0.001)

1. Standard errors are calculated by 1000 iteration bootstrap.

2. If the child is 8 months and 3 weeks old, the values for Child's Age: Month, and Child's Age: Week are 8 and 3, respectively.

Table K.6: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level (Language Skill (Scalar Model))

Level 3	Point Estimate	1.295	Level 8	Point Estimate	4.598
	Standard Error	(0.054)		Standard Error	(0.277)
Level 4	Point Estimate	1.846	Level 9	Point Estimate	5.743
	Standard Error	(0.138)		Standard Error	(0.312)
Level 5	Point Estimate	2.545	Level 10	Point Estimate	13.779
	Standard Error	(0.216)		Standard Error	(1.248)
Level 6	Point Estimate	3.219	Level 11	Point Estimate	15.795
	Standard Error	(0.243)		Standard Error	(1.273)
Level 7	Point Estimate	3.693			
	Standard Error	(0.258)			

1. Standard errors are calculated by 1000 iteration bootstrap.
2. All children started from level 2 or above upon enrolling.
3. Level 2 value is normalized to 1.

Table K.7: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level (Language Skill (Scalar Model))

Level 3	Point Estimate	0.992	Level 8	Point Estimate	88.239
	Standard Error	(0.001)		Standard Error	(30.634)
Level 4	Point Estimate	1.384	Level 9	Point Estimate	0.999
	Standard Error	(0.060)		Standard Error	(5.30e-5)
Level 5	Point Estimate	0.990	Level 10	Point Estimate	0.995
	Standard Error	(0.001)		Standard Error	(0.001)
Level 6	Point Estimate	6.293	Level 11	Point Estimate	138.791
	Standard Error	(2.252)		Standard Error	(85.175)
Level 7	Point Estimate	0.999			
	Standard Error	(1.00e-4)			

1. Standard errors are calculated by 1000 iteration bootstrap.
2. All children started from level 2 or above upon enrolling. Level 2 variance is normalized to 1.

Table K.8: Learning Component ($\delta_k \eta(X)$)
(Language Skill (Scalar Model))

η			δ_k			
Interaction quality:	Point Estimate	0.664	Level 3	3.053	Level 10	2.998
Home visitor and caregiver	Standard Error	(0.149)		(0.005)		(2.00e-4)
Interaction quality:	Point Estimate	0.245	Level 4	3.048	Level 11	2.999
Home visitor and child	Standard Error	(0.139)		(0.005)		(1.00e-4)
Teaching ability	Point Estimate	0.364	Level 5	0.023		
	Standard Error	(0.051)		(0.066)		
Grandmother rearing	Point Estimate	–0.260	Level 6	3.108		
	Standard Error	(0.027)		(0.013)		
Male	Point Estimate	–0.073	Level 7	6.000		
	Standard Error	(0.008)		(0.039)		
Constant	Point Estimate	–6.169	Level 8	5.986		
	Standard Error	(1.462)		(0.028)		
Variance of learning ability	Point Estimate	0.928	Level 9	5.970		
shock (σ^2_ω)	Standard Error	(0.007)		(0.015)		

1. Standard errors are calculated by 1000 iteration bootstrap.
2. All children started from level 2 or above upon enrolling. δ_2 at Level 2 is normalized to 1.
3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

Table K.9: Transformation Functions
(Language Skill (Scalar Model))

		$\gamma_{k,\ell}$			$\gamma_{k,\ell}$
Level 2	Point Estimate	0.460	Level 7	Point Estimate	1.125
	Standard Error	(0.071)		Standard Error	(0.293)
Level 3	Point Estimate	0.901	Level 8	Point Estimate	0.562
	Standard Error	(0.134)		Standard Error	(0.153)
Level 4	Point Estimate	0.645	Level 9	Point Estimate	1.113
	Standard Error	(0.079)		Standard Error	(0.336)
Level 5	Point Estimate	0.660	Level 10	Point Estimate	1.006
	Standard Error	(0.111)		Standard Error	(0.160)
Level 6	Point Estimate	1.522	Level 11	Point Estimate	1.223
	Standard Error	(0.232)		Standard Error	(0.364)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Our language task data starts from level 2.

K.2 Cognitive Skills (Scalar Model)

K.2.1 Model with common scale

Table K.10: Determinants of Initial Conditions and Maturation Effects
Cognitive Skill (Scalar Model)

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	–0.552
	Standard Error	(0.139)
Father's years of education	Point Estimate	0.058
	Standard Error	(0.001)
Mother's years of education	Point Estimate	0.052
	Standard Error	(2.30e-4)
Grandmother's years of education	Point Estimate	0.050
	Standard Error	(1.00e-4)
Monthly age of enrollment to the program	Point Estimate	0.471
	Standard Error	(0.052)
Constant	Point Estimate	–7.921
	Standard Error	(0.749)
Variance of Shock	Point Estimate	2.050
	Standard Error	(0.008)
Maturation Effects		
Child's Age: Month	Point Estimate	-3.450e-4
	Standard Error	(0.001)
Child's Age: Week	Point Estimate	1.529e-5
	Standard Error	(2.983e-4)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. If the child is 8 months and 3 weeks old, the values for Child's Age: Month, and Child's Age: Week are 8 and 3, respectively.

Table K.11: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level Cognitive Skill (Scalar Model)

Level 2	Point Estimate	2.083	Level 8	Point Estimate	23.317
	Standard Error	(0.202)		Standard Error	(4.058)
Level 3	Point Estimate	3.380	Level 9	Point Estimate	57.728
	Standard Error	(0.318)		Standard Error	(7.227)
Level 4	Point Estimate	5.374	Level 10	Point Estimate	89.071
	Standard Error	(0.574)		Standard Error	(8.336)
Level 5	Point Estimate	5.712	Level 11	Point Estimate	90.586
	Standard Error	(0.582)		Standard Error	(8.311)
Level 6	Point Estimate	7.179	Level 12	Point Estimate	91.901
	Standard Error	(0.637)		Standard Error	(8.333)
Level 7	Point Estimate	21.729	Level 13	Point Estimate	5856.449
	Standard Error	(4.086)		Standard Error	(1023.389)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Level 1 value is normalized to 1.

Table K.12: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level Cognitive Skill (Scalar Model)

Level 2	Point Estimate	1.246	Level 8	Point Estimate	64.556
	Standard Error	(0.083)		Standard Error	(75.766)
Level 3	Point Estimate	1.206	Level 9	Point Estimate	0.999
	Standard Error	(0.075)		Standard Error	(0.004)
Level 4	Point Estimate	0.977	Level 10	Point Estimate	175.186
	Standard Error	(0.015)		Standard Error	(372.405)
Level 5	Point Estimate	1.000	Level 11	Point Estimate	1.000
	Standard Error	(0.004)		Standard Error	(0.004)
Level 6	Point Estimate	1.128	Level 12	Point Estimate	265.272
	Standard Error	(0.022)		Standard Error	(850.998)
Level 7	Point Estimate	1.110			
	Standard Error	(0.017)			

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Level 1 and 13 variances are normalized to 1.

Table K.13: Learning Component ($\delta_k \eta(X)$)
Cognitive Skill (Scalar Model)

η			δ_k			
Interaction quality:	Point Estimate	0.954	Level 2	0.872	Level 8	2.000
Home visitor and caregiver	Standard Error	(0.555)		(0.226)		(0.001)
Interaction quality:	Point Estimate	0.002	Level 5	2.218	Level 10	1.998
Home visitor and child	Standard Error	(0.012)		(0.052)		(0.001)
Teaching ability	Point Estimate	0.026	Level 6	2.173	Level 11	3.997
	Standard Error	(0.016)		(0.025)		(0.027)
Grandmother rearing	Point Estimate	–0.037	Level 7	3.999	Level 12	2.000
	Standard Error	(0.012)		(0.008)		(0.001)
Male	Point Estimate	0.002				
	Standard Error	(0.012)				
Constant	Point Estimate	–3.747				
	Standard Error	(1.201)				
Variance of learning ability shock (σ^2_ω)	Point Estimate	0.986				
	Standard Error	(0.004)				

1. Standard errors are calculated by 1000 iteration bootstrap.

2. Since the number of tasks at level 1, 3, 4, 9, and 13 are less than 3, we normalize the values of δ_k to 1.

3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

K.2.2 Model without common scale

Table K.14: Determinants of Initial Conditions and Maturation Effects
Cognitive Skill (Scalar Model)

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	–0.580
	Standard Error	(0.100)
Father's years of education	Point Estimate	0.058
	Standard Error	(0.001)
Mother's years of education	Point Estimate	0.052
	Standard Error	(1.567e-4)
Grandmother's years of education	Point Estimate	0.050
	Standard Error	(6.210e-7)
Monthly age of enrollment to the program	Point Estimate	0.437
	Standard Error	(0.034)
Constant	Point Estimate	–8.067
	Standard Error	(0.560)
Variance of Shock	Point Estimate	2.051
	Standard Error	(0.008)
Maturation Effects		
Child's Age: Month	Point Estimate	-3.622e-4
	Standard Error	(2.306e-5)
Child's Age: Week	Point Estimate	9.386e-5
	Standard Error	(2.430e-5)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. If the child is 8 months and 3 weeks old, the values for Child's Age: Month, and Child's Age: Week are 8 and 3, respectively.

Table K.15: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level Cognitive Skill (Scalar Model)

Level 2	Point Estimate	2.127	Level 8	Point Estimate	21.662
	Standard Error	(0.156)		Standard Error	(2.959)
Level 3	Point Estimate	3.468	Level 9	Point Estimate	56.722
	Standard Error	(0.258)		Standard Error	(5.510)
Level 4	Point Estimate	5.472	Level 10	Point Estimate	89.275
	Standard Error	(0.508)		Standard Error	(7.329)
Level 5	Point Estimate	5.813	Level 11	Point Estimate	90.812
	Standard Error	(0.514)		Standard Error	(7.340)
Level 6	Point Estimate	7.271	Level 12	Point Estimate	92.136
	Standard Error	(0.590)		Standard Error	(7.344)
Level 7	Point Estimate	19.361	Level 13	Point Estimate	5817.490
	Standard Error	(2.948)		Standard Error	(791.794)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Level 1 value is normalized to 1.

Table K.16: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level Cognitive Skill (Scalar Model)

Level 2	Point Estimate	1.238	Level 8	Point Estimate	61.185
	Standard Error	(0.055)		Standard Error	(39.474)
Level 3	Point Estimate	1.236	Level 9	Point Estimate	0.999
	Standard Error	(0.044)		Standard Error	(7.00e-5)
Level 4	Point Estimate	0.978	Level 10	Point Estimate	195.013
	Standard Error	(0.003)		Standard Error	(384.660)
Level 5	Point Estimate	1.000	Level 11	Point Estimate	1.000
	Standard Error	(1.00e-5)		Standard Error	(3.00e-5)
Level 6	Point Estimate	1.128	Level 12	Point Estimate	335.661
	Standard Error	(0.018)		Standard Error	(700.474)
Level 7	Point Estimate	1.110			
	Standard Error	(0.017)			

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Level 1 and 13 variances are normalized to 1.

Table K.17: Learning Component ($\delta_k \eta(X)$)
Cognitive Skill (Scalar Model)

η			δ_k			
Interaction quality:	Point Estimate	0.938	Level 2	0.863	Level 8	2.000
Home visitor and caregiver	Standard Error	(0.421)		(0.168)		(1.00e-6)
Interaction quality:	Point Estimate	0.002	Level 5	2.204	Level 10	1.998
Home visitor and child	Standard Error	(2.00e-4)		(0.072)		(2.00e-4)
Teaching ability	Point Estimate	0.026	Level 6	2.181	Level 11	3.997
	Standard Error	(0.004)		(0.028)		(0.015)
Grandmother rearing	Point Estimate	–0.037	Level 7	4.000	Level 12	2.000
	Standard Error	(0.005)		(0.002)		(1.00e-4)
Male	Point Estimate	0.002				
	Standard Error	(2.00e-4)				
Constant	Point Estimate	–3.763				
	Standard Error	(1.954)				
Variance of learning ability	Point Estimate	0.986				
shock (σ^2_ω)	Standard Error	(0.002)				

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Since the number of tasks at level 1, 3, 4, 9, and 13 are less than 3, we normalize the values of δ_k to 1.
3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels and δ_k is level specific.

Table K.18: Transformation Functions
Cognitive Skill (Scalar Model)

		$\gamma_{k,\ell}$			$\gamma_{k,\ell}$
Level 1	Point Estimate	0.800	Level 8	Point Estimate	1.893
	Standard Error	(0.101)		Standard Error	(0.434)
Level 2	Point Estimate	0.929	Level 9	Point Estimate	0.744
	Standard Error	(0.655)		Standard Error	(0.138)
Level 3	Point Estimate	0.936	Level 10	Point Estimate	2.068
	Standard Error	(0.651)		Standard Error	(0.306)
Level 4	Point Estimate	0.621	Level 11	Point Estimate	2.292
	Standard Error	(1.007)		Standard Error	(0.391)
Level 5	Point Estimate	2.235	Level 12	Point Estimate	5.614
	Standard Error	(0.625)		Standard Error	(1.218)
Level 6	Point Estimate	0.317	Level 13	Point Estimate	1.420
	Standard Error	(0.163)		Standard Error	(0.202)
Level 7	Point Estimate	0.791			
	Standard Error	(0.347)			

1. Standard errors are calculated by 1000 iteration bootstrap.

K.3 Fine Motor Skills

K.3.1 Model with common scale

Table K.19: Determinants of Initial Conditions and Maturation Effects
Fine Motor Skill (Scalar Model)

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	0.067
	Standard Error	(0.014)
Father's years of education	Point Estimate	0.035
	Standard Error	(0.002)
Mother's years of education	Point Estimate	0.049
	Standard Error	(1.40e-4)
Grandmother's years of education	Point Estimate	0.072
	Standard Error	(0.002)
Monthly age of enrollment to the program	Point Estimate	0.037
	Standard Error	(0.014)
Constant	Point Estimate	0.206
	Standard Error	(0.047)
Variance of Shock	Point Estimate	2.087
	Standard Error	(0.011)
Maturation Effects		
Child's Age: Month	Point Estimate	-9.414e-5
	Standard Error	(2.133e-4)
Child's Age: Week	Point Estimate	-1.807e-4
	Standard Error	(2.740e-4)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. If the child is 8 months and 3 weeks old, the values for Child's Age: Month, and Age Child's week are 8 and 3, respectively.

Table K.20: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level Fine Motor Skill (Scalar Model)

Level 2	Point Estimate	1.004
	Standard Error	(0.011)
Level 3	Point Estimate	3.238
	Standard Error	(0.568)
Level 4	Point Estimate	3.304
	Standard Error	(0.568)
Level 5	Point Estimate	4.993
	Standard Error	(0.613)
Level 6	Point Estimate	21.789
	Standard Error	(3.972)
Level 7	Point Estimate	53.818
	Standard Error	(7.751)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Level 1 value is normalized to 1.

Table K.21: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level Fine Motor Skill (Scalar Model)

Level 2	Point Estimate	2.033
	Standard Error	(0.332)
Level 3	Point Estimate	1.000
	Standard Error	(0.004)
Level 4	Point Estimate	1.000
	Standard Error	(0.004)
Level 5	Point Estimate	28.002
	Standard Error	(18.843)
Level 6	Point Estimate	16.359
	Standard Error	(27.517)
Level 7	Point Estimate	172.202
	Standard Error	(281.399)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Level 1 variance is normalized to 1.

Table K.22: Learning Component ($\delta_k \eta(X)$)
Fine Motor Skill (Scalar Model)

η			δ_k	
Interaction quality:	Point Estimate	0.026	Level 3	2.619
Home visitor and caregiver	Standard Error	(0.023)		(0.126)
Interaction quality:	Point Estimate	0.039	Level 4	4.000
Home visitor and child	Standard Error	(0.018)		(0.002)
Teaching ability	Point Estimate	1.50e-4	Level 5	2.000
	Standard Error	(0.012)		(0.004)
Grandmother rearing	Point Estimate	–0.007	Level 6	3.899
	Standard Error	(0.011)		(0.067)
Male	Point Estimate	0.164	Level 7	3.318
	Standard Error	(0.033)		(0.100)
Constant	Point Estimate	–5.849		
	Standard Error	(0.603)		
Variance of learning ability shock (σ^2_ω)	Point Estimate	1.015		
	Standard Error	(0.004)		

1. Standard errors are calculated by 1000 iteration bootstrap.

2. Since the number of tasks at level 1 and 2 are less than 3, we normalize the values of δ_k to 1.

3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

K.3.2 Model without common scale

Table K.23: Determinants of Initial Conditions and Maturation Effects
Fine Motor Skill (Scalar Model)

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	0.067
	Standard Error	(0.021)
Father's years of education	Point Estimate	0.035
	Standard Error	(0.004)
Mother's years of education	Point Estimate	0.049
	Standard Error	(2.90e-4)
Grandmother's years of education	Point Estimate	0.072
	Standard Error	(0.004)
Monthly age of enrollment to the program	Point Estimate	0.037
	Standard Error	(0.013)
Constant	Point Estimate	0.206
	Standard Error	(0.060)
Variance of Shock	Point Estimate	2.087
	Standard Error	(0.024)
Maturation Effects		
Child's Age: Month	Point Estimate	-1.820e-4
	Standard Error	(0.006)
Child's Age: Week	Point Estimate	-4.352e-5
	Standard Error	(0.012)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. If the child is 8 months and 3 three weeks old, the values for Child's Age: Month, and Child's Age: Week are 8 and 3, respectively.

Table K.24: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level Fine Motor Skill (Scalar Model)

Level 2	Point Estimate	1.004
	Standard Error	(0.012)
Level 3	Point Estimate	3.238
	Standard Error	(0.729)
Level 4	Point Estimate	3.307
	Standard Error	(0.731)
Level 5	Point Estimate	4.998
	Standard Error	(0.865)
Level 6	Point Estimate	21.814
	Standard Error	(4.912)
Level 7	Point Estimate	57.883
	Standard Error	(15.155)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Level 1 value is normalized to 1.

Table K.25: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level Fine Motor Skill (Scalar Model)

Level 2	Point Estimate	2.034
	Standard Error	(0.371)
Level 3	Point Estimate	1.000
	Standard Error	(0.004)
Level 4	Point Estimate	1.000
	Standard Error	(0.004)
Level 5	Point Estimate	28.039
	Standard Error	(28.111)
Level 6	Point Estimate	16.381
	Standard Error	(32.714)
Level 7	Point Estimate	170.883
	Standard Error	(247.758)

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Level 1 variance is normalized to 1.

Table K.26: Learning Component ($\delta_k \eta(X)$)
Fine Motor Skill (Scalar Model)

η			δ_k	
Interaction quality:	Point Estimate	0.026	Level 3	2.619
Home visitor and caregiver	Standard Error	(0.013)		(0.197)
Interaction quality:	Point Estimate	0.039	Level 4	4.000
Home visitor and child	Standard Error	(0.029)		(0.027)
Teaching ability	Point Estimate	1.50e-4	Level 5	2.000
	Standard Error	(0.012)		(0.004)
Grandmother rearing	Point Estimate	–0.007	Level 6	3.932
	Standard Error	(0.011)		(0.156)
Male	Point Estimate	0.164	Level 7	3.319
	Standard Error	(0.050)		(0.182)
Constant	Point Estimate	–5.850		
	Standard Error	(31.366)		
Variance of learning ability shock (σ_ω^2)	Point Estimate	1.015		
	Standard Error	(0.007)		

1. Standard errors are calculated by 1000 iteration bootstrap.
2. Since the number of tasks at level 1, 3, 4, 9, and 13 are less than 3, we normalize the values of δ_k to 1.
3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

Table K.27: Transformation Function
Fine Motor Skill (Scalar Model)

		$\gamma_{k,\ell}$
Level 1	Point Estimate	1.365
	Standard Error	(0.307)
Level 2	Point Estimate	1.005
	Standard Error	(0.520)
Level 3	Point Estimate	0.963
	Standard Error	(0.252)
Level 4	Point Estimate	1.446
	Standard Error	(0.507)
Level 5	Point Estimate	0.798
	Standard Error	(0.238)
Level 6	Point Estimate	0.748
	Standard Error	(0.223)
Level 7	Point Estimate	0.955
	Standard Error	(0.243)

1. Standard errors are calculated by 1000 iteration bootstrap.

Table K.28: Common Scale Hypothesis Tests by Levels (Scalar Model)

	Language			Cognitive			Fine Motor		
	Slope($\gamma_{1,\ell}$)	$\chi^2(1)$	p-value	Slope($\gamma_{1,\ell}$)	$\chi^2(1)$	p-value	Slope($\gamma_{1,\ell}$)	$\chi^2(1)$	p-value
Level 2				0.929	0.012	0.914	1.005	0.000	0.992
Level 3	0.901	0.546	0.460	0.936	0.010	0.922	0.963	0.022	0.883
Level 4	0.645	20.193	0.000	0.621	0.142	0.707	1.446	0.774	0.379
Level 5	0.66	9.382	0.002	2.235	3.899	0.048	0.798	0.720	0.396
Level 6	1.522	5.063	0.024	0.317	17.482	0.000	0.748	1.277	0.258
Level 7	1.125	0.182	0.670	0.791	0.362	0.547	0.955	0.034	0.853
Level 8	0.562	8.195	0.004	1.893	4.237	0.040			
Level 9	1.113	0.113	0.737	0.744	3.432	0.064			
Level 10	1.006	0.001	0.970	2.068	12.211	0.000			
Level 11	1.223	0.375	0.540	2.292	10.927	0.001			
Level 12				5.614	14.351	0.000			
Level 13				1.420	4.333	0.037			
Total		44.051	0.000		71.398	0.000		2.827	0.830

1. For each level we test the null hypothesis that $\gamma_{1,\ell}$=1 .
2. The column of p-value reports the probability of not rejecting the null hypothesis.
3. The row "Total" tests whether the common scale assumption is valid across all the levels.
4. Our data for language tasks starts from level 2.

L Model for Joint Skills

L.1 Vector Model

We next consider the model which allows different skills to evolve jointly:

$$\ln \boldsymbol{K}(a) = \boldsymbol{A'} \ln \boldsymbol{K}(a-1) + \boldsymbol{B'\delta}(a)\eta + \boldsymbol{C'V}(\boldsymbol{Q(a)}) + \boldsymbol{\varepsilon}(a). \tag{L.1}$$

When we impose the assumption of common scale for skills, Equation (L.1) can be written:

$$\begin{bmatrix} \ln K^{\ell}(a) \\ \ln K^{c}(a) \\ \ln K^{f}(a) \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} \ln K^{\ell}(a-1) \\ \ln K^{c}(a-1) \\ \ln K^{f}(a-1) \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} \delta^{\ell}(a)\eta & 0 & 0 \\ 0 & \delta^{c}(a)\eta & 0 \\ 0 & 0 & \delta^{f}(a)\eta \end{bmatrix} +$$
$$\begin{bmatrix} c_{11} & 0 & 0 \\ 0 & c_{22} & 0 \\ 0 & 0 & c_{33} \end{bmatrix} \begin{bmatrix} V^{\ell}(\boldsymbol{Q(a)}) & 0 & 0 \\ 0 & V^{c}(\boldsymbol{Q(a)}) & 0 \\ 0 & 0 & V^{f}(\boldsymbol{Q(a)}) \end{bmatrix} + \begin{bmatrix} \varepsilon^{\ell}(a) \\ \varepsilon^{c}(a) \\ \varepsilon^{f}(a) \end{bmatrix}$$

where $\ln K^{\ell}(a)$ denotes the latent language skill at age a, $\ln K^{c}(a)$ and $\ln K^{f}(a)$ denotes the cognitive and fine motor latent skills respectively at age a. Notice that the investment components $\delta^{j}(a)$ is age and task-specific, which means if the task is a fine motor task, the investment for language and cognitive skill is zero (i.e., $\delta^{\ell}(a) = \delta^{c}(a) = 0$).

The above equation system is the case if we impose common scale assumption across all skill types. We first present the model for the case without imposing the common scale assumption using language as an example, and the logic is the same for cognitive and fine motor skills. We track the task difficulty levels from the language task at age a to the next language task at age $a+1$ and examine whether the difficulty level changes from m to $m+1$ for the same type of skill. Therefore, the system will be written as follows:

$$\begin{bmatrix} \ln K^{\ell}(a) \\ \ln K^{c}(a) \\ \ln K^{f}(a) \end{bmatrix} = \left(\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \right) \begin{bmatrix} \gamma_0^m + \gamma_1^m \ln K^{\ell}(a-1) \\ \ln K^{c}(a-1) \\ \ln K^{f}(a-1) \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} \delta^{\ell}(a)\eta & 0 & 0 \\ 0 & \delta^{c}(a)\eta & 0 \\ 0 & 0 & \delta^{f}(a)\eta \end{bmatrix} + \begin{bmatrix} c_{11} & 0 & 0 \\ 0 & c_{22} & 0 \\ 0 & 0 & c_{33} \end{bmatrix} \begin{bmatrix} V^{\ell}(\boldsymbol{Q}(\boldsymbol{a})) & 0 & 0 \\ 0 & V^{c}(\boldsymbol{Q}(\boldsymbol{a})) & 0 \\ 0 & 0 & V^{f}(\boldsymbol{Q}(\boldsymbol{a})) \end{bmatrix} + \begin{bmatrix} \varepsilon^{\ell}(a) \\ \varepsilon^{c}(a) \\ \varepsilon^{f}(a) \end{bmatrix}$$

Similarly, for cognitive skills, from cognitive skill at age a to the next cognitive task at age $a+1$, the cognitive skill difficulty level changes from n to $n+1$, then we have:

$$\begin{bmatrix} \ln K^{\ell}(a) \\ \ln K^{c}(a) \\ \ln K^{f}(a) \end{bmatrix} = \left(\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \right) \begin{bmatrix} \ln K^{\ell}(a-1) \\ \gamma_0^n + \gamma_1^n \ln K^{c}(a-1) \\ \ln K^{f}(a-1) \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} \delta^{\ell}(a)\eta & 0 & 0 \\ 0 & \delta^{c}(a)\eta & 0 \\ 0 & 0 & \delta^{f}(a)\eta \end{bmatrix} + \begin{bmatrix} c_{11} & 0 & 0 \\ 0 & c_{22} & 0 \\ 0 & 0 & c_{33} \end{bmatrix} \begin{bmatrix} V^{\ell}(\boldsymbol{Q}(\boldsymbol{a})) & 0 & 0 \\ 0 & V^{c}(\boldsymbol{Q}(\boldsymbol{a})) & 0 \\ 0 & 0 & V^{f}(\boldsymbol{Q}(\boldsymbol{a})) \end{bmatrix} + \begin{bmatrix} \varepsilon^{\ell}(a) \\ \varepsilon^{c}(a) \\ \varepsilon^{f}(a) \end{bmatrix}$$

Similarly, if from fine motor task at age a to the next fine motor task at age $a+1$,

the fine motor skill difficulty level changes from h to $h+1$, then the system will be:

$$\begin{bmatrix} \ln K^{\ell}(a) \\ \ln K^{c}(a) \\ \ln K^{f}(a) \end{bmatrix} = \left(\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \right) \begin{bmatrix} \ln K^{\ell}(a-1) \\ \ln K^{c}(a-1) \\ \gamma_0^h + \gamma_1^h \ln K^{f}(a-1) \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} \delta^{\ell}(a)\eta & 0 & 0 \\ 0 & \delta^{c}(a)\eta & 0 \\ 0 & 0 & \delta^{f}(a)\eta \end{bmatrix} +$$
$$\begin{bmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{bmatrix} \begin{bmatrix} V^{\ell}(\boldsymbol{Q}(\boldsymbol{a})) & 0 & 0 \\ 0 & V^{c}(\boldsymbol{Q}(\boldsymbol{a})) & 0 \\ 0 & 0 & V^{f}(\boldsymbol{Q}(\boldsymbol{a})) \end{bmatrix} + \begin{bmatrix} \varepsilon^{\ell}(a) \\ \varepsilon^{c}(a) \\ \varepsilon^{f}(a) \end{bmatrix}$$

L.2 Identification of the Model for Joint Skills

We draw on the identification analysis for scalar skill presented in Appendix H. We have the following key assumption in addition to those given in Appendix H.

Assumption L.1. $\boldsymbol{\varepsilon(a)}$ *is independent across* ℓ *for the same* s*, independent across* a *for the same* ℓ *and* s *and independent across* s*. (The second assumption repeats the assumption in Appendix H.*

Assumption L.2. *All of the elements of* $\boldsymbol{\delta(a)}$*, the vector of investments across skills are independent by the design of the experiment.*

Assumption L.3. $\sigma(s, 1, 1) = 1$ *all* $s \in \mathcal{S}$*.*

The model of Equation (L.1) can be written as a simultaneous equations latent probit model as analyzed in Heckman (1978), Case 1. Adopting the normalizations in Assumption (L.3) we obtain a latent variable simultaneous equations system. Assumption (L.2) guarantees the exogeneity of all investments with respect to $\boldsymbol{\varepsilon(a)}$ for all a and s and ℓ.

Application of Assumption (L.1) and the row transformation theorem of Fisher (1966) shows that the model is identified because any other linear combination of (L.1) would lead to violations of that assumption–specifically the $\boldsymbol{\varepsilon(a)}$ obtained from any such linear combination would not be independent across equations as required in the initial specification. Accordingly, the model is identified.

L.3 Estimation: Moment Fit

Contents

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Table L.1: Moments Used in Estimation (Vector Model)

Moment	Number of Moments		
	Language	Cognitive	Fine Motor
All task passing rate	73	70	30
Each difficulty level task passing rate	10	13	7
Each task passing rate for newly enrolled children (≤ 1 month)	73	70	30
Each task passing rate for children enrolled in the program for > 1 month	73	70	30
Each difficulty level duration measure	10	13	7
Each difficulty level variance of duration measure	10	13	7
Each difficulty level correlation between duration and interaction measures	30	39	21
Within each level, conditional on children who can pass the jth task, the probability of passing the j'th task ($j \neq j'$)	100	82	43
Across difficulty levels, conditional on children who can pass the jth task at level ℓ, the probability of passing the j'th task at level $\ell + 1$	225	177	84
Across difficulty levels, conditional on children who can pass the jth task at level ℓ, the probability of passing the j'th task at level $\ell + 2$	200	142	79
Total	804	689	338

In summary, more than 80% of the simulated moments are in the 95% confidence intervals of data moments.

- Overall, our estimates fit the moments very well. The model without common scale has better fit.
- χ^2 test results are reported in column χ^2 of Table L.2.

Table L.2: Goodness of Fit Summary (Vector Model)

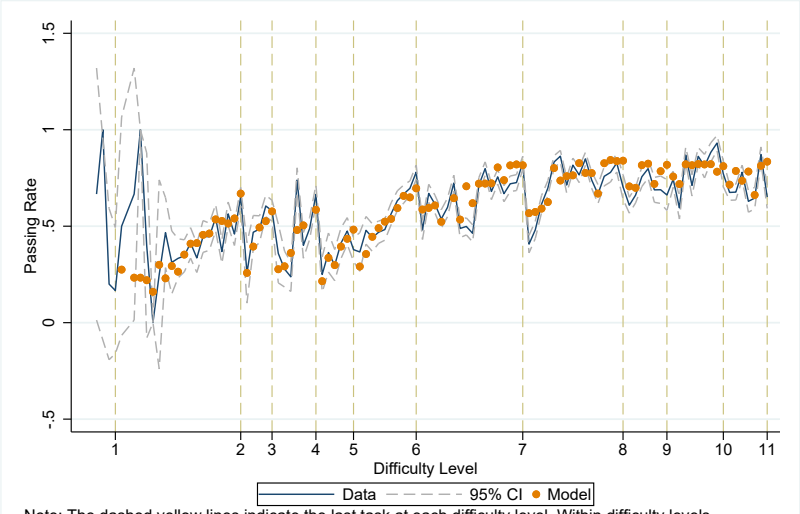
	χ^2
With common scale	25.19
Without common scale	16.07

1. For all models, we cannot reject the model at the 0.0001 level.

L.3.1 Language

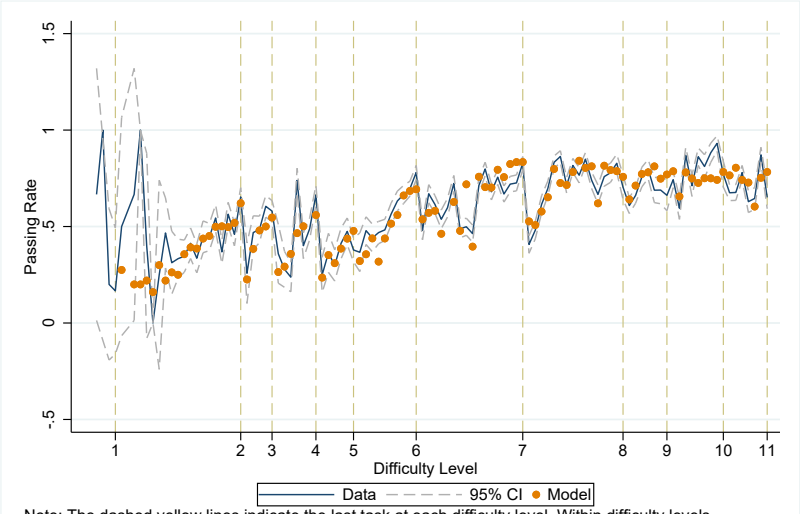
Figure L.1: Fit on All Language Tasks by Level (Vector Model)

(a) common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged by order of the children taking them.
All the children started from level 2 or above upon enrolling.

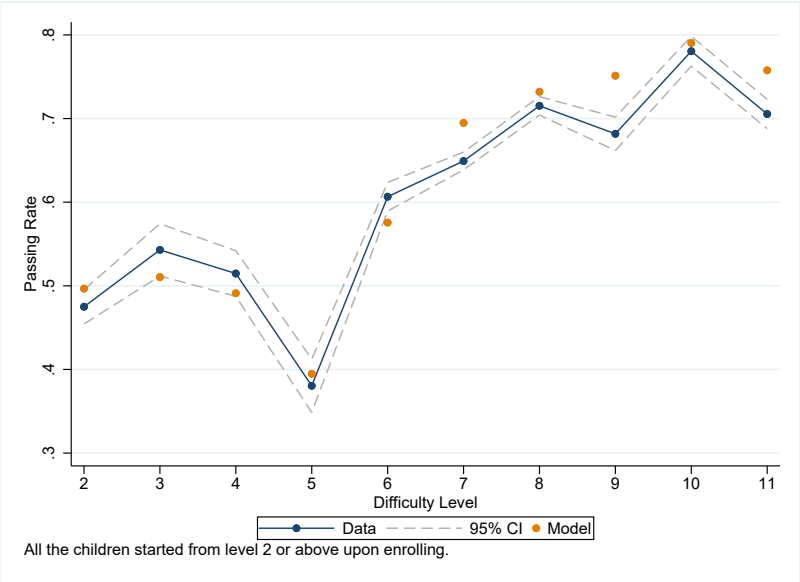
(b) w/o common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged by order of the children taking them.
All the children started from level 2 or above upon enrolling.

Figure L.2: Fit on Average Passing Rate by Level (Language (Vector Model))

(a) common scale



(b) w/o common scale

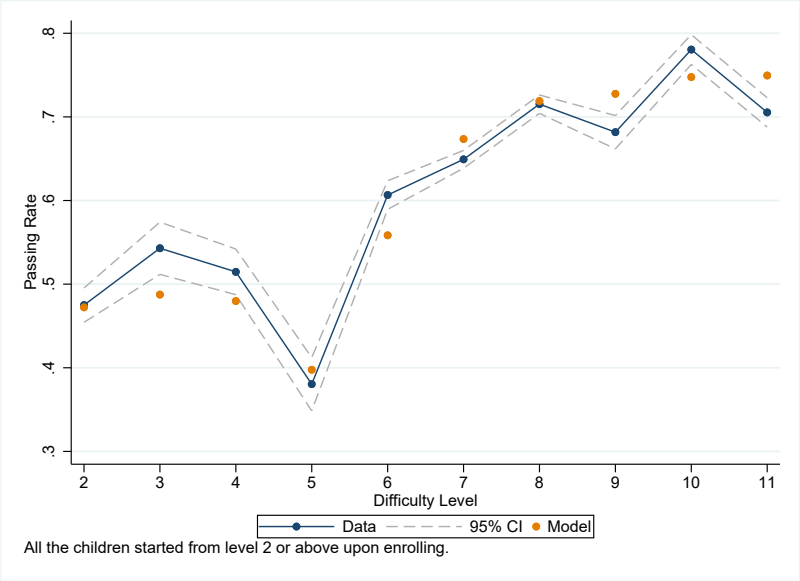
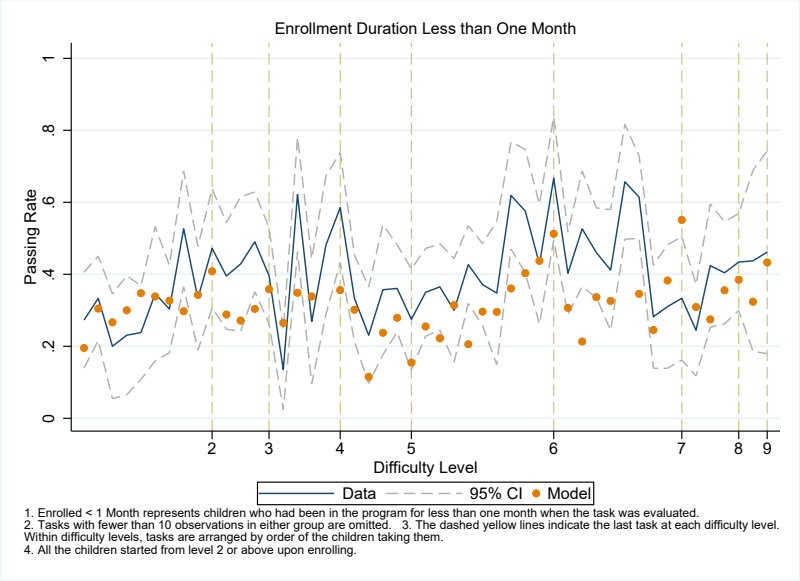


Figure L.3: Fit by Length of Enrollment: Newly Enrolled Group (Language (Vector Model))

(a) common scale



(b) w/o common scale

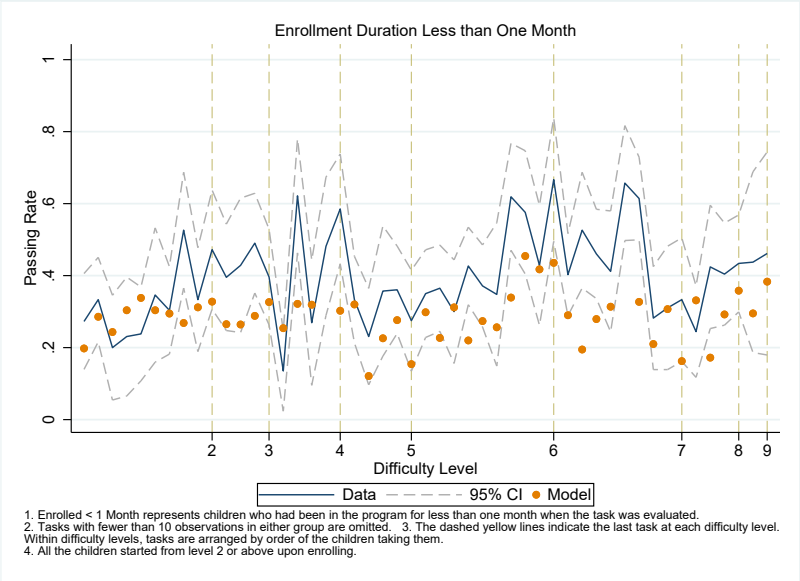
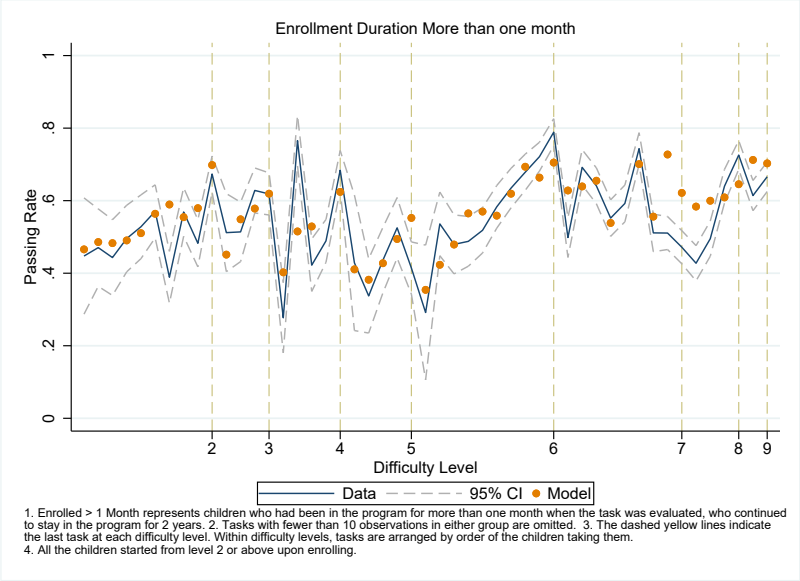


Figure L.4: Fit by Length of Enrollment: Group Enrolled > 1 Month (Language (Vector Model))

(a) common scale



(b) w/o common scale

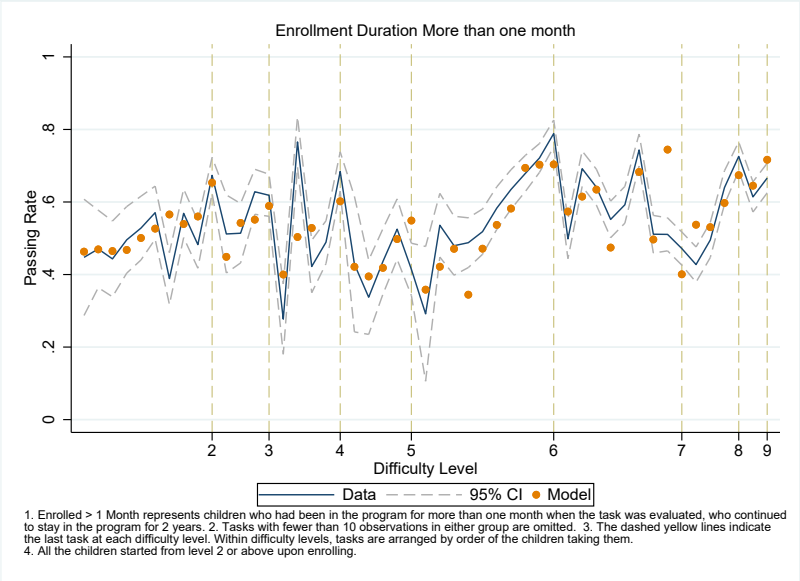
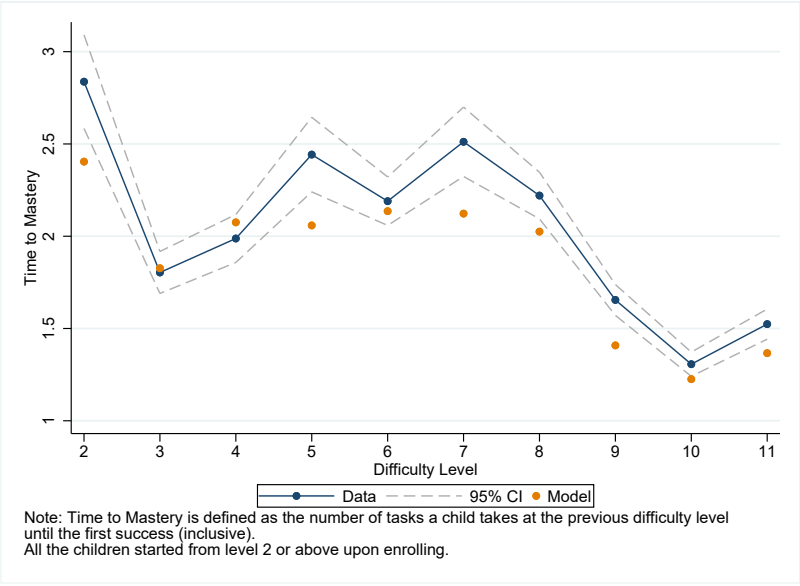
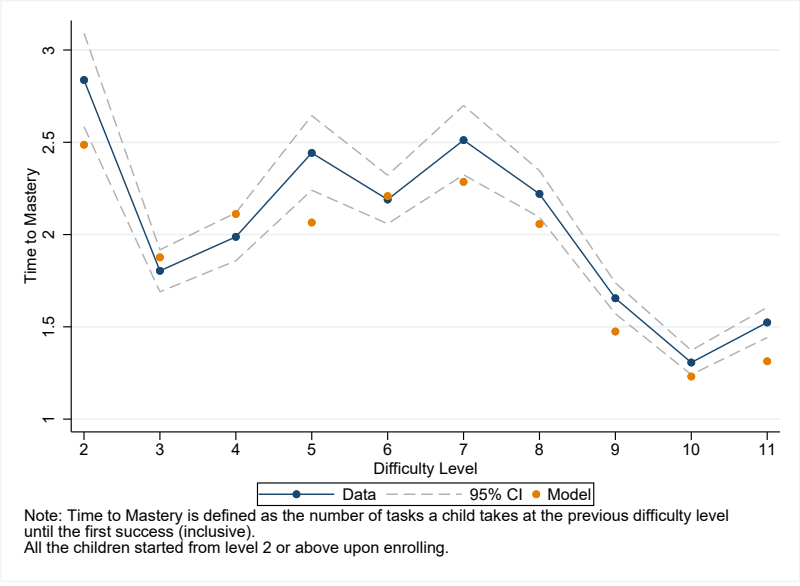


Figure L.5: Fit on Time to Mastery by Level (Language (Vector Model))

(a) common scale



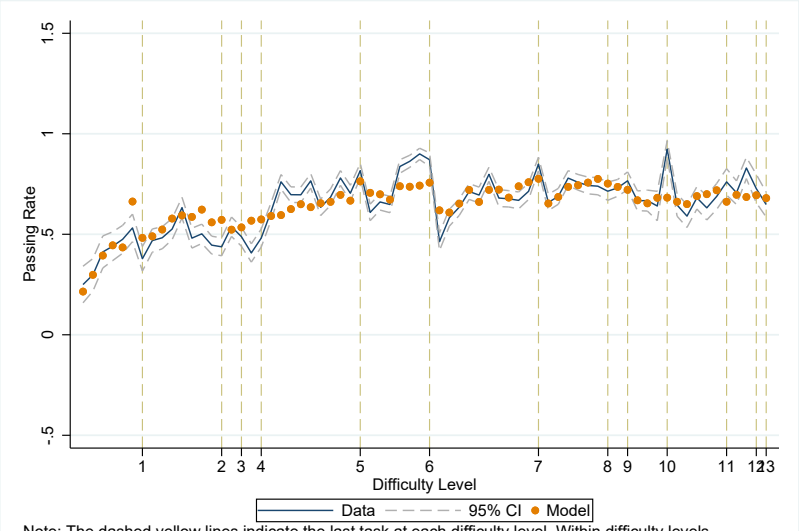
(b) w/o common scale



L.3.2 Cognition

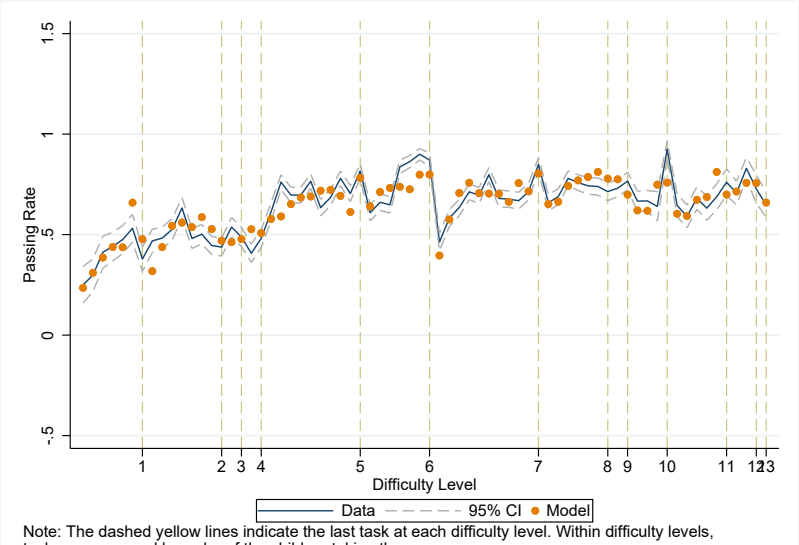
Figure L.6: Fit on All Cognitive Tasks by Level (Vector Model)

(a) common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged by order of the children taking them.

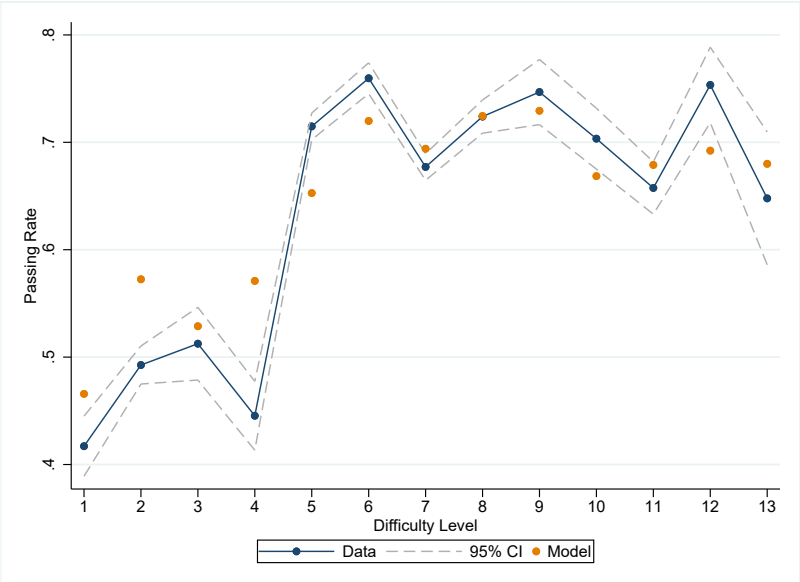
(b) w/o common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged by order of the children taking them.

Figure L.7: Fit on Average Passing Rate by Level (Cognitive (Vector Model))

(a) common scale



(b) w/o common scale

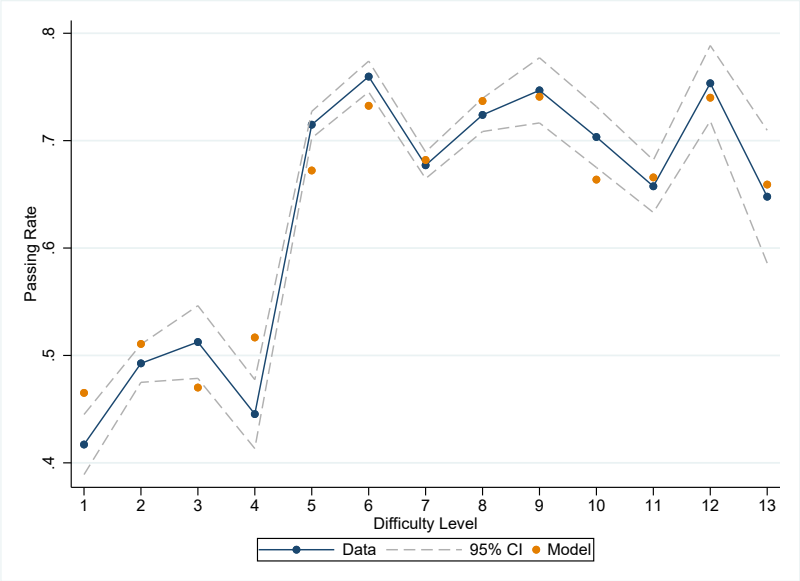
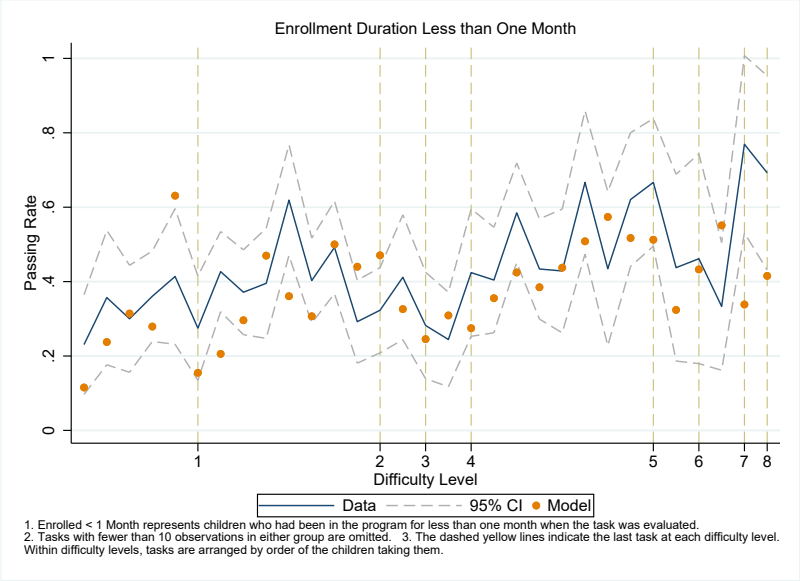


Figure L.8: Fit by Length of Enrollment: Newly Enrolled Group (Cognitive (Vector Model))

(a) common scale



(b) w/o common scale

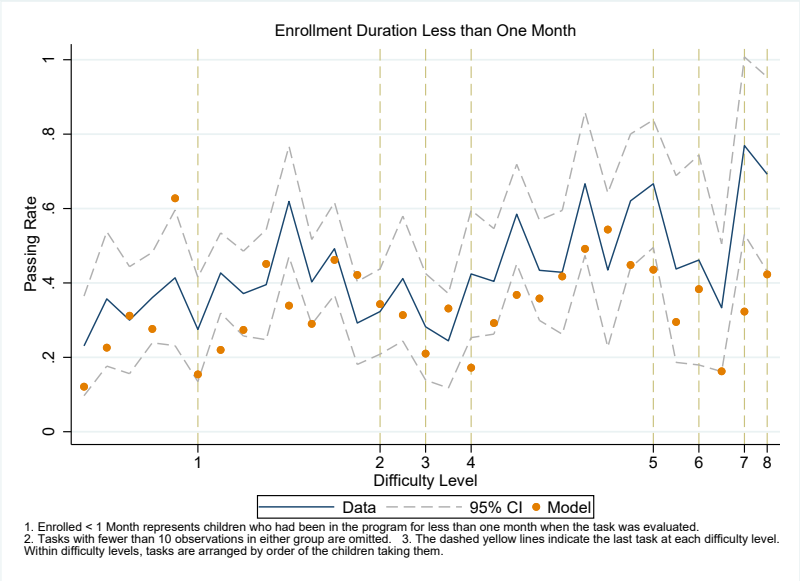
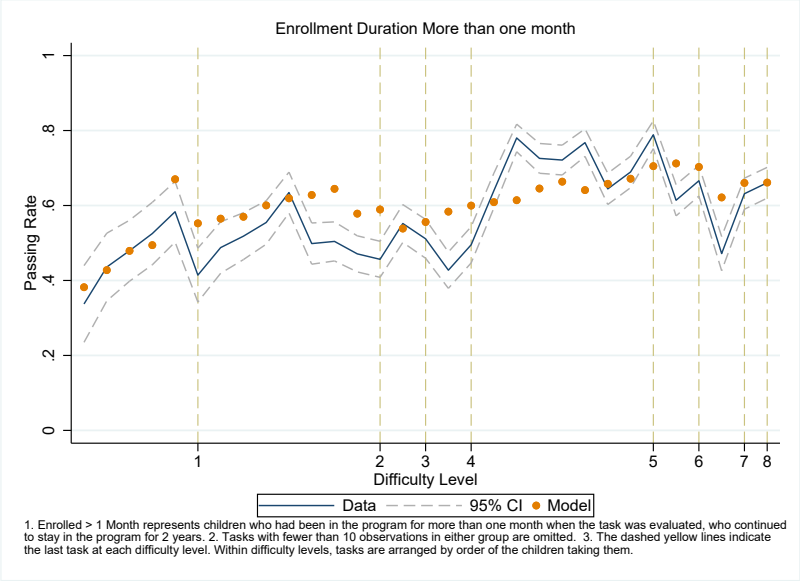


Figure L.9: Fit by Length of Enrollment: Group Enrolled > 1 Month (Cognitive (Vector Model))

(a) common scale



(b) w/o common scale

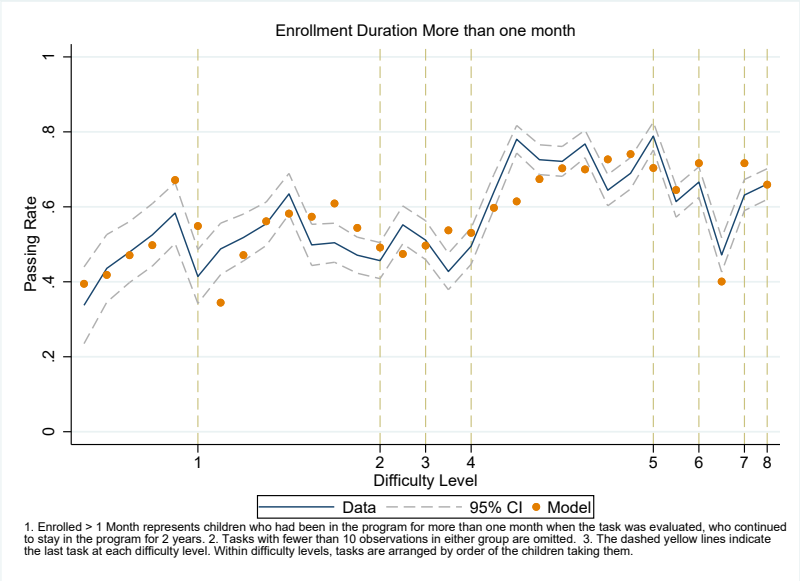
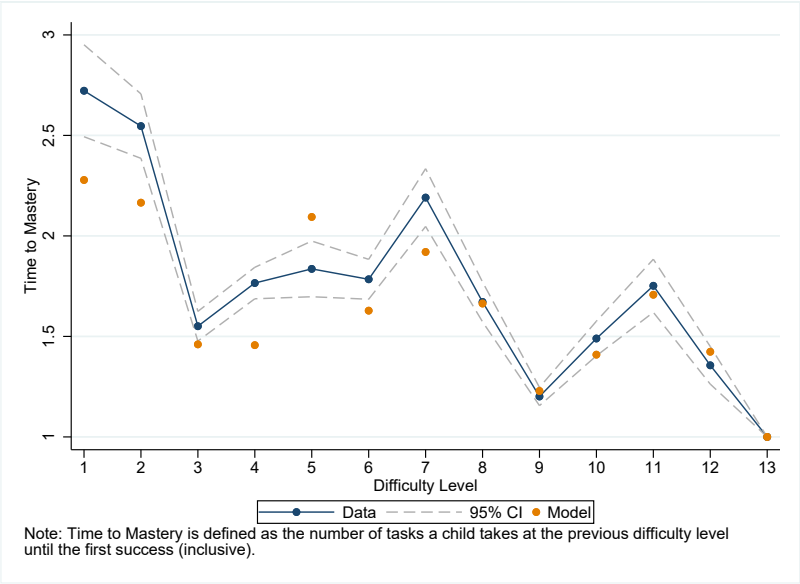
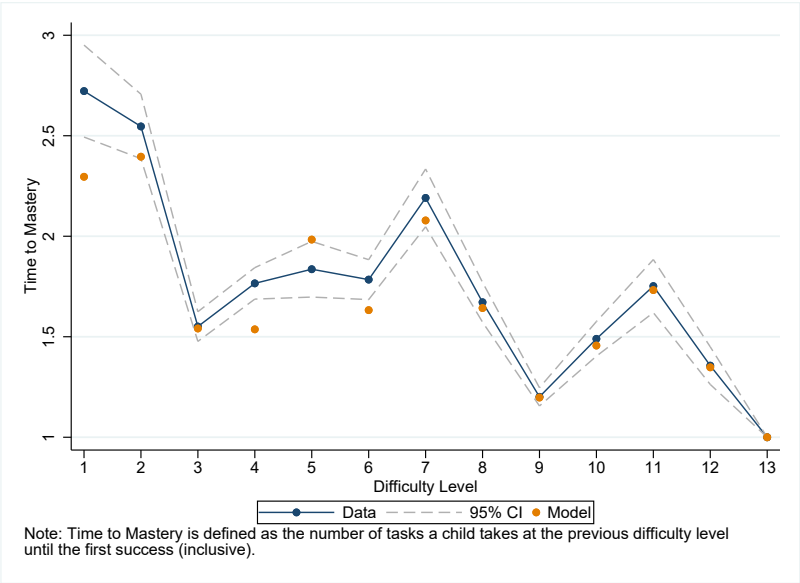


Figure L.10: Fit on Time to Mastery by Level (Cognitive (Vector Model))

(a) common scale



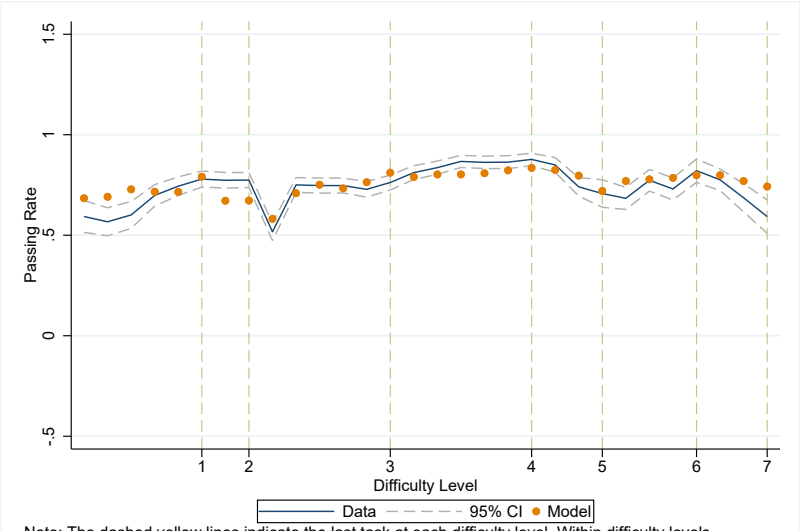
(b) w/o common scale



L.3.3 Fine Motor

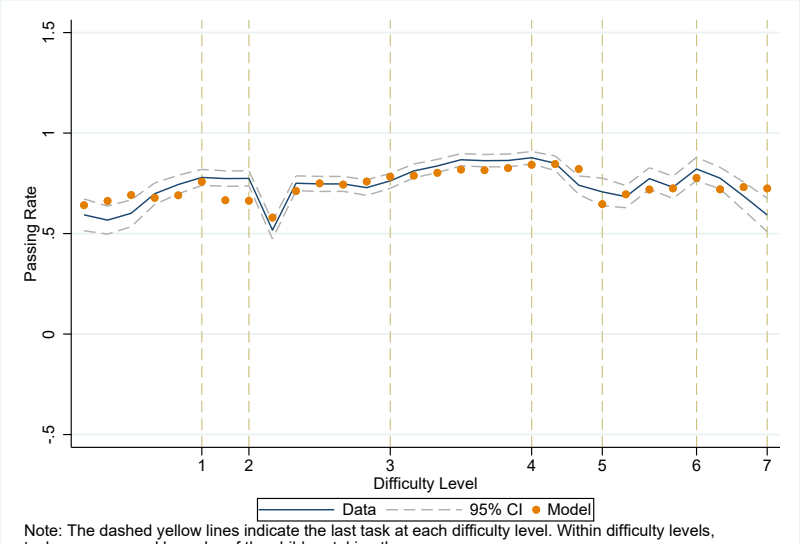
Figure L.11: Fit on All Fine Motor Tasks by Level (Vector Model)

(a) common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged by order of the children taking them.

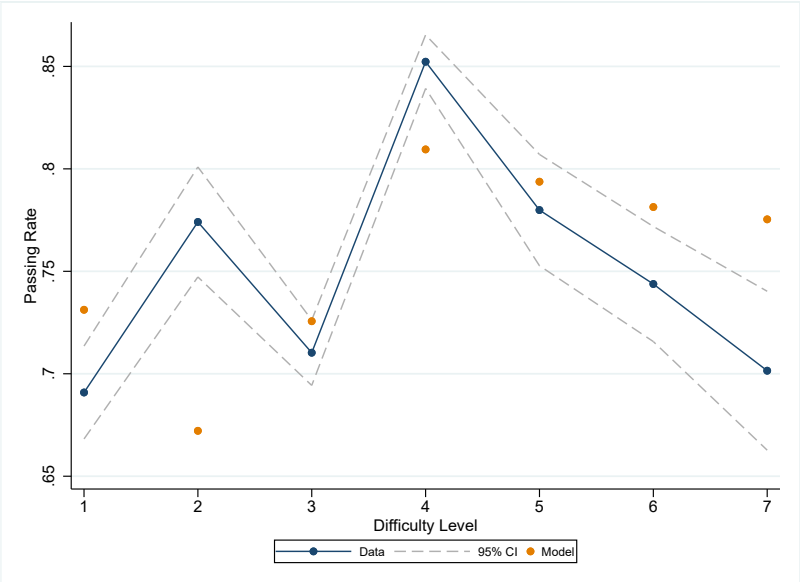
(b) w/o common scale



Note: The dashed yellow lines indicate the last task at each difficulty level. Within difficulty levels, tasks are arranged by order of the children taking them.

Figure L.12: Fit on Average Passing Rate by Level (Fine Motor (Vector Model))

(a) common scale



(b) w/o common scale

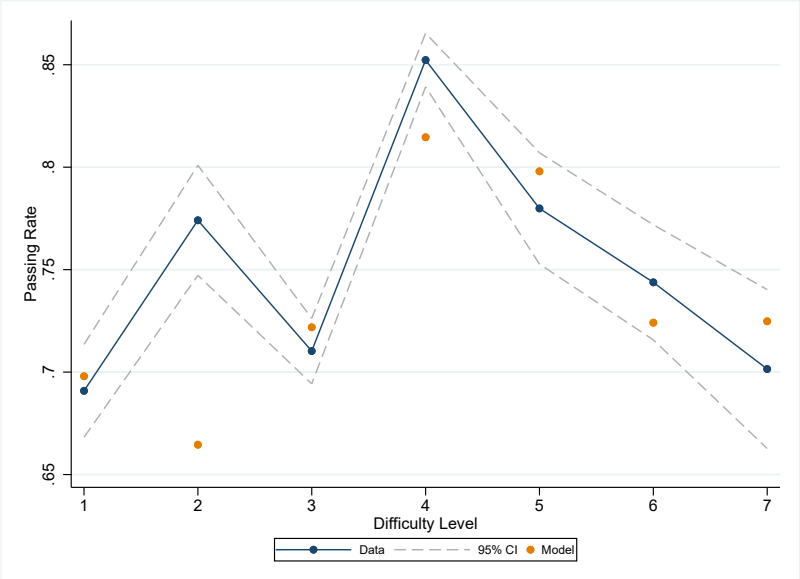
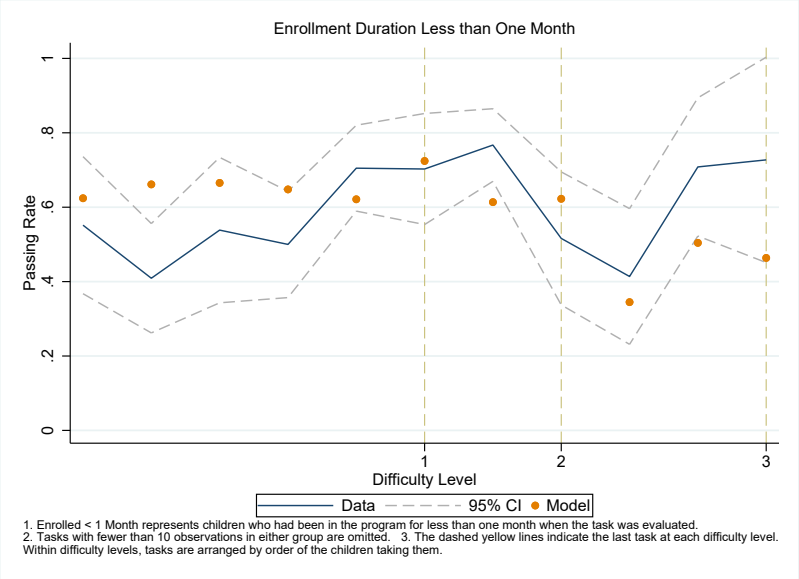


Figure L.13: Fit by Length of Enrollment: Newly Enrolled Group (Fine Motor (Vector Model))

(a) common scale



(b) w/o common scale

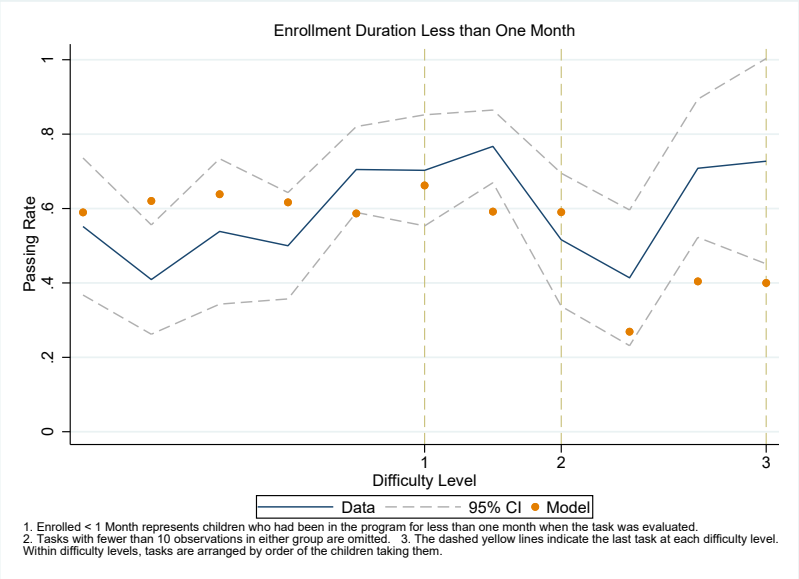
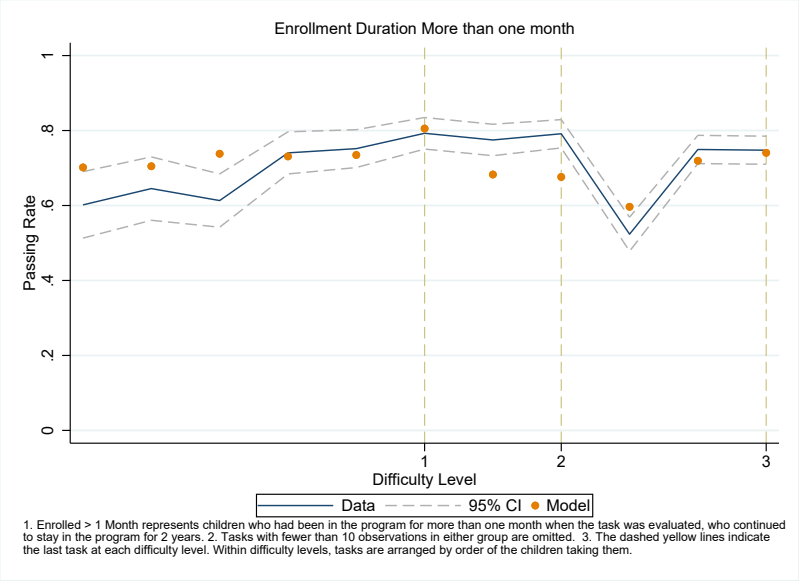


Figure L.14: Fit by Length of Enrollment: Group Enrolled > 1 Month (Fine Motor (Vector Model))

(a) common scale



(b) w/o common scale

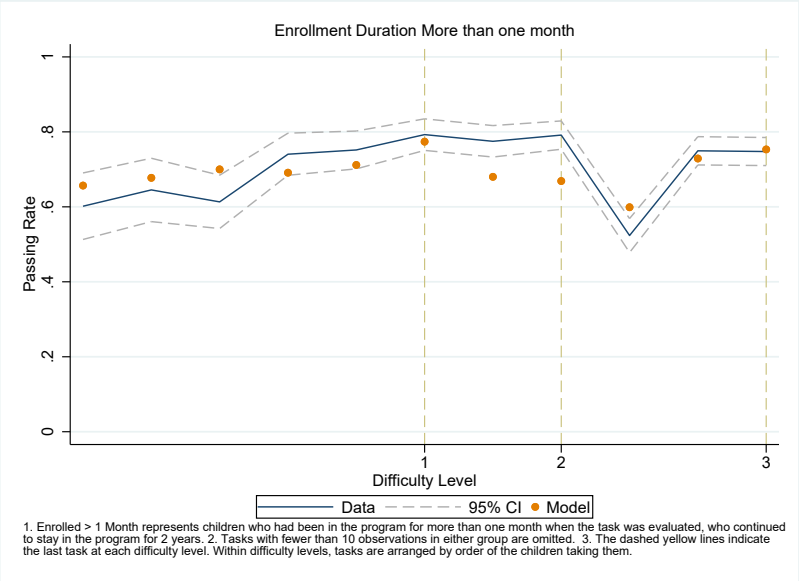
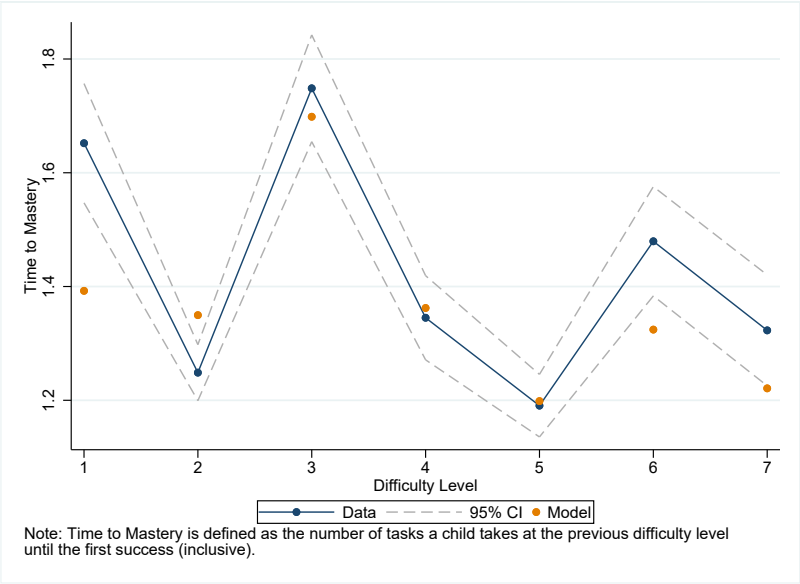
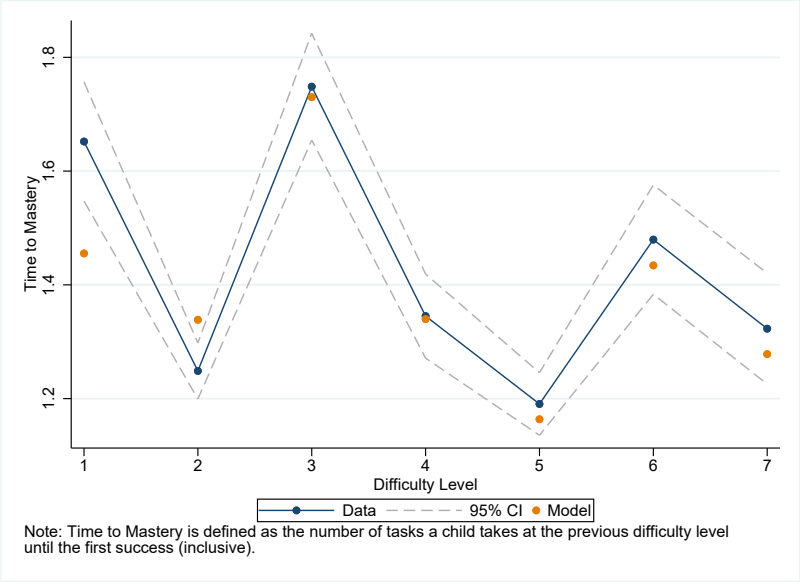


Figure L.15: Fit on Time to Mastery by Level (Fine Motor (Vector Model))

(a) common scale



(b) w/o common scale



L.4 Point Estimates of the Vector Model

From Table L.3, we find that cognitive skill will benefits both language and fine motor skill development in the next period. Cognitive and language skill will benefit fine motor skill development but fine motor skill itself cannot benefit language nor cognitive skill development.

Table L.3: Estimates of the Skill Transition Matrix

$A_{Lang-Lang}$	Point Estimate	0.933***	$A_{Lang-Cog}$	Point Estimate	0.002	$A_{Lang-Fine}$	Point Estimate	0.015**
	Standard Error	(0.085)		Standard Error	(0.009)		Standard Error	(0.007)
	Confidence Interval	[0.856,1.002]		Confidence Interval	[-0.008,0.013]		Confidence Interval	[0.003,0.023]
$A_{Cog-Lang}$	Point Estimate	0.050***	$A_{Cog-Cog}$	Point Estimate	0.994***	$A_{Cog-Fine}$	Point Estimate	0.038***
	Standard Error	(0.028)		Standard Error	(4.478)		Standard Error	(0.009)
	Confidence Interval	[0.035,0.122]		Confidence Interval	[0.890,1.121]		Confidence Interval	[0.030,0.050]
$A_{Fine-Lang}$	Point Estimate	-0.001	$A_{Fine-Cog}$	Point Estimate	-0.001	$A_{Fine-Fine}$	Point Estimate	1.028***
	Standard Error	(0.007)		Standard Error	(0.015)		Standard Error	(5.287)
	Confidence Interval	[-0.011,0.009]		Confidence Interval	[-0.011,0.031]		Confidence Interval	[0.688,1.161]

1. Standard errors are calculated by 500 iteration bootstrap.
2. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table L.4: Estimates of the Investment Transition Matrix

$B_{Lang-Lang}$	Point Estimate	0.363***	$B_{Lang-Cog}$	Point Estimate	0.001	$B_{Lang-Fine}$	Point Estimate	0.014***
	Standard Error	(0.035)		Standard Error	(0.006)		Standard Error	(0.006)
	Confidence Interval	[0.324,0.465]		Confidence Interval	[-0.009,0.011]		Confidence Interval	[0.002,0.021]
$B_{Cog-Lang}$	Point Estimate	-0.001	$B_{Cog-Cog}$	Point Estimate	1.295***	$B_{Cog-Fine}$	Point Estimate	0.015***
	Standard Error	(0.006)		Standard Error	(0.134)		Standard Error	(0.006)
	Confidence Interval	[-0.010,0.009]		Confidence Interval	[1.133,1.690]		Confidence Interval	[0.005,0.024]
$B_{Fine-Lang}$	Point Estimate	-0.002	$B_{Fine-Cog}$	Point Estimate	-0.000	$B_{Fine-Fine}$	Point Estimate	1.812***
	Standard Error	(0.007)		Standard Error	(0.006)		Standard Error	(0.113)
	Confidence Interval	[-0.012,0.008]		Confidence Interval	[-0.010,0.009]		Confidence Interval	[1.662,2.089]

1. Standard errors are calculated by 500 iteration bootstrap.
2. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

L.4.1 Language Skills

Model with common scale

Table L.5: Determinants of Initial Conditions and Maturation Effects (Language (Vector Model))

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	-0.000
	Standard Error	(0.104)
Father‘s years of education	Point Estimate	0.062
	Standard Error	(0.000)
Mother’s years of education	Point Estimate	0.058
	Standard Error	(0.000)
Grandmother’s years of education	Point Estimate	0.050
	Standard Error	(0.000)
Monthly age of enrollement to the program	Point Estimate	-0.004
	Standard Error	(0.007)
Constant	Point Estimate	-15.996
	Standard Error	(4.423)
Variance of Shock	Point Estimate	3.350
	Standard Error	(0.045)
Maturation Effects		
Child’s Month	Point Estimate	-0.001
	Standard Error	(0.010)
Child’s Week	Point Estimate	-0.000
	Standard Error	(0.012)

1. Standard errors are calculated by 500 iteration bootstrap.
2. If the child is 8 months and 3 weeks old, the values for Child’s Age: Month, and Child’s Age: Week are 8 and 3, respectively.

Table L.6: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level (Language (Vector Model))

Level 3	Point Estimate	1.292	Level 8	Point Estimate	5.365
	Standard Error	(0.022)		Standard Error	(0.213)
Level 4	Point Estimate	2.013	Level 9	Point Estimate	9.449
	Standard Error	(0.054)		Standard Error	(0.276)
Level 5	Point Estimate	2.474	Level 10	Point Estimate	68.623
	Standard Error	(0.061)		Standard Error	(1.854)
Level 6	Point Estimate	3.274	Level 11	Point Estimate	74.707
	Standard Error	(0.075)		Standard Error	(1.902)
Level 7	Point Estimate	3.934			
	Standard Error	(0.080)			

1. Standard errors are calculated by 500 iteration bootstrap.
2. All children started from level 2 or above upon enrolling.
3. Level 2 value is normalized to 1.

Table L.7: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level (Language (Vector Model))

Level 3	Point Estimate	0.995	Level 8	Point Estimate	16.508
	Standard Error	(0.009)		Standard Error	(13.713)
Level 4	Point Estimate	1.459	Level 9	Point Estimate	1.000
	Standard Error	(0.040)		Standard Error	(0.011)
Level 5	Point Estimate	0.998	Level 10	Point Estimate	0.999
	Standard Error	(0.017)		Standard Error	(0.033)
Level 6	Point Estimate	2.531	Level 11	Point Estimate	110.123
	Standard Error	(0.284)		Standard Error	(169.723)
Level 7	Point Estimate	0.999			
	Standard Error	(0.022)			

1. Standard errors are calculated by 500 iteration bootstrap.
2. All children started from level 2 or above upon enrolling.
3. Level 2 variance is normalized to 1.

Table L.8: Learning Component ($\delta_k \eta(X)$)
(Language (Vector Model))

	η			δ_k		
Interaction quality:	Point Estimate	4.504	Level 3	3.068	Level 10	2.998
Home Visitor and Caregiver	Standard Error	(0.591)		(0.003)		(0.002)
Interaction quality:	Point Estimate	0.384	Level 4	3.085	Level 11	2.999
Home Visitor and Child	Standard Error	(0.026)		(0.003)		(0.004)
Teaching ability	Point Estimate	0.438	Level 5	0.378		
	Standard Error	(0.022)		(0.082)		
Grandmother Rearing	Point Estimate	-0.100	Level 6	3.162		
	Standard Error	(0.007)		(0.005)		
Male	Point Estimate	-0.052	Level 7	6.000		
	Standard Error	(0.006)		(0.000)		
Constant	Point Estimate	-3.525	Level 8	6.000		
	Standard Error	(0.342)		(0.000)		
Variance of learning ability shock (η)	Point Estimate	0.964	Level 9	5.997		
	Standard Error	(0.003)		(0.002)		

1. Standard errors are calculated by 500 iteration bootstrap.

2. All children started from level 2 or above upon enrolling. δ_2 at Level 2 is normalized to 1.

3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

Model without common scale

Table L.9: Determinants of Initial Conditions and Maturation Effects (Language (Vector Model))

Male	Point Estimate	-0.000
	Standard Error	(0.010)
Father‘s years of education	Point Estimate	0.063
	Standard Error	(0.000)
Mother’s years of education	Point Estimate	0.057
	Standard Error	(0.000)
Grandmother’s years of education	Point Estimate	0.050
	Standard Error	(0.000)
Monthly age of enrollement to the program	Point Estimate	-0.004
	Standard Error	(0.005)
Constant	Point Estimate	-17.660
	Standard Error	(2.203)
Variance of Shock	Point Estimate	3.342
	Standard Error	(0.033)
Maturation Effects		
Child’s Month	Point Estimate	-0.001
	Standard Error	(0.006)
Child’s Week	Point Estimate	-0.000
	Standard Error	(0.009)

1. Standard errors are calculated by 500 iteration bootstrap.

2. If the child is 8 months and 3 weeks old, the values for Child’s Age: Month, and Child’s Age: Week are 8 and 3, respectively.

Table L.10: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level (Language (Vector Model))

Level 3	Point Estimate	1.302	Level 8	Point Estimate	5.403
	Standard Error	(0.019)		Standard Error	(0.108)
Level 4	Point Estimate	2.034	Level 9	Point Estimate	9.450
	Standard Error	(0.052)		Standard Error	(0.202)
Level 5	Point Estimate	2.493	Level 10	Point Estimate	75.001
	Standard Error	(0.061)		Standard Error	(3.165)
Level 6	Point Estimate	3.302	Level 11	Point Estimate	81.064
	Standard Error	(0.077)		Standard Error	(3.205)
Level 7	Point Estimate	3.970			
	Standard Error	(0.085)			

1. Standard errors are calculated by 500 iteration bootstrap.
2. All children started from level 2 or above upon enrolling.
3. Level 2 value is normalized to 1.

Table L.11: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level (Language (Vector Model))

Level 3	Point Estimate	0.995	Level 8	Point Estimate	11.527
	Standard Error	(0.003)		Standard Error	(26.601)
Level 4	Point Estimate	1.449	Level 9	Point Estimate	1.000
	Standard Error	(0.046)		Standard Error	(0.013)
Level 5	Point Estimate	0.998	Level 10	Point Estimate	0.999
	Standard Error	(0.020)		Standard Error	(0.008)
Level 6	Point Estimate	2.434	Level 11	Point Estimate	63.867
	Standard Error	(0.203)		Standard Error	(19.991)
Level 7	Point Estimate	0.999			
	Standard Error	(0.018)			

1. Standard errors are calculated by 500 iteration bootstrap.
2. All children started from level 2 or above upon enrolling. Level 2 variance is normalized to 1.

Table L.12: Learning Component ($\delta_k \eta(X)$)
(Language (Vector Model))

μ			δ_k			
Interaction quality:	Point Estimate	4.272	Level 3	3.069	Level 10	2.998
Home Visitor and Caregiver	Standard Error	(0.514)		(0.003)		(0.001)
Interaction quality:	Point Estimate	0.372	Level 4	3.088	Level 11	2.999
Home Visitor and Child	Standard Error	(0.023)		(0.003)		(0.007)
Teaching ability	Point Estimate	0.435	Level 5	0.382		
	Standard Error	(0.018)		(0.039)		
Grandmother Rearing	Point Estimate	-0.100	Level 6	3.161		
	Standard Error	(0.007)		(0.007)		
Male	Point Estimate	-0.053	Level 7	5.999		
	Standard Error	(0.006)		(0.000)		
Constant	Point Estimate	-6.984	Level 8	6.000		
	Standard Error	(0.695)		(0.000)		
Variance of learning ability shock (η)	Point Estimate	-6.984	Level 9	5.996		
	Standard Error	(0.695)		(0.051)		

1. Standard errors are calculated by 500 iteration bootstrap.
2. All children started from level 2 or above upon enrolling. δ_2 at Level 2 is normalized to 1.
3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

Table L.13: Transformation Functions
(Language (Vector Model))

		$\gamma_{k,l}$			$\gamma_{k,l}$
Level 2	Point Estimate	0.796	Level 7	Point Estimate	1.546
	Standard Error	(0.140)		Standard Error	(0.126)
Level 3	Point Estimate	1.748	Level 8	Point Estimate	2.007
	Standard Error	(0.272)		Standard Error	(0.270)
Level 4	Point Estimate	0.833	Level 9	Point Estimate	1.915
	Standard Error	(0.107)		Standard Error	(0.470)
Level 5	Point Estimate	1.332	Level 10	Point Estimate	1.000
	Standard Error	(0.133)		Standard Error	(0.169)
Level 6	Point Estimate	1.242	Level 11	Point Estimate	0.551
	Standard Error	(0.095)		Standard Error	(0.063)

1. Standard errors are calculated by 500 iteration bootstrap.
2. Our language task data starts from level 2.

L.4.2 Cognitive Skills

Model with common scale

Table L.14: Determinants of Initial Conditions and Maturation Effects (Cognitive (Vector Model))

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	-0.439
	Standard Error	(0.017)
Father‘s years of education	Point Estimate	0.058
	Standard Error	(0.000)
Mother's years of education	Point Estimate	0.052
	Standard Error	(0.000)
Grandmother's years of education	Point Estimate	0.050
	Standard Error	(0.000)
Monthly age of enrollment to the program	Point Estimate	0.380
	Standard Error	(0.029)
Constant	Point Estimate	-4.778
	Standard Error	(0.415)
Variance of Shock	Point Estimate	2.108
	Standard Error	(0.005)
Maturation Effects		
Age Child's Month	Point Estimate	-0.000
	Standard Error	(0.012)
Age Child's Week	Point Estimate	-0.001
	Standard Error	(0.008)

1. Standard errors are calculated by 500 iteration bootstrap.
2. If the child is 8 months and 3 weeks old, the values for Child's Age: Month, and Child's Age: Week are 8 and 3, respectively.

Table L.15: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level (Cognitive (Vector Model))

Level 2	Point Estimate	3.556	Level 8	Point Estimate	78.296
	Standard Error	(0.171)		Standard Error	(3.303)
Level 3	Point Estimate	4.424	Level 9	Point Estimate	131.704
	Standard Error	(0.180)		Standard Error	(3.932)
Level 4	Point Estimate	5.452	Level 10	Point Estimate	178.587
	Standard Error	(0.190)		Standard Error	(4.696)
Level 5	Point Estimate	6.542	Level 11	Point Estimate	180.592
	Standard Error	(0.200)		Standard Error	(4.702)
Level 6	Point Estimate	9.504	Level 12	Point Estimate	181.956
	Standard Error	(0.238)		Standard Error	(4.705)
Level 7	Point Estimate	72.251	Level 13	Point Estimate	3102.413
	Standard Error	(3.273)		Standard Error	(88.714)

1. Standard errors are calculated by 500 iteration bootstrap.
2. Level 1 value is normalized to 1.

Table L.16: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level (Cognitive (Vector Model))

Level 2	Point Estimate	4.537	Level 8	Point Estimate	29.744
	Standard Error	(1.848)		Standard Error	(23.839)
Level 3	Point Estimate	1535.080	Level 9	Point Estimate	0.999
	Standard Error	(2199.263)		Standard Error	(0.006)
Level 4	Point Estimate	0.991	Level 10	Point Estimate	1.4e+05
	Standard Error	(0.003)		Standard Error	(2.4e+09)
Level 5	Point Estimate	1.000	Level 11	Point Estimate	1.000
	Standard Error	(0.013)		Standard Error	(0.016)
Level 6	Point Estimate	1.375	Level 12	Point Estimate	1059.640
	Standard Error	(0.015)		Standard Error	(1.7e+05)
Level 7	Point Estimate	1.246			
	Standard Error	(0.012)			

1. Standard errors are calculated by 500 iteration bootstrap.
2. Level 1 and 13 variances are normalized to 1.

Table L.17: Learning Component ($\delta_k \eta(X)$)
(Cognitive (Vector Model))

η			δ_k			
Interaction quality:	Point Estimate	8.115	Level 2	1.843	Level 8	2.000
Home Visitor and Caregiver	Standard Error	(0.867)		(0.006)		(0.042)
Interaction quality:	Point Estimate	0.003	Level 5	3.615	Level 10	1.997
Home Visitor and Child	Standard Error	(0.015)		(0.038)		(0.001)
Teaching ability	Point Estimate	0.045	Level 6	2.233	Level 11	3.937
	Standard Error	(0.007)		(0.007)		(0.027)
Grandmother Rearing	Point Estimate	-0.008	Level 7	4.000	Level 12	2.000
	Standard Error	(0.030)		(0.000)		(0.004)
Male	Point Estimate	0.003				
	Standard Error	(0.008)				
Constant	Point Estimate	-7.071				
	Standard Error	(0.922)				
Variance of learning ability shock (η)	Point Estimate	0.995				
	Standard Error	(0.003)				

1. Standard errors are calculated by 500 iteration bootstrap.

2. Since the number of tasks at level 1, 3, 4, 9, and 13 are less than 3, we normalize the values of δ_k to 1.

3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

Model without common scale

Table L.18: Determinants of Initial Conditions and Maturation Effects (Cognitive (Vector Model))

Male	Point Estimate	-0.440
	Standard Error	(0.016)
Father‘s years of education	Point Estimate	0.059
	Standard Error	(0.000)
Mother’s years of education	Point Estimate	0.052
	Standard Error	(0.000)
Grandmother’s years of education	Point Estimate	0.050
	Standard Error	(0.000)
Monthly age of enrollment to the program	Point Estimate	0.375
	Standard Error	(0.029)
Constant	Point Estimate	-4.877
	Standard Error	(0.536)
Variance of Shock	Point Estimate	2.101
	Standard Error	(0.004)
Maturation Effects		
Age Child’s Month	Point Estimate	-0.000
	Standard Error	(0.011)
Age Child’s Week	Point Estimate	-0.001
	Standard Error	(0.007)

1. Standard errors are calculated by 500 iteration bootstrap.
2. If the child is 8 months and 3 weeks old, the values for Child’s Age: Month, and Child’s Age: Week are 8 and 3, respectively.

Table L.19: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level (Cognitive (Vector Model))

Level 2	Point Estimate	3.565	Level 8	Point Estimate	80.730
	Standard Error	(0.125)		Standard Error	(3.032)
Level 3	Point Estimate	4.436	Level 9	Point Estimate	135.247
	Standard Error	(0.134)		Standard Error	(4.533)
Level 4	Point Estimate	5.485	Level 10	Point Estimate	182.582
	Standard Error	(0.146)		Standard Error	(4.982)
Level 5	Point Estimate	6.588	Level 11	Point Estimate	184.873
	Standard Error	(0.161)		Standard Error	(4.994)
Level 6	Point Estimate	9.428	Level 12	Point Estimate	186.231
	Standard Error	(0.201)		Standard Error	(4.997)
Level 7	Point Estimate	74.739	Level 13	Point Estimate	3831.614
	Standard Error	(3.028)		Standard Error	(170.892)

1. Standard errors are calculated by 500 iteration bootstrap.
2. Level 1 value is normalized to 1.

Table L.20: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level (Cognitive (Vector Model))

Level 2	Point Estimate	4.427	Level 8	Point Estimate	34.511
	Standard Error	(0.574)		Standard Error	(21.560)
Level 3	Point Estimate	1148.305	Level 9	Point Estimate	0.999
	Standard Error	(2158.972)		Standard Error	(0.005)
Level 4	Point Estimate	0.991	Level 10	Point Estimate	1.7e+06
	Standard Error	(0.004)		Standard Error	(7.5e+09)
Level 5	Point Estimate	1.000	Level 11	Point Estimate	1.000
	Standard Error	(0.008)		Standard Error	(0.027)
Level 6	Point Estimate	1.362	Level 12	Point Estimate	1053.387
	Standard Error	(0.015)		Standard Error	(4.2e+06)
Level 7	Point Estimate	1.356			
	Standard Error	(0.021)			

1. Standard errors are calculated by 500 iteration bootstrap.
2. Level 1 and 13 variances are normalized to 1.

Table L.21: Learning Component ($\delta_k \eta(X)$)
(Cognitive (Vector Model))

η			δ_k			
Interaction quality:	Point Estimate	7.881	Level 2	1.843	Level 8	2.000
Home Visitor and Caregiver	Standard Error	(1.124)		(0.007)		(0.005)
Interaction quality:	Point Estimate	0.003	Level 5	3.611	Level 10	1.997
Home Visitor and Child	Standard Error	(0.014)		(0.030)		(0.001)
Teaching ability	Point Estimate	0.045	Level 6	2.233	Level 11	3.928
	Standard Error	(0.007)		(0.009)		(0.010)
Grandmother Rearing	Point Estimate	-0.008	Level 7	4.000	Level 12	2.000
	Standard Error	(0.010)		(0.000)		(0.002)
Male	Point Estimate	0.003				
	Standard Error	(0.014)				
Constant	Point Estimate	-6.367				
	Standard Error	(0.703)				
Variance of learning ability shock (η)	Point Estimate	0.995				
	Standard Error	(0.006)				

1. Standard errors are calculated by 500 iteration bootstrap.
2. Since the number of tasks at level 1, 3, 4, 9, and 13 are less than 3, we normalize the values of δ_k to 1.
3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels and δ_k is level specific.

Table L.22: Transformation Functions
(Cognitive (Vector Model))

		$\gamma_{k,\ell}$			$\gamma_{k,\ell}$
Level 1	Point Estimate	0.241	Level 8	Point Estimate	3.555
	Standard Error	(0.044)		Standard Error	(0.226)
Level 2	Point Estimate	1.070	Level 9	Point Estimate	0.837
	Standard Error	(0.063)		Standard Error	(0.101)
Level 3	Point Estimate	0.839	Level 10	Point Estimate	3.051
	Standard Error	(0.063)		Standard Error	(0.316)
Level 4	Point Estimate	0.409	Level 11	Point Estimate	2.917
	Standard Error	(0.043)		Standard Error	(0.242)
Level 5	Point Estimate	2.816	Level 12	Point Estimate	8.603
	Standard Error	(0.257)		Standard Error	(0.249)
Level 6	Point Estimate	0.616	Level 13	Point Estimate	1.748
	Standard Error	(0.033)		Standard Error	(0.057)
Level 7	Point Estimate	0.556			
	Standard Error	(0.030)			

1. Standard errors are calculated by 500 iteration bootstrap.

L.4.3 Fine Motor Skills

Model with common scale

Table L.23: Determinants of Initial Conditions and Maturation Effects (Fine Motor (Vector Model))

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	0.123
	Standard Error	(0.007)
Father‘s years of education	Point Estimate	0.006
	Standard Error	(0.000)
Mother's years of education	Point Estimate	0.047
	Standard Error	(0.000)
Grandmother's years of education	Point Estimate	0.068
	Standard Error	(0.001)
Monthly age of enrollment to the program	Point Estimate	0.014
	Standard Error	(0.002)
Constant	Point Estimate	0.172
	Standard Error	(0.008)
Variance of Shock	Point Estimate	2.257
	Standard Error	(0.008)
Maturation Effects		
Age Child's Month	Point Estimate	-0.000
	Standard Error	(0.010)
Age Child's Week	Point Estimate	0.000
	Standard Error	(0.002)

1. Standard errors are calculated by 500 iteration bootstrap.
2. If the child is 8 months and 3 weeks old, the values for Child's Age: Month, and Age Child's week are 8 and 3, respectively.

Table L.24: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level (Fine Motor (Vector Model))

Level 2	Point Estimate	1.003
	Standard Error	(0.067)
Level 3	Point Estimate	17.544
	Standard Error	(2.721)
Level 4	Point Estimate	18.441
	Standard Error	(2.723)
Level 5	Point Estimate	20.629
	Standard Error	(2.715)
Level 6	Point Estimate	189.555
	Standard Error	(7.474)
Level 7	Point Estimate	195.501
	Standard Error	(7.489)

1. Standard errors are calculated by 500 iteration bootstrap.
2. Level 1 value is normalized to 1.

Table L.25: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level (Fine Motor (Vector Model))

Level 2	Point Estimate	1.572
	Standard Error	(0.030)
Level 3	Point Estimate	1.000
	Standard Error	(0.006)
Level 4	Point Estimate	1.000
	Standard Error	(0.031)
Level 5	Point Estimate	5363.250
	Standard Error	(2804.652)
Level 6	Point Estimate	32.687
	Standard Error	(14.071)
Level 7	Point Estimate	204.018
	Standard Error	(736.631)

1. Standard errors are calculated by 500 iteration bootstrap.
2. Level 1 variance is normalized to 1.

Table L.26: Learning Component ($\delta_k \eta(X)$)
(Fine Motor (Vector Model))

η			δ_k	
Interaction quality:	Point Estimate	0.758	Level 3	4.356
Home Visitor and Caregiver	Standard Error	(0.040)		(0.016)
Interaction quality:	Point Estimate	0.050	Level 4	4.000
Home Visitor and Child	Standard Error	(0.007)		(0.000)
Teaching ability	Point Estimate	0.002	Level 5	2.002
	Standard Error	(0.008)		(0.008)
Grandmother appearance	Point Estimate	-0.009	Level 6	24.123
	Standard Error	(0.022)		(2.217)
Male	Point Estimate	0.913	Level 7	3.598
	Standard Error	(0.037)		(0.020)
Constant	Point Estimate	-5.517		
	Standard Error	(0.944)		
Variance of learning ability shock (η)	Point Estimate	1.130		
	Standard Error	(0.006)		

1. Standard errors are calculated by 500 iteration bootstrap.

2. Since the number of tasks at level 1 and 2 are less than 3, we normalize the values of δ_k to 1.

3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

Model without common scale

Table L.27: Determinants of Initial Conditions and Maturation Effects (Fine Motor (Vector Model))

Initial Conditions $\mu_0(Z)$		
Male	Point Estimate	0.122
	Standard Error	(0.007)
Father‘s years of education	Point Estimate	0.006
	Standard Error	(0.001)
Mother’s years of education	Point Estimate	0.047
	Standard Error	(0.000)
Grandmother’s years of education	Point Estimate	0.068
	Standard Error	(0.001)
Monthly age of enrollment to the program	Point Estimate	0.014
	Standard Error	(0.002)
Constant	Point Estimate	0.174
	Standard Error	(0.008)
Variance of Shock	Point Estimate	2.261
	Standard Error	(0.023)
Maturation Effects		
Age Child’s Month	Point Estimate	-0.000
	Standard Error	(0.008)
Age Child’s Week	Point Estimate	0.000
	Standard Error	(0.007)

1. Standard errors are calculated by 500 iteration bootstrap.
2. If the child is 8 months and 3 three weeks old, the values for Child’s Age: Month, and Child’s Age: Week are 8 and 3, respectively.

Table L.28: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level (Fine Motor (Vector Model))

Level 2	Point Estimate	1.003
	Standard Error	(0.023)
Level 3	Point Estimate	22.927
	Standard Error	(2.405)
Level 4	Point Estimate	23.829
	Standard Error	(2.405)
Level 5	Point Estimate	26.042
	Standard Error	(2.410)
Level 6	Point Estimate	234.757
	Standard Error	(7.163)
Level 7	Point Estimate	240.762
	Standard Error	(7.177)

1. Standard errors are calculated by 500 iteration bootstrap.
2. Level 1 value is normalized to 1.

Table L.29: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level (Fine Motor (Vector Model))

Level 2	Point Estimate	1.584
	Standard Error	(0.027)
Level 3	Point Estimate	1.000
	Standard Error	(0.006)
Level 4	Point Estimate	1.000
	Standard Error	(0.008)
Level 5	Point Estimate	1434.774
	Standard Error	(596.792)
Level 6	Point Estimate	33.484
	Standard Error	(10.114)
Level 7	Point Estimate	190.318
	Standard Error	(1.6e+05)

1. Standard errors are calculated by 500 iteration bootstrap.
2. Level 1 variance is normalized to 1.

Table L.30: Learning Component ($\delta_k \eta(X)$)
(Fine Motor (Vector Model))

η			δ_k	
Interaction quality:	Point Estimate	0.724	Level 3	2.117
Home Visitor and Caregiver	Standard Error	(0.039)		(0.007)
Interaction quality:	Point Estimate	0.052	Level 4	4.000
Home Visitor and Child	Standard Error	(0.007)		(0.000)
Teaching ability	Point Estimate	0.002	Level 5	2.002
	Standard Error	(0.007)		(0.030)
Grandmother appearance	Point Estimate	-0.009	Level 6	3.995
	Standard Error	(0.015)		(0.007)
Male	Point Estimate	0.904	Level 7	3.592
	Standard Error	(0.041)		(0.024)
Constant	Point Estimate	-5.950		
	Standard Error	(0.447)		
Variance of learning ability shock (η)	Point Estimate	1.151		
	Standard Error	(0.006)		

1. Standard errors are calculated by 500 iteration bootstrap.
2. Since the number of tasks at level 1, 3, 4, 9, and 13 are less than 3, we normalize the values of δ_k to 1.
3. In the model, we consider the following setting $\delta_k \bar{\eta} = \delta_k(X'\beta_\eta + \omega_i)$. The coefficients of X in η are the same across all levels, and δ_k is level specific.

Table L.31: Transformation Function
(Fine Motor (Vector Model))

		$\gamma_{k,\ell}$
Level 1	Point Estimate	1.429
	Standard Error	(0.069)
Level 2	Point Estimate	1.066
	Standard Error	(0.049)
Level 3	Point Estimate	1.059
	Standard Error	(0.064)
Level 4	Point Estimate	1.017
	Standard Error	(0.073)
Level 5	Point Estimate	0.967
	Standard Error	(0.048)
Level 6	Point Estimate	0.900
	Standard Error	(0.027)
Level 7	Point Estimate	1.013
	Standard Error	(0.037)

1. Standard errors are calculated by 500 iteration bootstrap.

L.5 Comparison of Vector Model Estimates

L.5.1 Test whether Estimates are Constant across All Difficulty Levels

Table L.32: Minimum Latent Skills Requirement ($\bar{K}$) for Each Level

Language Skill			Cognitive Skill			Fine Motor Skill		
Level 3	Point Estimate	1.302	Level 2	Point Estimate	3.565	Level 2	Point Estimate	1.003
	Standard Error	(0.019)		Standard Error	(0.125)		Standard Error	(0.023)
	Confidence Interval	[1.273,1.341]		Confidence Interval	[3.340,3.797]		Confidence Interval	[0.993,1.017]
Level 4	Point Estimate	2.034	Level 3	Point Estimate	4.436	Level 3	Point Estimate	22.927
	Standard Error	(0.052)		Standard Error	(0.134)		Standard Error	(2.405)
	Confidence Interval	[1.956,2.135]		Confidence Interval	[4.197,4.671]		Confidence Interval	[17.258,24.599]
Level 5	Point Estimate	2.493	Level 4	Point Estimate	5.485	Level 4	Point Estimate	23.829
	Standard Error	(0.061)		Standard Error	(0.146)		Standard Error	(2.405)
	Confidence Interval	[2.385,2.619]		Confidence Interval	[5.213,5.769]		Confidence Interval	[18.154,25.508]
Level 6	Point Estimate	3.302	Level 5	Point Estimate	6.588	Level 5	Point Estimate	26.042
	Standard Error	(0.077)		Standard Error	(0.161)		Standard Error	(2.410)
	Confidence Interval	[3.134,3.446]		Confidence Interval	[6.296,6.935]		Confidence Interval	[20.300,27.746]
Level 7	Point Estimate	3.970	Level 6	Point Estimate	9.428	Level 6	Point Estimate	234.757
	Standard Error	(0.085)		Standard Error	(0.201)		Standard Error	(7.163)
	Confidence Interval	[3.788,4.157]		Confidence Interval	[9.041,9.886]		Confidence Interval	[228.039,253.973]
Level 8	Point Estimate	5.403	Level 7	Point Estimate	74.739	Level 7	Point Estimate	240.762
	Standard Error	(0.108)		Standard Error	(3.028)		Standard Error	(7.177)
	Confidence Interval	[5.206,5.676]		Confidence Interval	[68.401,80.596]		Confidence Interval	[234.061,260.085]
Level 9	Point Estimate	9.450	Level 8	Point Estimate	80.730			
	Standard Error	(0.202)		Standard Error	(3.032)			
	Confidence Interval	[9.248,9.941]		Confidence Interval	[74.773,86.534]			
Level 10	Point Estimate	75.001	Level 9	Point Estimate	135.247			
	Standard Error	(3.165)		Standard Error	(4.533)			
	Confidence Interval	[73.003,82.036]		Confidence Interval	[128.153,143.942]			
Level 11	Point Estimate	81.064	Level 10	Point Estimate	182.582			
	Standard Error	(3.205)		Standard Error	(4.982)			
	Confidence Interval	[79.136,88.106]		Confidence Interval	[175.267,193.358]			
			Level 11	Point Estimate	184.873			
				Standard Error	(4.994)			
				Confidence Interval	[177.624,195.692]			
			Level 12	Point Estimate	186.231			
				Standard Error	(4.997)			
				Confidence Interval	[179.040,197.059]			
			Level 13	Point Estimate	3831.614			
				Standard Error	(170.892)			
				Confidence Interval	[3712.782,4164.378]			
F-value	213626.310		F-value	251498.410		F-value	285423.730	
P-value	0.000		P-value	0.000		P- value	0.000	

1. F-value and P-value present the hypothesis test whether parameters are the same across all levels.

Table L.33: Variances of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) at Each Level

Language Skill			Cognitive Skill			Fine Motor Skill		
Level 3	Point Estimate	0.995	Level 2	Point Estimate	4.427	Level 2	Point Estimate	1.584
	Standard Error	(0.003)		Standard Error	(0.574)		Standard Error	(0.027)
	Confidence Interval	[0.991,0.998]		Confidence Interval	[3.106,5.361]		Confidence Interval	[1.557,1.645]
Level 4	Point Estimate	1.449	Level 3	Point Estimate	1148.305	Level 3	Point Estimate	1.000
	Standard Error	(0.046)		Standard Error	(2158.972)		Standard Error	(0.006)
	Confidence Interval	[1.277,1.461]		Confidence Interval	[105.683,1623.719]		Confidence Interval	[0.997,1.004]
Level 5	Point Estimate	0.998	Level 4	Point Estimate	0.991	Level 4	Point Estimate	1.000
	Standard Error	(0.020)		Standard Error	(0.004)		Standard Error	(0.008)
	Confidence Interval	[0.995,1.002]		Confidence Interval	[0.988,0.994]		Confidence Interval	[0.997,1.003]
Level 6	Point Estimate	2.434	Level 5	Point Estimate	1.000	Level 5	Point Estimate	1434.774
	Standard Error	(0.203)		Standard Error	(0.008)		Standard Error	(596.792)
	Confidence Interval	[1.929,2.863]		Confidence Interval	[0.997,1.004]		Confidence Interval	[261.090,1933.432]
Level 7	Point Estimate	0.999	Level 6	Point Estimate	1.362	Level 6	Point Estimate	33.484
	Standard Error	(0.018)		Standard Error	(0.015)		Standard Error	(10.114)
	Confidence Interval	[0.996,1.004]		Confidence Interval	[1.345,1.395]		Confidence Interval	[15.374,55.489]
Level 8	Point Estimate	11.527	Level 7	Point Estimate	1.356	Level 7	Point Estimate	190.318
	Standard Error	(26.601)		Standard Error	(0.021)		Standard Error	(1.6e+05)
	Confidence Interval	[6.953,27.931]		Confidence Interval	[1.329,1.399]		Confidence Interval	[3.332,932.830]
Level 9	Point Estimate	1.000	Level 8	Point Estimate	34.511			
	Standard Error	(0.013)		Standard Error	(21.560)			
	Confidence Interval	[0.995,1.005]		Confidence Interval	[25.292,104.349]			
Level 10	Point Estimate	0.999	Level 9	Point Estimate	0.999			
	Standard Error	(0.008)		Standard Error	(0.005)			
	Confidence Interval	[0.995,1.003]		Confidence Interval	[0.996,1.003]			
Level 11	Point Estimate	63.867	Level 10	Point Estimate	1.7e+06			
	Standard Error	(19.991)		Standard Error	(7.5e+09)			
	Confidence Interval	[9.435,80.774]		Confidence Interval	[1.7e+06,2.8e+09]			
			Level 11	Point Estimate	1.000			
				Standard Error	(0.027)			
				Confidence Interval	[0.996,1.004]			
			Level 12	Point Estimate	1053.387			
				Standard Error	(4.2e+06)			
				Confidence Interval	[0.458,1.7e+05]			
F-value	8977.530		F-value	25.260		F-value	72780.940	
P-value	0.000		P-value	0.000		P- value	0.000	

1. F-value and P-value present the hypothesis test whether parameters are the same across all levels.

Table L.34: Learning Component (δ_ℓ) at Each Level

Language Skill			Cognitive Skill			Fine Motor Skill		
Level 3	Point Estimate	3.069	Level 2	Point Estimate	1.843	Level 3	Point Estimate	2.117
	Standard Error	(0.003)		Standard Error	(0.007)		Standard Error	(0.007)
	Confidence Interval	[3.066,3.074]		Confidence Interval	[1.839,1.863]		Confidence Interval	[2.112,2.129]
Level 4	Point Estimate	3.088	Level 5	Point Estimate	3.611	Level 4	Point Estimate	4.000
	Standard Error	(0.003)		Standard Error	(0.030)		Standard Error	(0.000)
	Confidence Interval	[3.084,3.095]		Confidence Interval	[3.590,3.697]		Confidence Interval	[4.000,4.000]
Level 5	Point Estimate	0.382	Level 6	Point Estimate	2.233	Level 5	Point Estimate	2.002
	Standard Error	(0.039)		Standard Error	(0.009)		Standard Error	(0.030)
	Confidence Interval	[0.314,0.457]		Confidence Interval	[2.223,2.253]		Confidence Interval	[1.999,2.005]
Level 6	Point Estimate	3.161	Level 7	Point Estimate	4.000	Level 6	Point Estimate	3.995
	Standard Error	(0.007)		Standard Error	(0.000)		Standard Error	(0.007)
	Confidence Interval	[3.157,3.175]		Confidence Interval	[4.000,4.000]		Confidence Interval	[3.984,3.995]
Level 7	Point Estimate	5.999	Level 8	Point Estimate	2.000	Level 7	Point Estimate	3.592
	Standard Error	(0.000)		Standard Error	(0.005)		Standard Error	(0.024)
	Confidence Interval	[5.999,6.000]		Confidence Interval	[1.999,2.001]		Confidence Interval	[3.566,3.634]
Level 8	Point Estimate	6.000	Level 10	Point Estimate	1.997			
	Standard Error	(0.000)		Standard Error	(0.001)			
	Confidence Interval	[6.000,6.000]		Confidence Interval	[1.996,1.998]			
Level 9	Point Estimate	5.996	Level 11	Point Estimate	3.928			
	Standard Error	(0.051)		Standard Error	(0.010)			
	Confidence Interval	[5.995,5.998]		Confidence Interval	[3.916,3.944]			
Level 10	Point Estimate	2.998	Level 12	Point Estimate	2.000			
	Standard Error	(0.001)		Standard Error	(0.002)			
	Confidence Interval	[2.997,2.999]		Confidence Interval	[1.999,2.001]			
Level 11	Point Estimate	2.999						
	Standard Error	(0.007)						
	Confidence Interval	[2.998,3.001]						
F-value	8.28E+08		F-value	9.86E+08			F-value	1.22E+07
P-value	0.000		P-value	0.000			P-value	0.000

1. F-value and P-value present the hypothesis test whether parameters are the same across all levels.

L.5.2 Comparison between Vector Model and Scalar Model

Table L.35: Comparison of Minimum skill Requirement ($\bar{K}$) at Each Level
(Without common scale)

Language Skill				
		Vector Model	Scalar Model	P-value
Level 3	Point Estimate	1.302	1.295	0.842
	Standard Error	(0.019)	0.054	
Level 4	Point Estimate	2.034	1.846	0.029
	Standard Error	(0.052)	0.138	
Level 5	Point Estimate	2.493	2.545	0.737
	Standard Error	(0.061)	0.216	
Level 6	Point Estimate	3.302	3.219	0.617
	Standard Error	(0.077)	0.243	
Level 7	Point Estimate	3.970	3.693	0.110
	Standard Error	(0.085)	0.258	
Level 8	Point Estimate	5.403	4.598	0.000
	Standard Error	(0.108)	0.277	
Level 9	Point Estimate	9.450	5.743	0.000
	Standard Error	(0.202)	0.312	
Level 10	Point Estimate	75.001	13.779	0.000
	Standard Error	(3.165)	1.248	
Level 11	Point Estimate	81.064	15.795	0.000
	Standard Error	(3.205)	1.273	

Cognitive Skill				
		Vector Model	Scalar Model	P-value
Level 2	Point Estimate	3.565	2.127	0.000
	Standard Error	(0.125)	(0.156)	
Level 3	Point Estimate	4.436	3.468	0.014
	Standard Error	(0.134)	(0.258)	
Level 4	Point Estimate	5.485	5.472	0.984
	Standard Error	(0.146)	(0.508)	
Level 5	Point Estimate	6.588	5.813	0.251
	Standard Error	(0.161)	(0.514)	
Level 6	Point Estimate	9.428	7.271	0.007
	Standard Error	(0.201)	(0.590)	
Level 7	Point Estimate	74.739	19.361	0.000
	Standard Error	(3.028)	(2.948)	
Level 8	Point Estimate	80.730	21.662	0.000
	Standard Error	(3.032)	(2.959)	
Level 9	Point Estimate	135.247	56.722	0.000
	Standard Error	(4.533)	(5.510)	
Level 10	Point Estimate	182.582	89.275	0.000
	Standard Error	(4.982)	(7.329)	
Level 11	Point Estimate	184.873	90.812	0.000
	Standard Error	(4.994)	(7.340)	
Level 12	Point Estimate	186.231	92.136	0.000
	Standard Error	(4.997)	(7.344)	
Level 13	Point Estimate	3831.614	5817.490	0.039
	Standard Error	(170.892)	(791.794)	

Fine Motor Skill				
		Vector Model	Scalar Model	P-value
Level 2	Point Estimate	1.003	1.004	0.977
	Standard Error	(0.023)	(0.012)	
Level 3	Point Estimate	22.927	3.238	0.000
	Standard Error	(2.405)	(0.729)	
Level 4	Point Estimate	23.829	3.307	0.000
	Standard Error	(2.405)	(0.731)	
Level 5	Point Estimate	26.042	4.998	0.000
	Standard Error	(2.410)	(0.865)	
Level 6	Point Estimate	234.757	21.814	0.000
	Standard Error	(7.163)	(4.912)	
Level 7	Point Estimate	240.762	57.883	0.000
	Standard Error	(7.177)	(15.155)	

1. P-value present the hypothesis test whether parameters are the same between the vector model and the scalar model.

Table L.36: Variances of Task Shocks ($\sigma_{\varepsilon(\ell)}$) at Each Level (Without common scale)

Language Skill				
		Vector Model	Scalar Model	P-value
Level 3	Point Estimate	0.995	0.992	0.454
	Standard Error	(0.003)	(0.001)	
Level 4	Point Estimate	1.449	1.384	0.540
	Standard Error	(0.046)	(0.060)	
Level 5	Point Estimate	0.998	0.990	0.703
	Standard Error	(0.020)	(0.001)	
Level 6	Point Estimate	2.434	6.293	0.116
	Standard Error	(0.203)	(2.252)	
Level 7	Point Estimate	0.999	0.999	1.000
	Standard Error	(0.018)	(0.000)	
Level 8	Point Estimate	11.527	88.239	0.181
	Standard Error	(26.601)	(30.634)	
Level 9	Point Estimate	1.000	0.999	0.939
	Standard Error	(0.013)	(0.000)	
Level 10	Point Estimate	0.999	0.995	0.657
	Standard Error	(0.008)	(0.001)	
Level 11	Point Estimate	63.867	138.791	0.476
	Standard Error	(19.991)	(85.175)	

Cognitive Skill				
		Vector Model	Scalar Model	P-value
Level 2	Point Estimate	4.427	1.238	0.000
	Standard Error	(0.574)	(0.055)	
Level 3	Point Estimate	1148.305	1.236	0.595
	Standard Error	(2158.972)	(0.044)	
Level 4	Point Estimate	0.991	0.978	0.064
	Standard Error	(0.004)	(0.003)	
Level 5	Point Estimate	1.000	1.000	1.000
	Standard Error	(0.008)	(0.000)	
Level 6	Point Estimate	1.362	1.128	0.000
	Standard Error	(0.015)	(0.018)	
Level 7	Point Estimate	1.356	1.110	0.000
	Standard Error	(0.021)	(0.017)	
Level 8	Point Estimate	34.511	61.185	0.662
	Standard Error	(21.560)	(39.474)	
Level 9	Point Estimate	0.999	0.999	1.000
	Standard Error	(0.005)	(0.000)	
Level 10	Point Estimate	1.7e+06	195.013	1.000
	Standard Error	(7.5e+09)	(384.660)	
Level 11	Point Estimate	1.000	1.000	1.000
	Standard Error	(0.027)	(0.000)	
Level 12	Point Estimate	1053.387	335.661	1.000
	Standard Error	(4.2e+06)	(700.474)	

Fine Motor Skill				
		Vector Model	Scalar Model	P-value
Level 2	Point Estimate	1.584	2.034	0.259
	Standard Error	(0.027)	(0.371)	
Level 3	Point Estimate	1.000	1.000	1.000
	Standard Error	(0.006)	(0.004)	
Level 4	Point Estimate	1.000	1.000	1.000
	Standard Error	(0.008)	(0.004)	
Level 5	Point Estimate	1434.774	28.039	0.025
	Standard Error	(596.792)	(28.111)	
Level 6	Point Estimate	33.484	16.381	0.690
	Standard Error	(10.114)	(32.714)	
Level 7	Point Estimate	190.318	170.883	1.000
	Standard Error	(1.6e+05)	(247.758)	

1. P-value present the hypothesis test whether parameters are the same between the vector model and the scalar model.

Table L.37: Comparison of Learning Component (δ_ℓ) at Each Level
(Without common scale)

Language Skill					Cognitive Skill					Cognitive Skill				
		Vector Model	Scalar Model	P-value			Vector Model	Scalar Model	P-value			Vector Model	Scalar Model	P-value
Level 3	Point Estimate	3.069	3.053	0.046	Level 2	Point Estimate	1.843	0.863	0.000	Level 3	Point Estimate	2.117	2.619	0.008
	Standard Error	(0.003)	(0.005)			Standard Error	(0.007)	(0.168)			Standard Error	(0.007)	(0.197)	
Level 4	Point Estimate	3.088	3.048	0.000	Level 5	Point Estimate	3.611	2.204	0.000	Level 4	Point Estimate	4.000	4.000	1.000
	Standard Error	(0.003)	(0.005)			Standard Error	(0.030)	(0.072)			Standard Error	(0.000)	(0.027)	
Level 5	Point Estimate	0.382	0.023	0.001	Level 6	Point Estimate	2.233	2.181	0.006	Level 5	Point Estimate	2.002	2.000	0.939
	Standard Error	(0.039)	(0.066)			Standard Error	(0.009)	(0.028)			Standard Error	(0.030)	(0.004)	
Level 6	Point Estimate	3.161	3.108	0.008	Level 7	Point Estimate	4.000	4.000	1.000	Level 6	Point Estimate	3.995	3.932	0.673
	Standard Error	(0.007)	(0.013)			Standard Error	(0.000)	(0.002)			Standard Error	(0.007)	(0.156)	
Level 7	Point Estimate	5.999	5.986	0.643	Level 8	Point Estimate	2.000	2.000	1.000	Level 7	Point Estimate	3.592	3.319	0.084
	Standard Error	(0.000)	(0.028)			Standard Error	(0.005)	(0.000)			Standard Error	(0.024)	(0.182)	
Level 8	Point Estimate	6.000	5.986	0.351	Level 10	Point Estimate	1.997	1.998	0.212					
	Standard Error	(0.000)	(0.015)			Standard Error	(0.001)	(0.000)						
Level 9	Point Estimate	5.996	5.97	0.694	Level 11	Point Estimate	3.928	3.997	0.000					
	Standard Error	(0.051)	(0.015)			Standard Error	(0.010)	(0.015)						
Level 10	Point Estimate	2.998	2.998	1.000	Level 12	Point Estimate	2.000	2.000	1.000					
	Standard Error	(0.001)	(0.000)			Standard Error	(0.002)	(0.000)						
Level 11	Point Estimate	2.999	2.999	1.000										
	Standard Error	(0.007)	(0.000)											

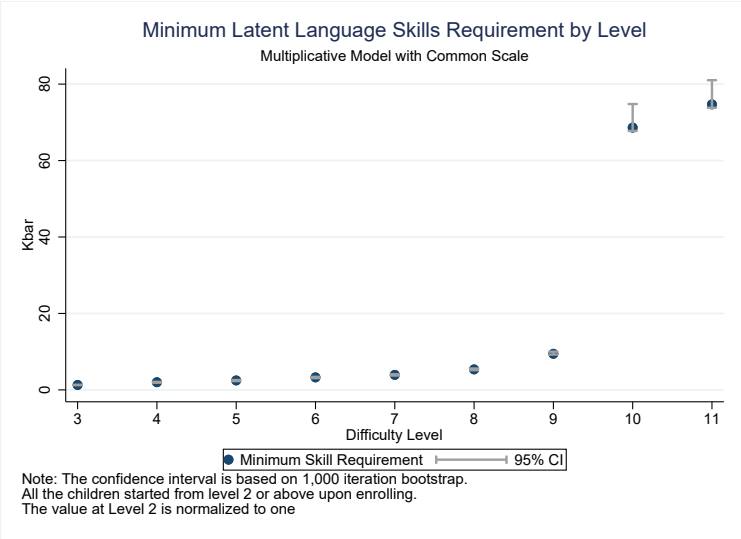
1. P-value present the hypothesis test whether parameters are the same between the vector model and the scalar model.

L.5.3 Vector Model Estimates

Vector Model Estimates (common scale v.s. Without common scale)

Figure L.16: Minimum Skill Requirement ($\bar{K}$) (Language (Vector Model))

(a) common scale



(b) w/o common scale

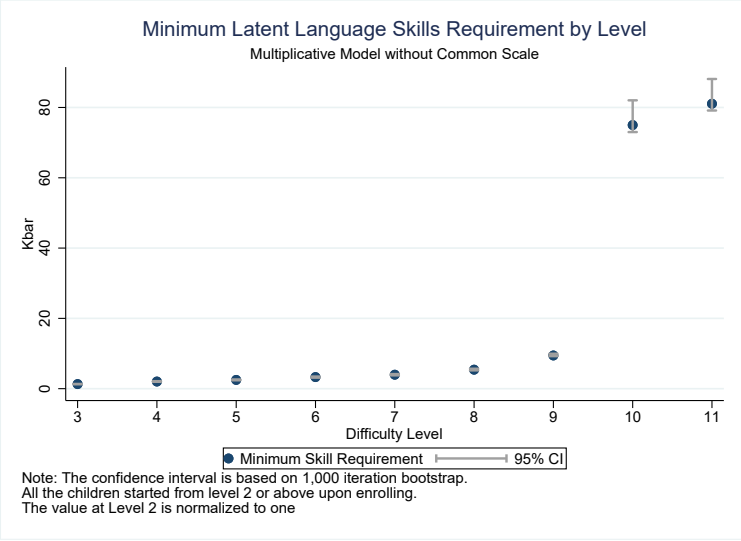
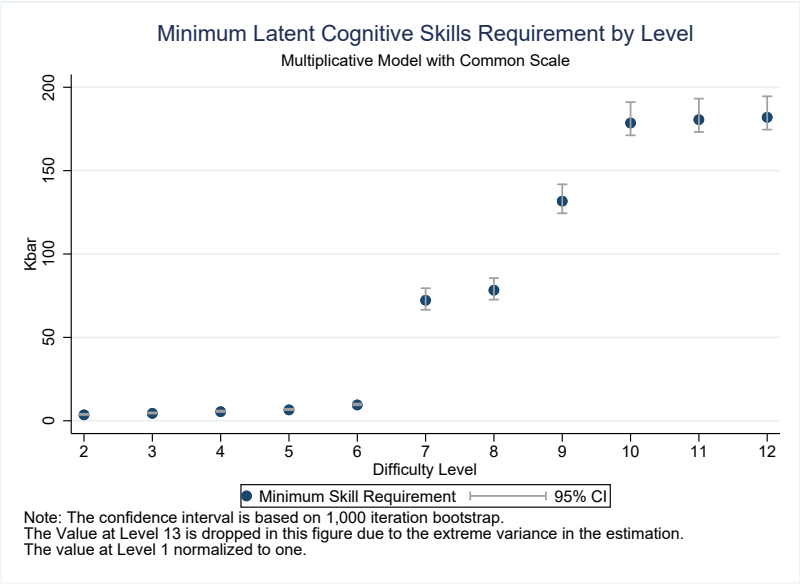


Figure L.17: Minimum Skill Requirement ($\bar{K}$) (Cognitive (Vector Model))

(a) common scale



(b) w/o common scale

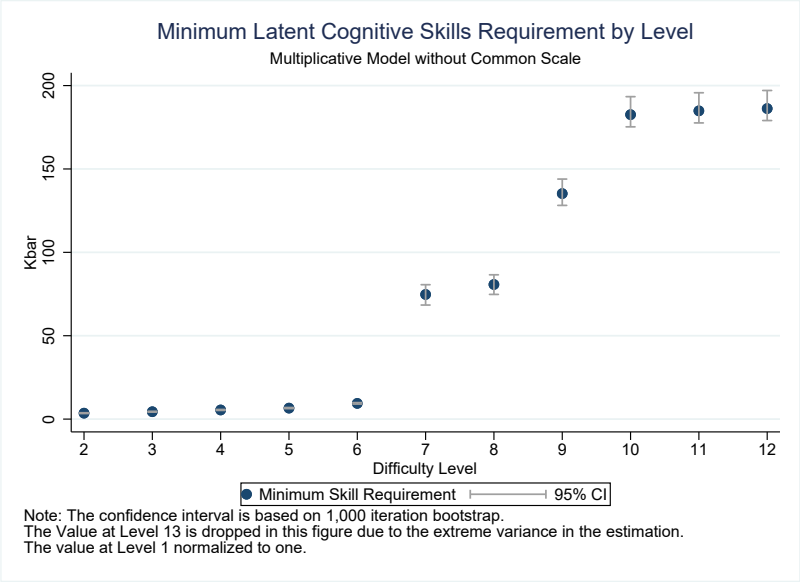
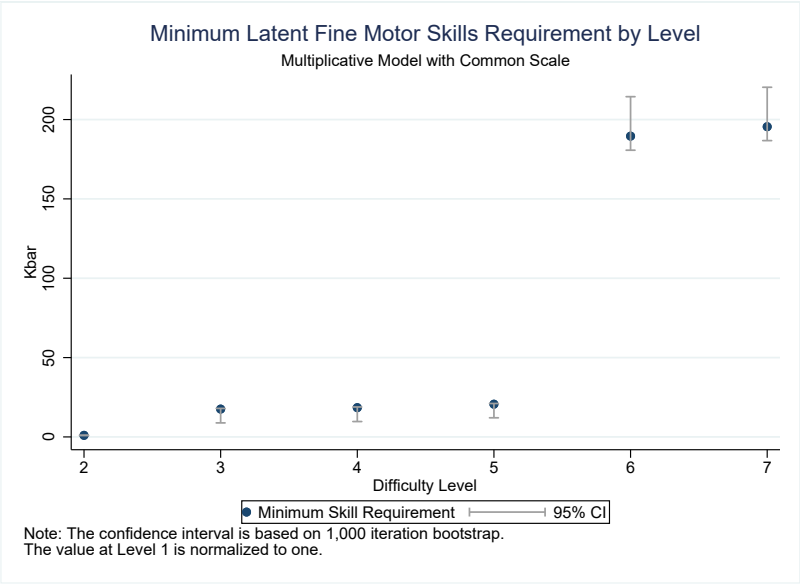


Figure L.18: Minimum Skill Requirement ($\bar{K}$) (Fine Motor (Vector Model))

(a) common scale



(b) w/o common scale

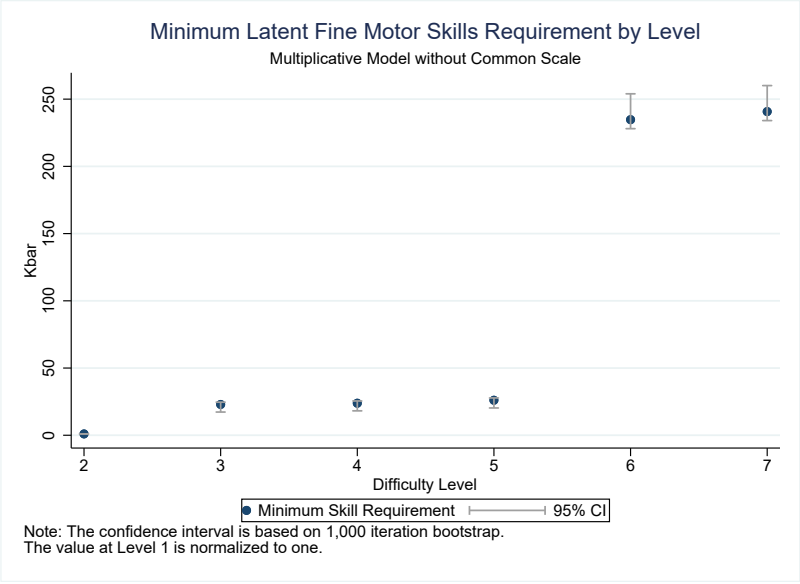
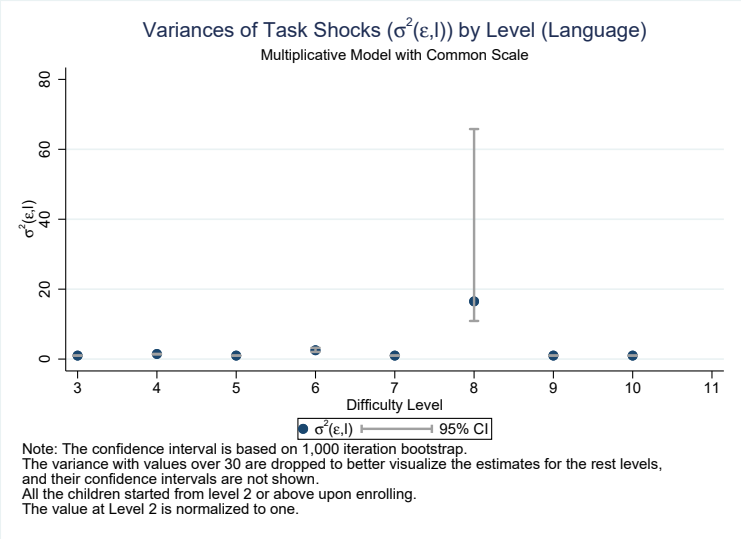


Figure L.19: Variance of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) (Language (Vector Model))

(a) common scale



(b) w/o common scale

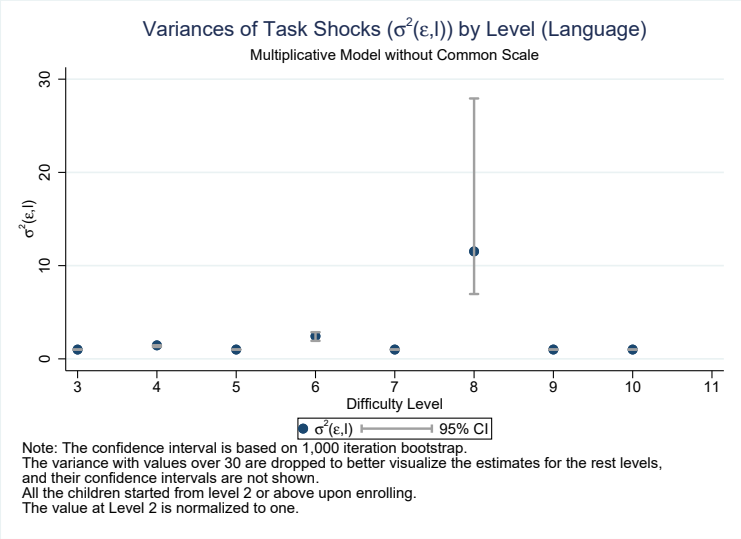
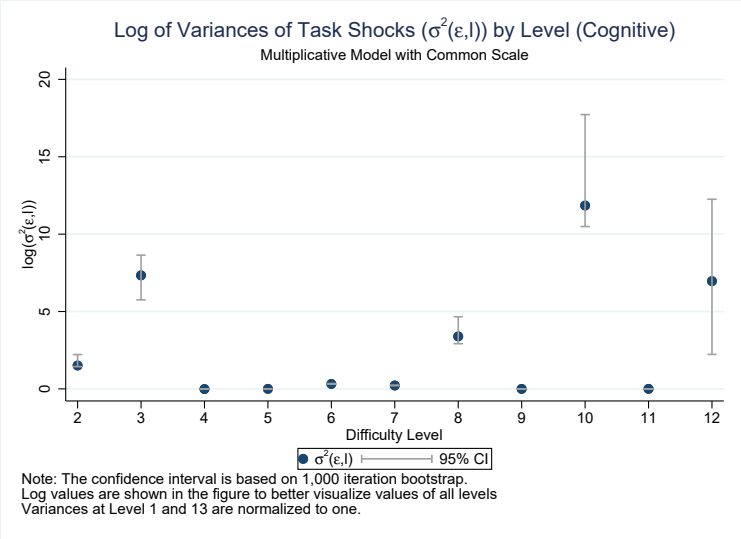


Figure L.20: Variance of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) (Cognitive (Vector Model))

(a) common scale



(b) w/o common scale

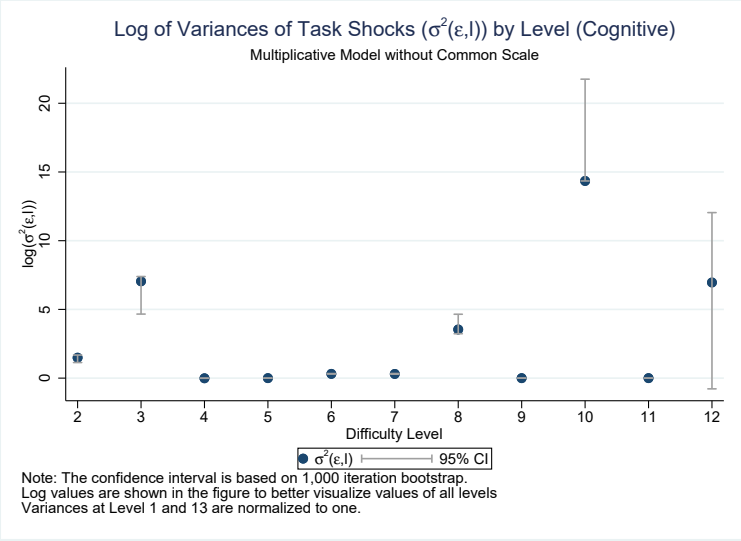
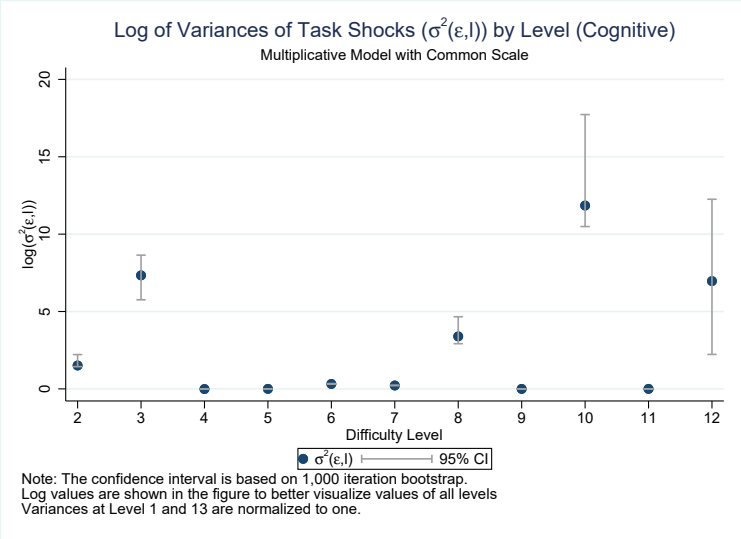


Figure L.21: Variance of Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) (Cognitive (Vector Model))

(a) common scale



(b) w/o common scale

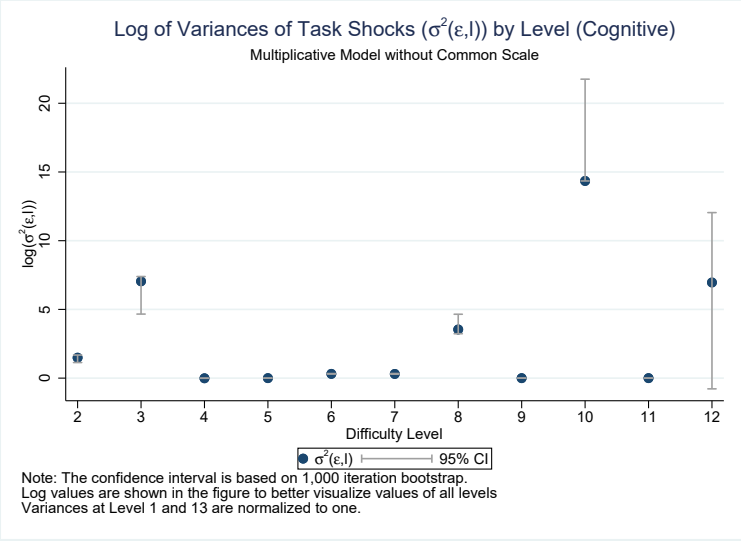
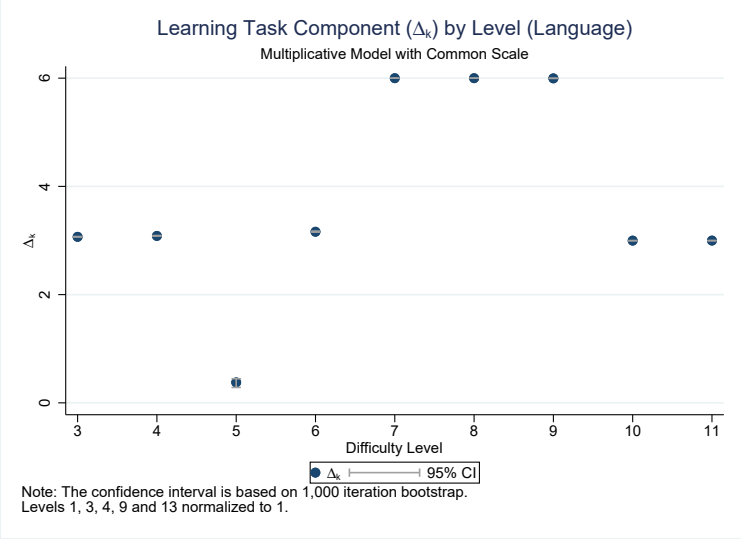


Figure L.22: Learning Component (δ_ℓ) (Language (Vector Model))

(a) common scale



(b) w/o common scale

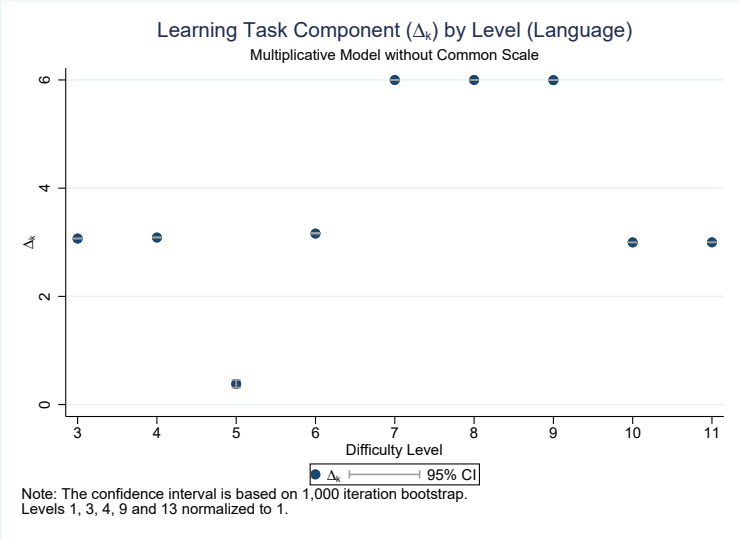
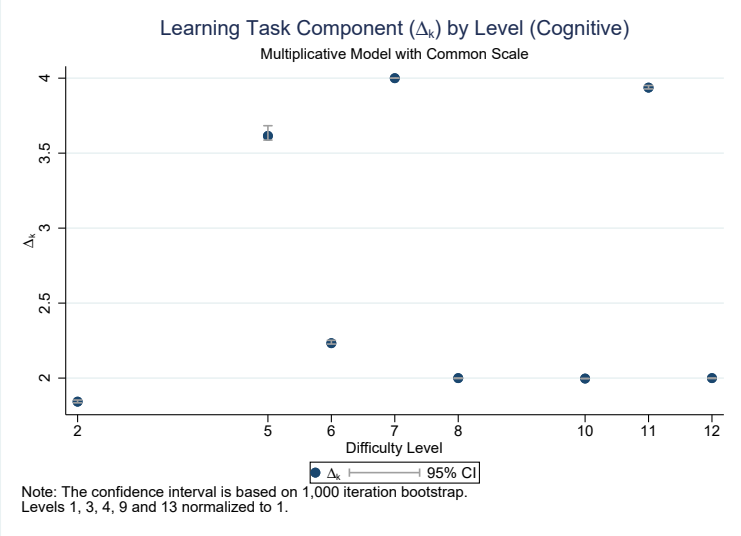


Figure L.23: Learning Component (δ_ℓ) (Cognitive (Vector Model))

(a) common scale



(b) w/o common scale

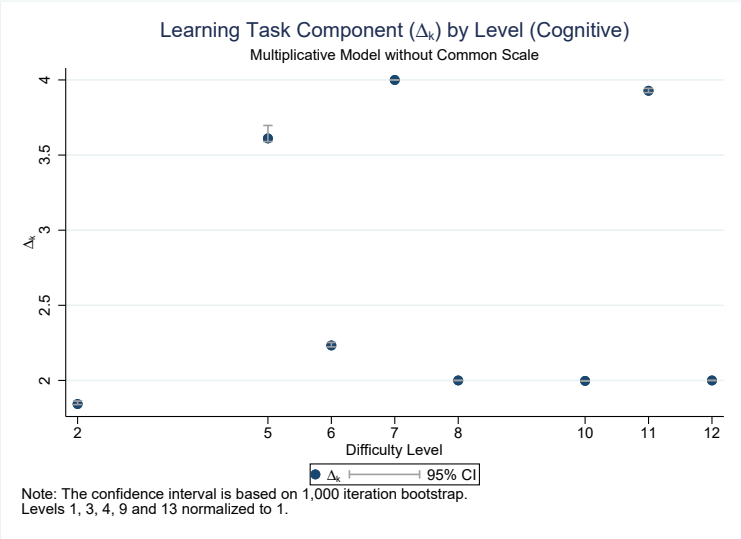
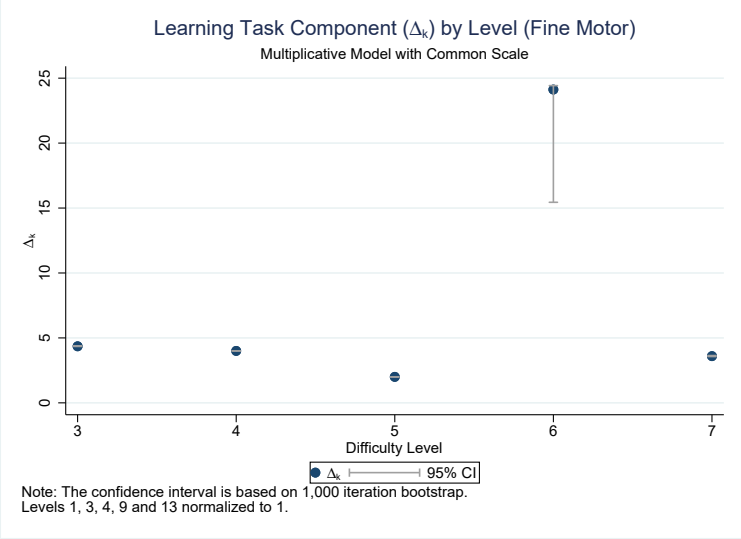
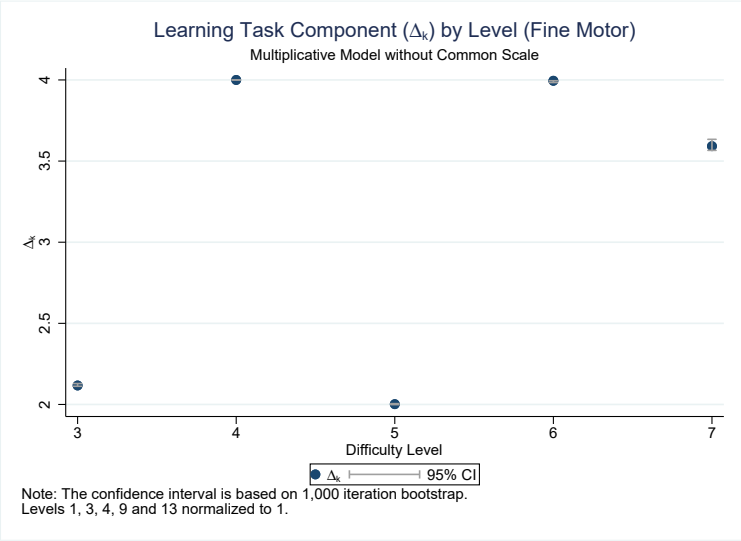


Figure L.24: Learning Component (δ_ℓ) (Fine Motor (Vector Model))

(a) common scale



(b) w/o common scale



L.5.4 Comparing Scalar Model and Vector Model Estimates

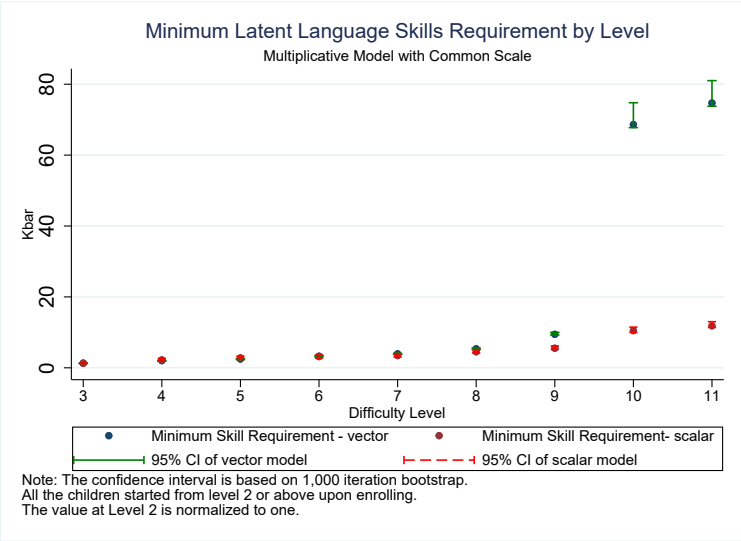
In this section, we compare the estimates based on the scalar and vector models. When comparing the minimum skill requirement $\bar{K}$, we find that for harder difficulty levels, the vector model estimates have larger values compared to the estimates from the scalar model (see Figures L.25-L.27). The pattern of larger values of $\bar{K}$ in the vector model is because the vector model allows different skills to evolve jointly, and the scales are more comparable across different skills. For the scalar model, we estimate the skill formation process independently across each type of skill. Therefore, there is no cross-fertilize effect between different skills.

Next, we compare the estimates of the variance of task shocks, and then we find that the estimates from the scalar and the vector models are very close (see Figures L.28-L.30). Both models can capture large variances if the task passing rates for the given difficulty level do not increase monotonically within the same level. Similarly, for the estimates of δ_ℓ, which capture the curriculum investment components during the intervention, we find the estimates between the scalar and the vector models are comparable (see Figures L.31-L.33).

Comparison of Minimum Skill Requirement $\bar{K}$ for Each Skill

Figure L.25: Comparing Minimum Language Skill Requirements ($\bar{K}$) (Scalar Model v.s Vector Model)

(a) common scale



(b) w/o common scale

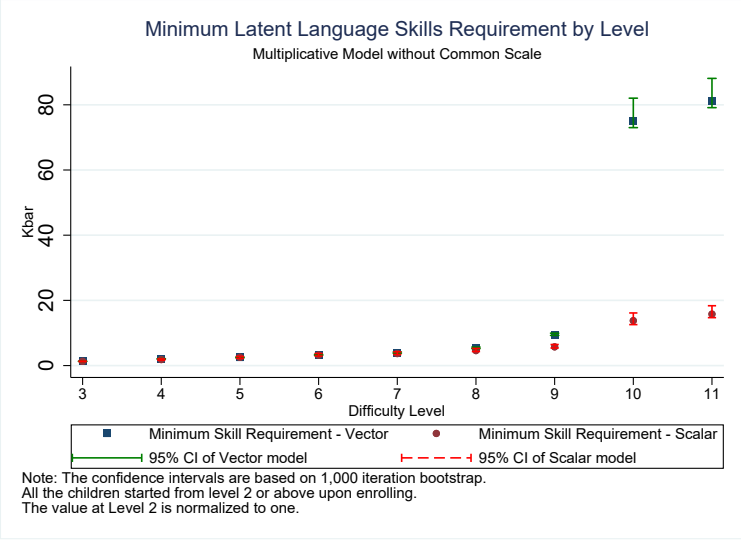
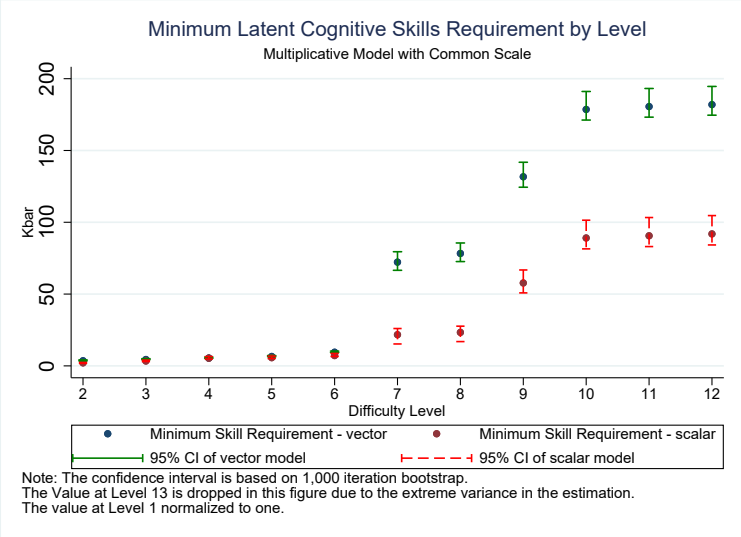


Figure L.26: Comparing Minimum Cognitive Skill Requirements ($\bar{K}$) (Scalar Model v.s Vector Model)

(a) common scale



(b) w/o common scale

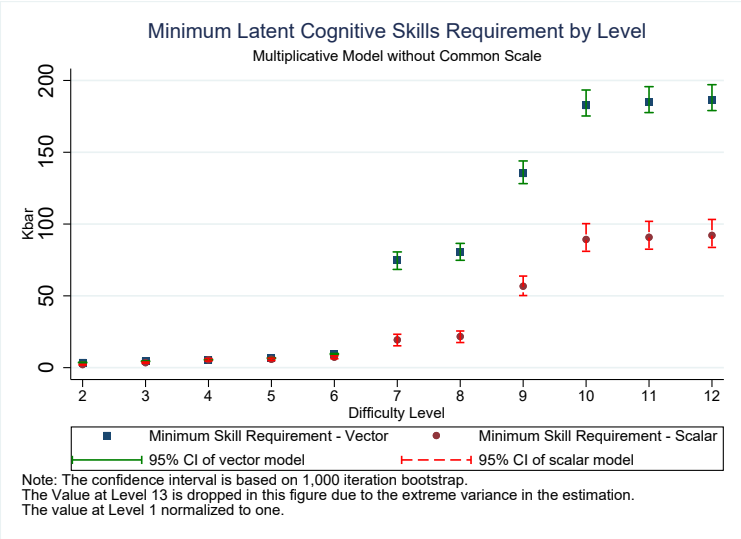
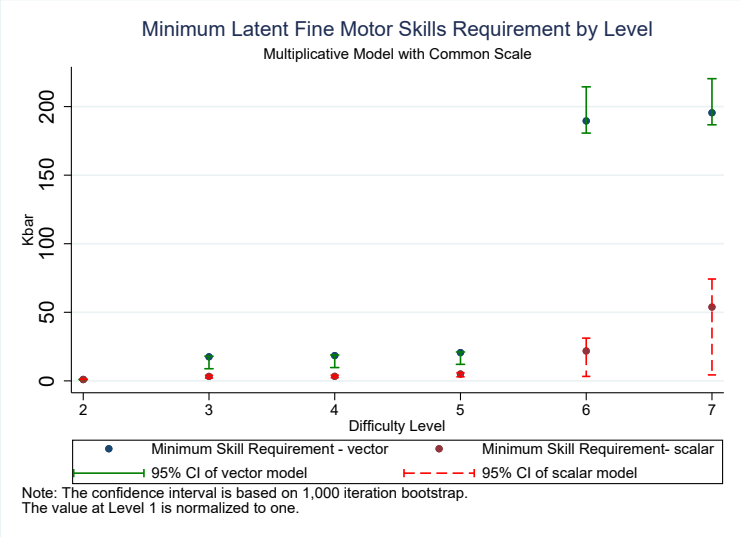
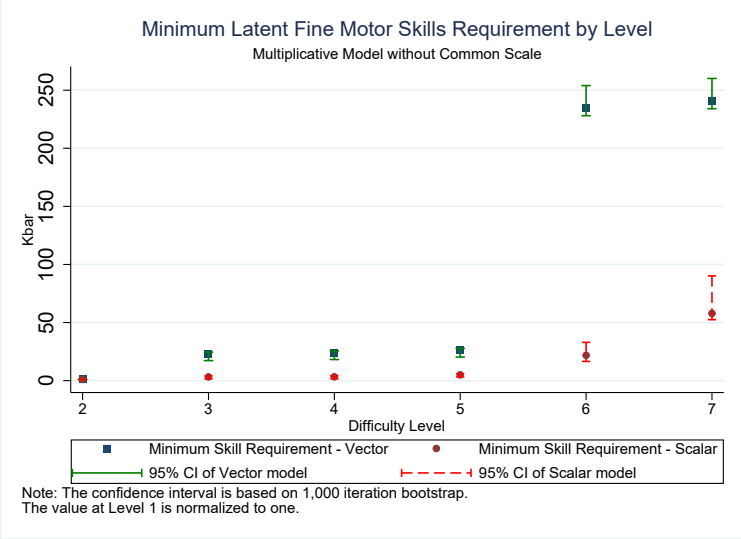


Figure L.27: Comparing Minimum Fine Motor Skill Requirements ($\bar{K}$) (Scalar Model v.s Vector Model)

(a) common scale



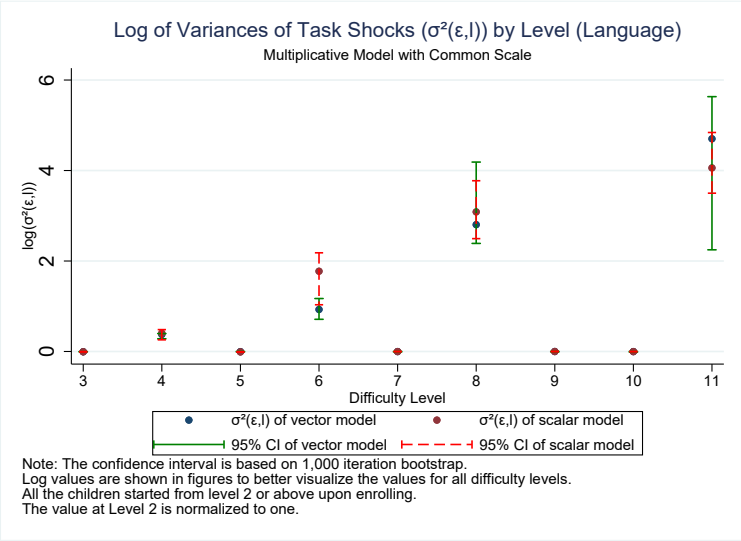
(b) w/o common scale



Comparison of Variance of Shocks $\sigma^2_{\varepsilon(\ell)}$ for Each Skill

Figure L.28: Comparing Variance of Language Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) (Scalar Model v.s Vector Model)

(a) common scale



(b) w/o common scale

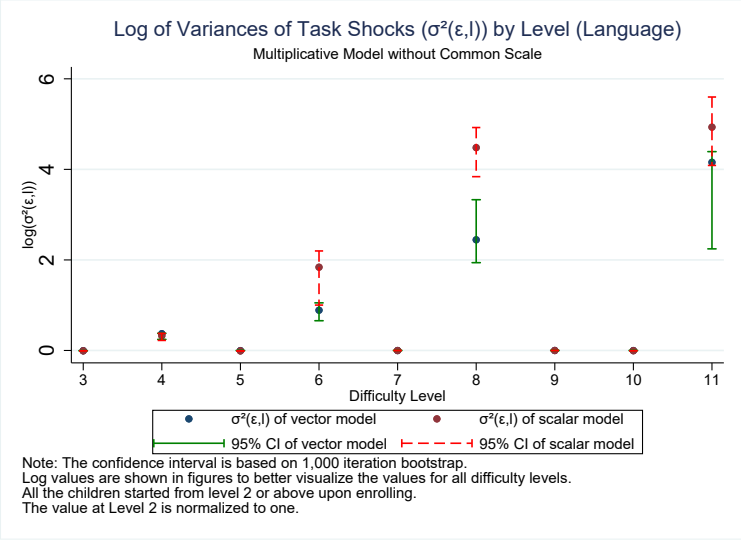
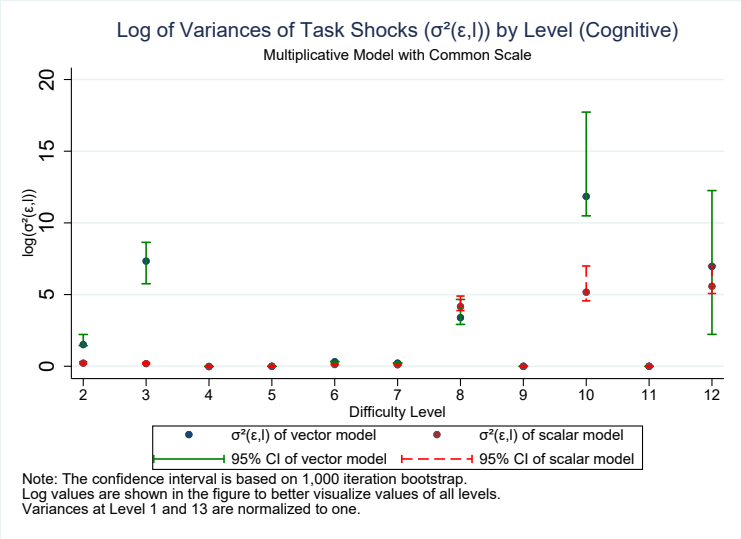


Figure L.29: Comparing Variance of Cognitive Task Shocks ($\sigma^2_{\varepsilon(\ell)}$)
(Scalar Model v.s Vector Model)

(a) common scale



(b) w/o common scale

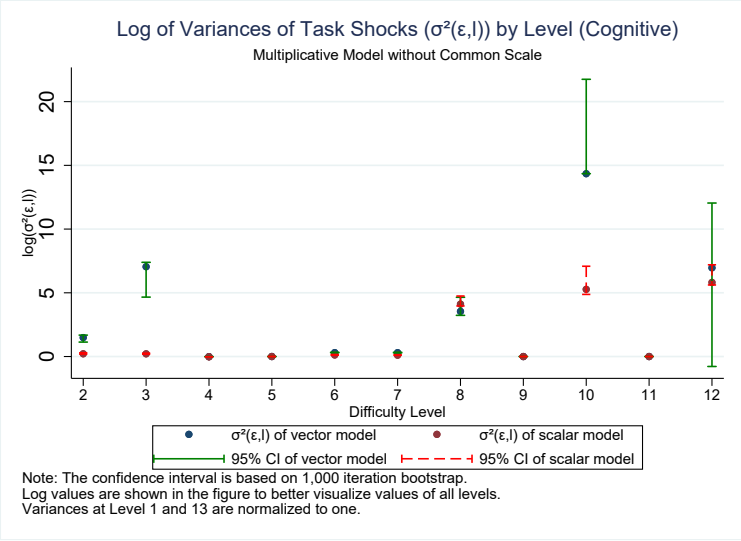
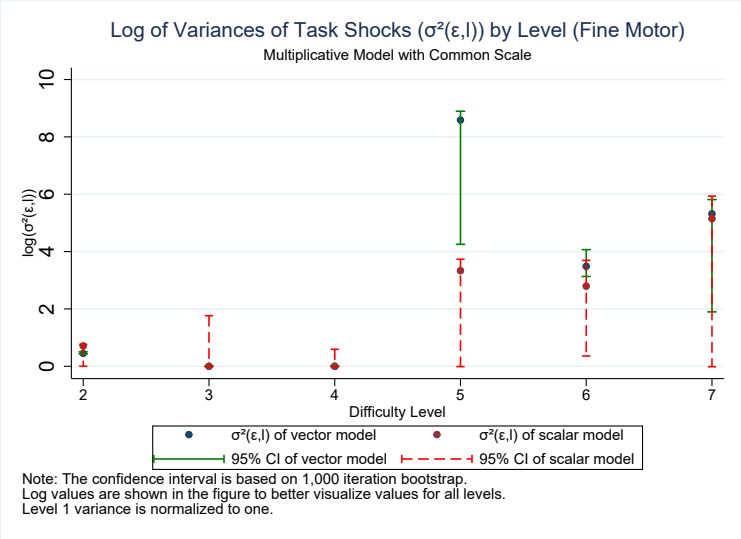
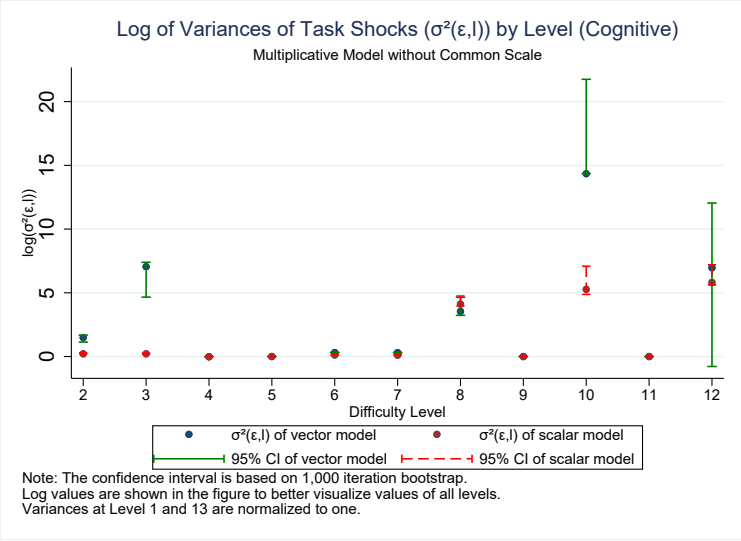


Figure L.30: Comparing Variance of Fine Motor Task Shocks ($\sigma^2_{\varepsilon(\ell)}$) (Scalar Model v.s Vector Model)

(a) common scale



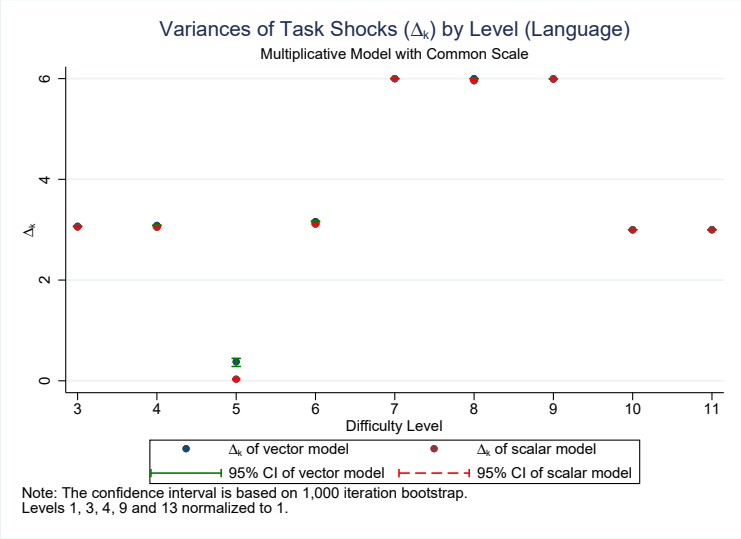
(b) w/o common scale



Comparison of Learning Component δ_ℓ for Each Skill

Figure L.31: Comparing Language Learning Component δ_ℓ (Scalar Model v.s Vector Model)

(a) common scale



(b) w/o common scale

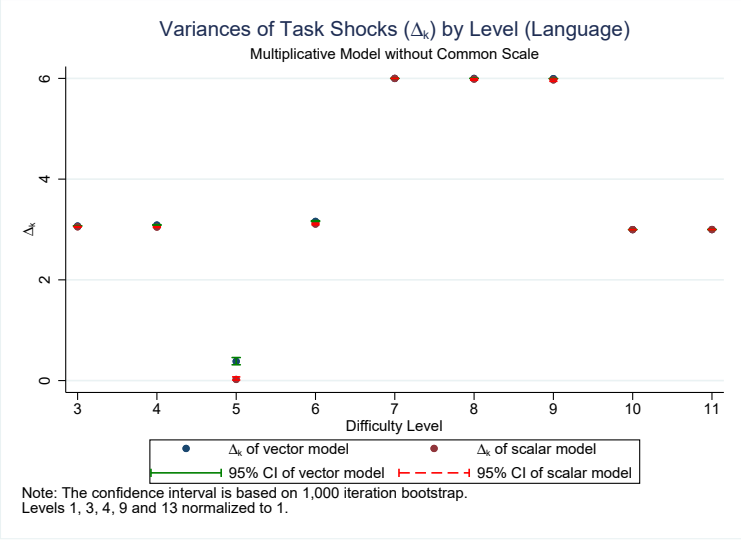
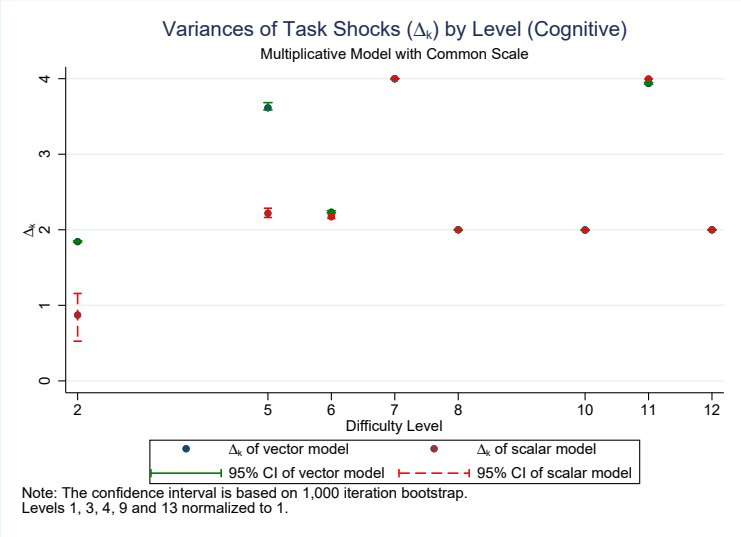


Figure L.32: Comparing Cognitive Learning Component δ_ℓ (Scalar Model v.s Vector Model)

(a) common scale



(b) w/o common scale

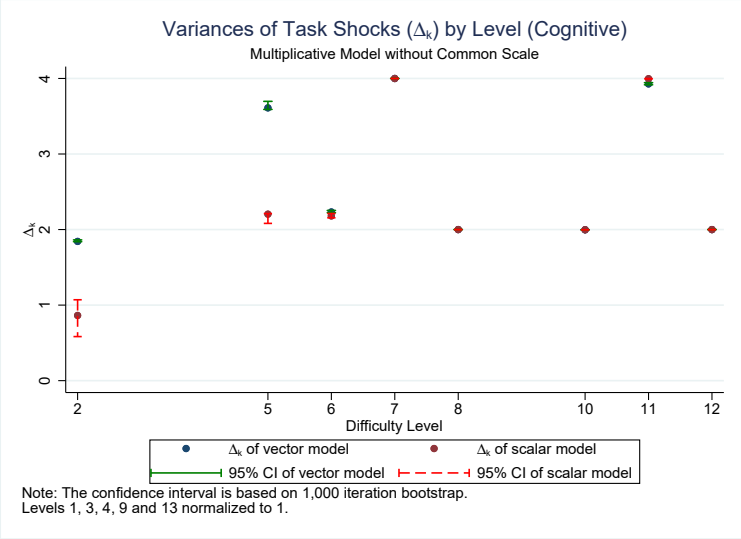
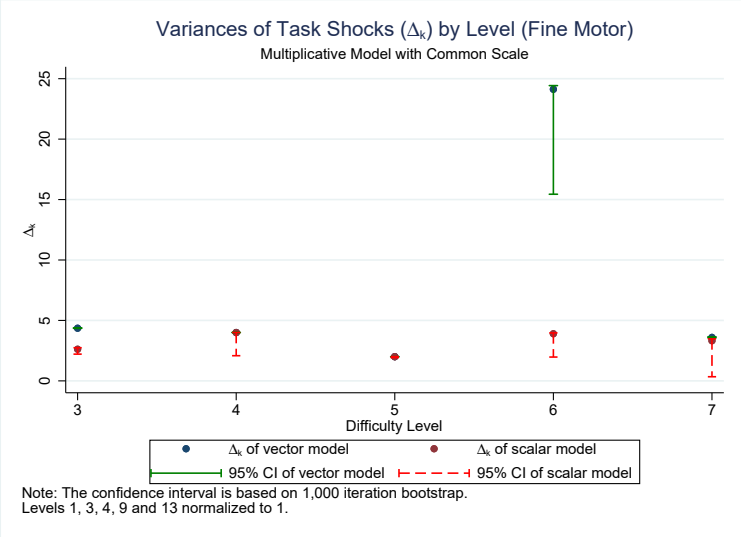
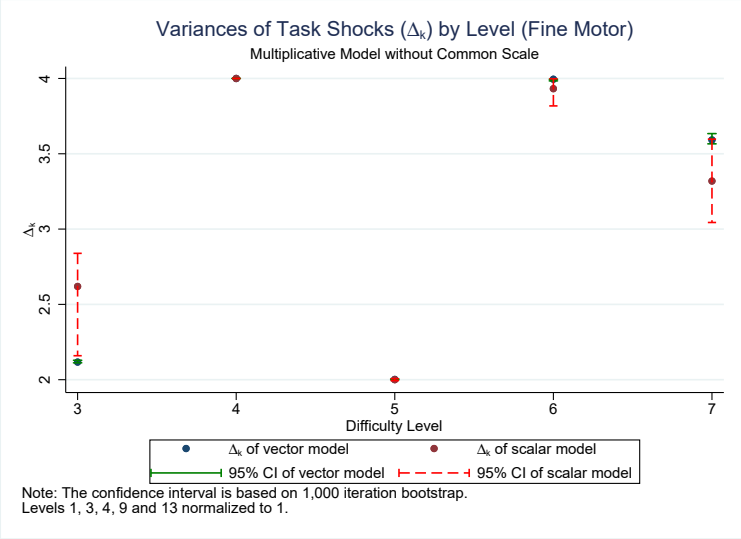


Figure L.33: Comparing Fine Motor Learning Component δ_ℓ (Scalar Model v.s Vector Model)

(a) common scale



(b) w/o common scale



M Learning Component

M.1 Scalar Model

Figure M.1: Learning Component $E(\eta(\boldsymbol{X}))$ of Language Tasks by Level

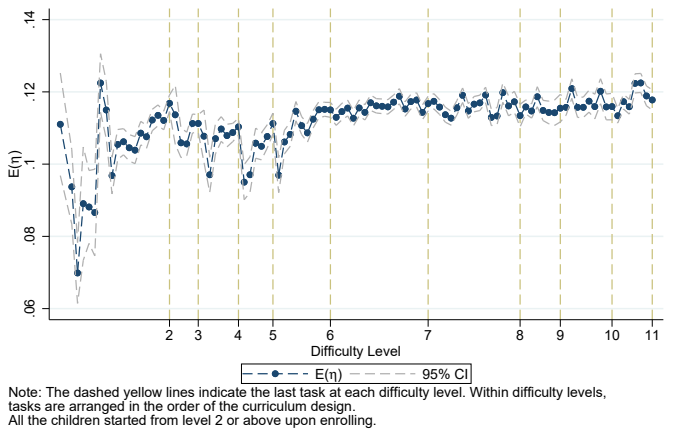


Figure M.2: Learning Component $E(\eta(X))$ of Language Tasks by Level and Ability Group

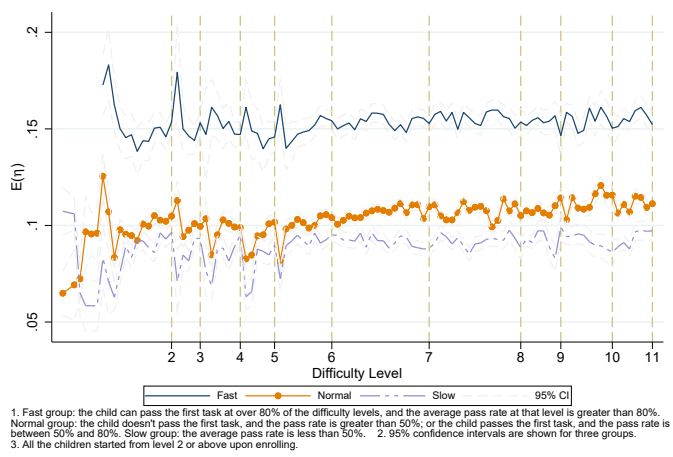


Figure M.3: Learning Component $E(\eta(X))$ of Fine Motor Tasks by Level

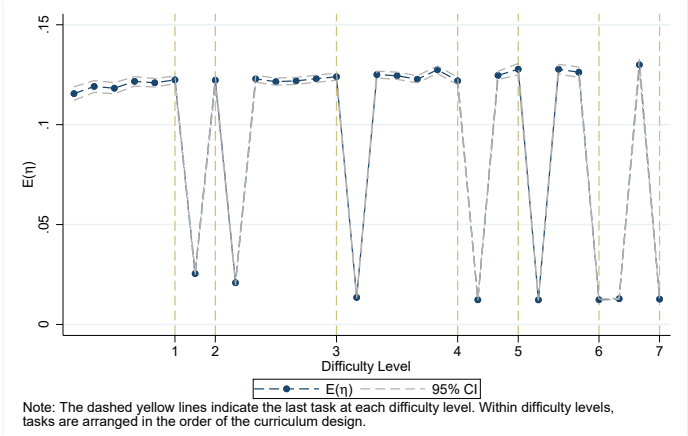
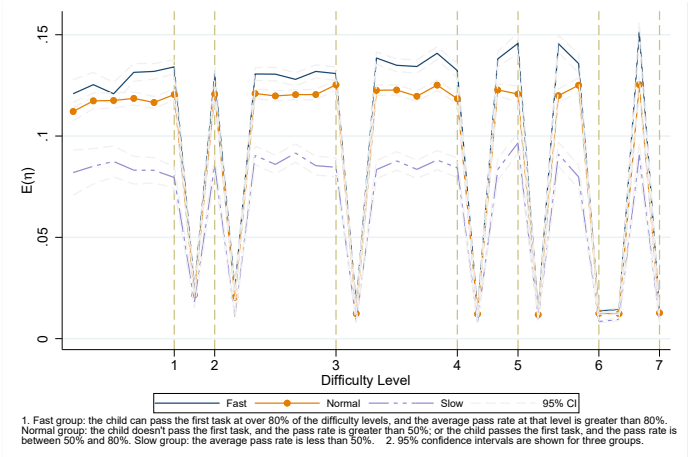


Figure M.4: Learning Component $E(\eta(X))$ of Fine Motor Tasks by Level and Ability Group



Remark. *Measures of teaching ability, interaction quality, home visitor, caregiver, and interaction of home visitor with the child, are developed in Appendix D.*

Table M.1: The Comparison of Interaction Components ($E(\eta(X)\delta_\ell)$) on Cognitive Skill Tasks' Learning Components by Family Educational Background (Scalar Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Father's Years of Education >9 Mean	1.0017	1.2745	1.0001
Father's Years of Education ≤9 Mean	1.0010	1.1641	1.0000
p-value	**(0.0012)**	**(0.0000)**	**(0.0190)**
Mother's Years of Education >9 Mean	1.0030	1.2996	1.0004
Mother's Years of Education ≤9 Mean	1.0009	1.1701	1.0000
p-value	**(0.0000)**	**(0.0000)**	**(0.0000)**
Grandmother's Years of Education≥3 Mean	1.0015	1.2273	1.0002
Grandmother's Years of Education <3 Mean	1.0009	1.1569	1.0000
p-value	**(0.0002)**	**(0.0000)**	**(0.0000)**

1. About 40% of children's grandmothers have more than 3 years of formal education.
2. p-values are presented in the parentheses.

Table M.2: The Comparison of Interaction Components ($E(\eta(\boldsymbol{X})\delta_\ell)$) by Cognitive Skill Ability (Scalar Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Slow Mean	0.9955	0.8262	0.9988
Fast Mean	1.0042	1.4681	1.0009
p-value	**(0.0000)**	**(0.0000)**	**(0.0000)**
Normal Mean	1.0006	1.1202	0.9999
Fast Mean	1.0042	1.4681	1.0009
p-value	**(0.0000)**	**(0.0000)**	**(0.0000)**
Slow Mean	0.9955	0.8262	0.9988
Normal Mean	1.0006	1.1202	0.9999
p-value	**(0.0000)**	**(0.0000)**	**(0.0000)**

1. Ability Definition: Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.3: The Comparison of Interaction Components ($E(\eta(\boldsymbol{X})\delta_\ell)$) by Cognitive Skill Ability and Age of Enrollment (Scalar Model)

Ability	Age of Enrollment	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
	Age enrollment 20–25 Months Mean	1.0045	1.4569	1.0008
	Age enrollment 9–15 Months Mean	1.0053	1.5277	1.0010
	p-value	**(0.0157)**	**(0.0003)**	**(0.0242)**
	Age enrollment 15–20 Months Mean	1.0034	1.4163	1.0008
Fast	Age enrollment 9–15 Months Mean	1.0053	1.5277	1.0010
	p-value	**(0.0000)**	**(0.0000)**	**(0.0017)**
	Age enrollment 20–25 Months Mean	1.0045	1.4569	1.0008
	Age enrollment 15–20 Months Mean	1.0034	1.4163	1.0008
	p-value	**(0.0007)**	**(0.0198)**	(0.6445)
	Age enrollment 20–25 Months Mean	1.0016	1.1802	1.0002
	Age enrollment 9–15 Months Mean	1.0004	1.0611	0.9998
	p-value	**(0.0000)**	**(0.0000)**	**(0.0000)**
	Age enrollment 15–20 Months Mean	1.0002	1.1419	0.9998
Normal	Age enrollment 9–15 Months Mean	1.0004	1.0611	0.9998
	p-value	(0.4940)	**(0.0000)**	(0.4512)
	Age enrollment 20–25 Months Mean	1.0016	1.1802	1.0002
	Age enrollment 15–20 Months Mean	1.0002	1.1419	0.9998
	p-value	**(0.0000)**	**(0.0032)**	**(0.0000)**
	Age enrollment 20–25 Months Mean	0.9965	0.7747	0.9988
	Age enrollment 9–15 Months Mean	0.9974	0.9248	0.9989
	p-value	**(0.0755)**	**(0.0000)**	(0.4359)
	Age enrollment 15–20 Months Mean	0.9927	0.7581	0.9985
Slow	Age enrollment 9–15 Months Mean	0.9974	0.9248	0.9989
	p-value	**(0.0000)**	**(0.0000)**	**(0.0034)**
	Age enrollment 20–25 Months Mean	0.9965	0.7747	0.9988
	Age enrollment 15–20 Months Mean	0.9927	0.7581	0.9985
	p-value	**(0.0000)**	(0.5448)	**(0.0192)**

1. Ability Definition: Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.4: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Language Skill Tasks' Learning Components by Family Educational Background (Scalar Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Father's Educ>9 Mean	1.033	1.158	1.071
Father's Educ≤9 Mean	1.019	1.073	1.049
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Mother's Educ>9 Mean	1.044	1.160	1.102
Mother's Educ≤9 Mean	1.019	1.080	1.046
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Grandmother's Educ>3 Mean	1.029	1.120	1.060
Grandmother's Educ≤3 Mean	1.017	1.069	1.049
p-value	**(0.000)**	**(0.000)**	**(0.000)**

1. About 40% of children's grandmother have more than 3 years of formal education.
2. p-values are presented in the parentheses.

Table M.5: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Language Skill Tasks' Learning Components by Language Skill Ability (Scalar Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Slow Mean	0.978	0.955	0.960
Fast Mean	1.078	1.360	1.181
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Normal Mean	1.010	1.022	1.023
Fast Mean	1.078	1.360	1.181
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Slow Mean	0.978	0.955	0.960
Normal Mean	1.010	1.022	1.023
p-value	**(0.000)**	**(0.000)**	**(0.000)**

1. Ability Definition:
Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.6: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Language Skill Tasks' Learning Components by Language Skill Ability and Age of Enrollment (Scalar Model)

Ability		Teaching	Interaction Quality	Interaction Quality
	Age enrollment 20–25 Months Mean	1.079	1.351	1.186
	Age enrollment 9–15 Months Mean	1.099	1.401	1.179
	p-value	**(0.000)**	**(0.000)**	(0.161)
	Age enrollment 15–20 Months Mean	1.064	1.316	1.188
Fast	Age enrollment 9–15 Months Mean	1.099	1.401	1.179
	p-value	**(0.000)**	**(0.000)**	**(0.027)**
	Age enrollment 20–25 Months Mean	1.079	1.351	1.186
	Age enrollment 15–20 Months Mean	1.064	1.316	1.188
	p-value	**(0.000)**	**(0.000)**	(0.531)
	Age enrollment 20–25 Months Mean	1.020	1.044	1.057
	Age enrollment 9–15 Months Mean	1.013	0.998	1.026
	p-value	**(0.001)**	**(0.000)**	**(0.000)**
	Age enrollment 15–20 Months Mean	1.005	1.047	1.001
Normal	Age enrollment 9–15 Months Mean	1.013	0.998	1.026
	p-value	**(0.000)**	**(0.000)**	**(0.000)**
	Age enrollment 20–25 Months Mean	1.020	1.044	1.057
	Age enrollment 15–20 Months Mean	1.005	1.047	1.001
	p-value	**(0.000)**	(0.528)	**(0.000)**
	Age enrollment 20–25 Months Mean	0.981	0.906	0.971
	Age enrollment 9–15 Months Mean	0.995	0.988	0.952
	p-value	**(0.000)**	**(0.000)**	**(0.001)**
	Age enrollment 15–20 Months Mean	0.945	0.932	0.936
Slow	Age enrollment 9–15 Months Mean	0.995	0.988	0.952
	p-value	**(0.000)**	**(0.000)**	**(0.005)**
	Age enrollment 20–25 Months Mean	0.981	0.906	0.971
	Age enrollment 15–20 Months Mean	0.945	0.932	0.936
	p-value	**(0.000)**	**(0.001)**	**(0.000)**

1. p-values are presented in the parentheses.

2. Ability Definition:

Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.

Table M.7: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Fine Motor Skill Tasks' Learning Components by Family Educational Background (Scalar Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Father's Educ>9 Mean	1.000	1.003	1.007
Father's Educ≤9 Mean	1.000	1.000	1.002
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Mother's Educ>9 Mean	1.000	1.003	1.012
Mother's Educ≤9 Mean	1.000	1.000	1.002
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Grandmother's Educ>3 Mean	1.000	1.002	1.005
Grandmother's Educ ≤3 Mean	1.000	0.999	1.002
p-value	**(0.000)**	**(0.000)**	**(0.000)**

1. About 40% of children's grandmothers have more than 3 years of formal education.
2. p-values are presented in the parentheses.

Table M.8: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Fine Motor Skill Tasks' Learning Components by Fine Motor Skill Ability (Scalar Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Slow Mean	1.000	0.987	0.973
Fast Mean	1.000	1.007	1.016
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Normal Mean	1.000	0.997	0.997
Fast Mean	1.000	1.007	1.016
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Slow Mean	1.000	0.987	0.973
Normal Mean	1.000	0.997	0.997
p-value	**(0.000)**	**(0.000)**	**(0.000)**

1. Ability Definition:
Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.9: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Fine Motor Skill Tasks' Learning Components by Fine Motor Skill Ability and Age of Enrollment (Scalar Model)

Ability		Teaching	Interaction Quality	Interaction Quality
	Age enrollment 20–25 Months Mean	1.000	1.006	1.016
	Age enrollment 9–15 Months Mean	1.000	1.005	1.015
	p-value	**(0.021)**	(0.192)	(0.731)
	Age enrollment 15–20 Months Mean	1.000	1.007	1.016
Fast	Age enrollment 9–15 Months Mean	1.000	1.005	1.015
	p-value	**(0.009)**	**(0.000)**	(0.331)
	Age enrollment 20–25 Months Mean	1.000	1.006	1.016
	Age enrollment 15–20 Months Mean	1.000	1.007	1.016
	p-value	(0.825)	**(0.000)**	(0.591)
	Age enrollment 20–25 Months Mean	1.000	0.998	1.004
	Age enrollment 9–15 Months Mean	1.000	0.998	0.996
	p-value	(0.923)	(0.190)	**(0.000)**
	Age enrollment 15–20 Months Mean	1.000	0.997	0.993
Normal	Age enrollment 9–15 Months Mean	1.000	0.998	0.996
	p-value	**(0.000)**	**(0.071)**	**(0.015)**
	Age enrollment 20–25 Months Mean	1.000	0.998	1.004
	Age enrollment 15–20 Months Mean	1.000	0.997	0.993
	p-value	**(0.000)**	**(0.004)**	**(0.000)**
	Age enrollment 20–25 Months Mean	1.000	0.986	0.976
	Age enrollment 9–15 Months Mean	1.000	0.987	0.967
	p-value	(0.106)	(0.635)	**(0.001)**
	Age enrollment 15–20 Months Mean	1.000	0.987	0.972
Slow	Age enrollment 9–15 Months Mean	1.000	0.987	0.967
	p-value	**(0.007)**	(0.665)	(0.126)
	Age enrollment 20–25 Months Mean	1.000	0.986	0.976
	Age enrollment 15–20 Months Mean	1.000	0.987	0.972
	p-value	**(0.000)**	(0.379)	(0.103)

1. p-values are presented in the parentheses.

2. Ability Definition:

Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.

M.2 Vector Model

Table M.10: The Comparison of Interaction Components ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Cognitive Skill Tasks' Learning Components by Family Educational Background (Vector Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Father's Years of Education >9 Mean	0.872	89.635	0.966
Father's Years of Education ≤9 Mean	0.903	76.705	0.975
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Mother's Years of Education >9 Mean	0.839	83.935	0.958
Mother's Years of Education ≤9 Mean	0.906	78.617	0.975
p-value	**(0.000)**	**(0.202)**	**(0.000)**
Grandmother's Years of Education≥3 Mean	0.902	89.202	0.974
Grandmother's Years of Education <3 Mean	0.893	72.599	0.972
p-value	**(0.001)**	**(0.000)**	**(0.001)**

1. About 40% of children's grandmothers have more than 3 years of formal education.
2. p-values are presented in the parentheses.

Table M.11: The Comparison of Interaction Components ($E(\eta(\boldsymbol{X})\delta_\ell)$) by Cognitive Skill Ability (Vector Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Slow Mean	0.852	41.242	0.961
Fast Mean	0.950	122.478	0.987
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Normal Mean	0.880	63.432	0.969
Fast Mean	0.950	122.478	0.987
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Slow Mean	0.852	41.242	0.961
Normal Mean	0.880	63.432	0.969
p-value	**(0.000)**	**(0.000)**	**(0.000)**

1. Ability Definition: Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.12: The Comparison of Interaction Components ($E(\eta(\boldsymbol{X})\delta_\ell)$) by Cognitive Skill Ability and Age of Enrollment (Vector Model)

Ability	Age of Enrollment	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
	Age enrollment 20–25 Months Mean	0.937	69.122	0.983
	Age enrollment 9–15 Months Mean	0.864	93.634	0.964
	p-value	**(0.000)**	**(0.000)**	**(0.000)**
	Age enrollment 15–20 Months Mean	0.904	73.265	0.975
	Age enrollment 9–15 Months Mean	0.864	93.634	0.964
	p-value	**(0.000)**	**(0.000)**	**(0.000)**
	Age enrollment 20–25 Months Mean	0.937	69.122	0.983
	Age enrollment 15–20 Months Mean	0.904	73.265	0.975
	p-value	**(0.000)**	**(0.010)**	(0.000)

1. Ability Definition: Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.13: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Language Skill Tasks' Learning Components by Family Educational Background (Vector Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Father's Educ>9 Mean	0.904	6.816	0.985
Father's Educ≤9 Mean	0.924	5.554	0.996
p-value	**(0.000)**	**(0.000)**	**(0.026)**
Mother's Educ>9 Mean	0.879	6.344	0.983
Mother's Educ≤9 Mean	0.926	5.728	0.996
p-value	**(0.000)**	**(0.000)**	**(0.025)**
Grandmother's Educ≥3 Mean	0.932	6.327	1.005
Grandmother's Educ<3 Mean	0.911	5.458	0.987
p-value	**(0.000)**	**(0.000)**	**(0.000)**

1. About 40% of children's grandmother have more than 3 years of formal education.
2. p-values are presented in the parentheses.

Table M.14: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Language Skill Tasks' Learning Components by Language Skill Ability (Vector Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Slow Mean	0.884	3.807	0.878
Fast Mean	0.996	10.489	1.182
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Normal Mean	0.893	4.587	0.942
Fast Mean	0.996	10.489	1.182
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Slow Mean	0.884	3.807	0.878
Normal Mean	0.893	4.587	0.942
p-value	**(0.000)**	**(0.000)**	**(0.000)**

1. Ability Definition: Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.15: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Language Skill Tasks' Learning Components by Language Skill Ability and Age of Enrollment (Vector Model)

Ability	Age of Enrollment	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
	Age enrollment 20–25 Months Mean	0.966	5.397	1.056
	Age enrollment 9–15 Months Mean	0.891	6.131	0.950
	p-value	**(0.000)**	**(0.000)**	**(0.000)**
	Age enrollment 15–20 Months Mean	0.919	5.613	0.990
	Age enrollment 9–15 Months Mean	0.891	6.131	0.950
	p-value	**(0.000)**	**(0.000)**	**(0.000)**
	Age enrollment 20–25 Months Mean	0.966	5.397	1.056
	Age enrollment 15–20 Months Mean	0.919	5.613	0.990
	p-value	**(0.000)**	**(0.004)**	**(0.000)**

1. Ability Definition: Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.16: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Fine Motor Skill Tasks' Learning Components by Family Educational Background (Vector Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Father's Educ>9 Mean	0.976	1.027	0.877
Father's Educ≤9 Mean	0.982	0.984	0.905
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Mother's Educ>9 Mean	0.970	0.988	0.848
Mother's Educ≤9 Mean	0.983	0.994	0.907
p-value	**(0.000)**	**(0.600)**	**(0.000)**
Grandmother's Educ≥3 Mean	0.982	1.027	0.906
Grandmother's Educ<3 Mean	0.980	0.970	0.894
p-value	**(0.042)**	**(0.000)**	**(0.009)**

1. About 40% of children's grandmother have more than 3 years of formal education.
2. p-values are presented in the parentheses.

Table M.17: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Fine Motor Skill Tasks' Learning Components by Fine Motor Skill Ability (Vector Model)

Mean	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
Slow Mean	0.968	0.669	0.794
Fast Mean	0.977	1.103	0.889
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Normal Mean	0.986	0.948	0.923
Fast Mean	0.977	1.103	0.889
p-value	**(0.000)**	**(0.000)**	**(0.000)**
Slow Mean	0.968	0.669	0.794
Normal Mean	0.986	0.948	0.923
p-value	**(0.000)**	**(0.000)**	**(0.000)**

1. Ability Definition: Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

Table M.18: The Effects of Interaction Measures ($E(\eta(\boldsymbol{X})\delta_\ell)$) on Fine Motor Skill Tasks' Learning Components by Fine Motor Skill Ability and Age of Enrollment (Vector Model)

Ability	Age of Enrollment	Teaching Ability	Interaction Quality Home Visitor and Caregiver	Interaction Quality Home Visitor and Child
	Age enrollment 20–25 Months Mean	0.988	1.029	0.943
	Age enrollment 9–15 Months Mean	0.975	0.940	0.862
	p-value	**(0.000)**	**(0.000)**	**(0.000)**
	Age enrollment 15–20 Months Mean	0.982	1.011	0.906
	Age enrollment 9–15 Months Mean	0.975	0.940	0.862
	p-value	**(0.000)**	**(0.000)**	**(0.000)**
	Age enrollment 20–25 Months Mean	0.988	1.029	0.943
	Age enrollment 15–20 Months Mean	0.982	1.011	0.906
	p-value	**(0.000)**	**(0.049)**	**(0.000)**

1. Ability Definition: Fast group: child passes the first tasks for more than 80% difficulty levels, and the average passing rate is more than 80% of all the tasks. Normal group: Child passes the first tasks less than 80% of difficulty levels, and the average passing rate is between 50% and 80%. Slow group: the average passing rate is less than 50%.
2. p-values are presented in the parentheses.

N Measurement Errors

N.1 Measurement Error

In our paper, we also allow discrete measurement errors. The observation of the child's performance: "recorded passed the item" comes from two sources: a) the child actually passed the item with no measurement error, or b) the child did not pass the item but it is recorded as "passed" by mistake. Similarly, the observation of the child's performance "recorded not passed the task" also comes from two occasions: a) the children actually did not pass the task and record it correctly, and b) the child passed the task but recorded it "not passed" by mistake.

In our model, $\mathcal{S}$ is the set of skills taught. Let $\ell(s, a)$ be the level of skill s taught at age a. Mastery of skill s at level ℓ at age a is characterized by:

$$D(s, \ell, a) = \begin{cases} 1 & K(s, \ell, a) \geq \bar{K}(s, \ell) \\ 0 & \text{otherwise} \end{cases} \tag{N.1}$$

where we use $D(s, \ell, a)$ to denote the task performance for skill s at level ℓ at age a in theory. Then, for each type of skill, we allow for the possibility that observations are recorded by mistake with the probability q_s for each skill type s, which is independent across each task given the skill type s.

$$\tilde{D}(s, \ell, a) = \begin{cases} D(s, \ell, a) & \text{with probability of} \quad 1 - q(s) \\ 1 - D(s, \ell, a) & \text{with probability of} \quad q(s) \end{cases} \tag{N.2}$$

where we let $\tilde{D}(s, \ell, a)$ denote the observations in our data. We allow measurement

errors (i.e., home visitors could record by mistakes (children passed the task but the record failed or the other way around.)).

In Table N.1, we present the estimates of the probability q_s for each skill type. Across all difficulty levels, the probability is not large. Also, given the existence of measurement errors, all estimates are consistent findings with those from a model without measurement errors.

Table N.1: Measurement Errors

Language	Point Estimate	0.136
	Standard Error	(0.031)
Cognitive	Point Estimate	0.112
	Standard Error	(0.029)
Fine Motor	Point Estimate	0.132
	Standard Error	(0.024)

N.2 IRT Model by Difficulty Level

In this section, we conduct a separate analysis apart from that reported above and report the estimates of an IRT model with the guessing parameters for language, cognitive, and fine motor skills by difficulty levels. We do this level-by-level for each item for each level and each skill. This analysis is highly disaggregated and confirms the more aggregated analysis above. We summarize the results by level.

Table N.2: Estimates of Error Probabilities for Language Skills by Difficulty Levels

UHP Language	Guessing Parameter	UHP Language	Guessing Parameter
Level 2	0.0000	Level 7	0.0373
	[-0.0001 0.0001]		[-0.0553 0.1300]
Level 3	0.0129	Level 8	0.0000
	[-0.2270 0.2528]		[-0.0001 0.0001]
Level 4	0.1522	Level 9	0.0000
	[-0.2527 0.5571]		[-0.0001 0.0001]
Level 5	0.0000	Level 10	0.4711
	[-0.0002 0.0002]		[0.2787 0.6635]
Level 6	0.1395	Level 11	0.0322
	[-0.0015 0.2804]		[-0.2458 0.3102]

1. 95% confidence intervals are reported in the brackets.

Table N.3: Estimates of Error Probabilities for Cognitive Skills by Difficulty Levels

UHP Cognitive	Guessing Parameter	UHP Cognitive	Guessing Parameter
Level 1	0.0255	Level 6	0.0125
	[-0.0968 0.1478]		[-0.0874 0.1123]
Level 2	0.0011	Level 7	0.0000
	[-0.0951 0.0974]		[-0.0001 0.0001]
Level 3	0.0000	Level 8	0.0000
	[-0.0013 0.0013]		[-0.0001 0.0001]
Level 5	0.0279		
	[-0.0346 0.0903]		

1. 95% confidence intervals are reported in the brackets.

2. UHP Cognitive Levels 4, 9 to 13 have too few tasks to estimate guessing parameters using 3 parameters IRT.

Table N.4: Estimates of Error Probabilities for Fine Motor Skills by Difficulty Levels

UHP Fine Motor	Guessing Parameter
Level 1	0.0000
	[-0.0031 0.0031]
Level 3	0.0000
	[-0.0002 0.0002]
Level 4	0.0590
	[-0.0516 0.1697]

1. 95% confidence intervals are reported in the brackets.
2. UHP Cognitive Levels 2, 5 to 7 have too few tasks to estimate guessing parameters using 3 parameters IRT.

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