

Article

Increasing Requests for Information by Preschoolers with and without Language-Based Disabilities

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Abstract: We report two experiments on the emission of questions to request the names of unfamiliar stimuli by preschoolers. In the first experiment, 19 preschoolers with and without disabilities served as participants. Experiment 1 was a descriptive analysis of whether or not the 19 participants asked questions about unfamiliar pictures and objects in one-to-one and group settings. These were dependent variables in the second experiment as well. Four participants, who did not ask any questions in the first experiment, served as participants in the second experiment. During the intervention, the participants observed the peer confederates (1) ask questions (e.g., “What is that?”), (2) receive information from the experimenter, and (3) receive praise and tokens contingent on asking a question. A multiple probe design across participants was used. The data showed that the participants increased the number of questions when we returned to baseline conditions. Results are discussed in terms of where the reinforcement exists for asking questions about unfamiliar things in one’s environment, and whether this truly measures the “need to know”.

Keywords: curiosity; conditioned reinforcement; question-asking; request information; need to know



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1. Introduction

Skinner [1] described the process of problem-solving as a behavior that strengthens some other behavior of the solver and involves constructions of discriminative stimuli. If one is unable to emit a behavior that had previously led to a particular type of reinforcement, one must manipulate the variables in the environment. The behavior that functions to change the environment is thus the problem-solving behavior. Behaviors that once emitted, solve problems, may be under the control of direct contingencies or governed by rules constructed by the solver or someone else. If one uses verbal behavior to mediate the environment through other people, one needs to ask questions or request information. Skinner categorized a question that currently has no answers as a “problem” [1]. It is the nature of most organisms, especially humans, to attempt to solve “problems”.

It would appear from the behavior analytic perspective that one of the behaviors associated with problem-solving is requesting information. Individuals who attempt to solve problems and those who request information to do so are described as being curious. Behavior analysts would not suggest that these requests or questions are caused by curiosity but rather that the emission of questions is a behavior that could be described as curiosity. A request for information is a behavior under the control of environmental conditions and a particular individual’s history of learned stimulus control as well as phylogenetic contributions. The focus of the behavior analysis is to study how experiences lead to the development of questions as both problem-solving and curiosity as behaviors.

Requesting information is such an important repertoire that behavioral educators and researchers have developed procedures for children with language-based disabilities such as Autism Spectrum Disorders (ASD) that specifically target increasing requests for information. Researchers and practitioners have used prompt-fading, modeling, echoic

training and chaining successfully to teach children with ASD to ask “what”, “where”, “which”, “when”, “why” and “how” questions [2–11].

By definition, all requests occur under states of either deprivation or satiation. Thus, the reinforcement procedures involve adding a (typically preferred) stimulus to the environment or removing a (typically non-preferred or aversive) stimulus from the environment. The term motivating operation (MO) is used for an environmental variable that temporarily alters the value of a stimulus as a reinforcer. Those that have an evocative effect on behavior are establishing operations (EOs), and those that have an abative effect on behaviors are abolishing operations (AOs) [12,13]. Loewenstein [14] suggested that when a gap in one’s knowledge arises, this produces a state of deprivation, which is the necessary condition that occasions attempts to obtain the missing information. The information gap, therefore, is the EO responsible for the increases in information-seeking behaviors such as questions.

Two strategies that children use to problem solve an unknown occurrence are causal interventions and asking questions that seek information or explanations. Research suggests that these strategies improve in efficiency as children age ([15] Liquin and Lombrozo, 2020). In a recent study by Shillingsburg, Frampton, Wymer, and Bartlett [16], the researcher taught children who did not previously request social information to do so. Two children with ASD participated in the study in which there was a pre-training phase, a treatment phase during which the children were prompted to ask questions of their social partners and then EO and AO conditions. Tokens and praise were used as reinforcers during the training phases. The results of the study showed that the procedure was effective in teaching the two participants to ask social questions under the relevant motivating conditions.

In another study, Shillingsburg, Marya, Bartlett, and Thompson [17] taught three young children with ASD to request information using assistive technology applications. The experimenters taught the children to request “Which cup?” or “Who has it?” under both EO and AO conditions. The children used the TouchChat, WordPower, and Proloquo2Go applications and were required to either navigate to a “Questions” page to choose the correct question or type the correct question once the motivating conditions were in place. During this experiment, the researchers placed preferred items under one of two cups to set the occasion for the “Which cup?” request form, and in one of the experimenter’s hands to set the occasion for the “Who has it?” request form. During the AO conditions, contingent on a request for the preferred item, the experimenter provided the information necessary to find the preferred item (e.g., “It is under the yellow cup”; “Alfred has it”) During the EO conditions, contingent on a request for a preferred item, the experimenter made a general statement such as “It is under one of the cups”. Request training was conducted following baseline using a constant time delay procedure. Correct requests for information resulted in the experimenter providing the information needed to find the preferred hidden item. The results of the study showed that none of the children emitted any requests for information during baseline but following request training, all three children requested for information with “Which cup?” and “Who has it?” in the EO conditions. No children requested for information during the AO conditions.

In a recent study on naming by exclusion, the authors proposed that if the reinforcement for acquiring information regarding novel stimuli is the removal of discomfort for not knowing about the novel stimulus, then the accompanying learned conditioned MO for the newly conditioned reinforcement might be described as the “need to know” [18]. The authors identified that multiple exemplar instruction (MEI) [19,20] resulted in naming by exclusion. Even though before the study, all participants reliably demonstrated learning the names of things under non-exclusionary conditions [21], the experimenter requesting unfamiliar objects with contrived names in the presence of familiar objects did not lead to the acquisition of the names of the unfamiliar objects. Their study suggested that establishing conditions under which unfamiliar stimuli resulted in naming by exclusion suggested not knowing the names of objects had acquired aversive stimulus control resulting in reinforcement for learning the names of things. “Need to know” should be the result of

novel stimuli acquiring reinforcing and motivating properties. The emission of requests for information, therefore, could function to alleviate the need to know and, therefore, serve as a valid measure.

Discovering the environmental conditions under which children are most likely to emit requests for information is also essential. By learning this, we can establish similar conditions to set the occasion for maximum “information seeking” behaviors, such as emitting requests for information in the form of questions, by children both in and out of the classroom. Jirout and Klahr [22] used a visual exploration game during which preschoolers had opportunities to visually search environments containing all familiar, some familiar, and all unfamiliar stimuli to determine “curiosity” levels in children. The results demonstrated that most of the children in the study did not visually search the environment when all of the stimuli were unfamiliar or when all of the stimuli were familiar. However, when a portion of the environmental stimuli was familiar, the children were more likely to engage in visual searching. In a related study, Jirout [23], using this same measure, showed that children who were more likely to explore unfamiliar stimuli visually asked more questions about presented topics. Liquin and Lombrozo [24] (2020) found in one experiment that the strongest predictors of explanation-seeking curiosity were three forward-looking triggers, which are triggers that involve the expected outcomes of pursuing information about the unknown. These were anticipated learning, learning potential and future utility. The results of another experiment showed that participants’ judgments of novelty, surprise, and the information gap associated with particular stimuli reliably predicted explanation-seeking curiosity, adding to the evidence put forth in previous research. In another paper, Liquin and Lombrozo [15] (2020) described the following triggers of explanation-seeking curiosity (ESC): novelty or surprise, an adult’s question or surprise and expectations about how much information may be gained. The authors also support the notion that curiosity is at its maximum when there is a moderate information gap as compared to a maximally surprising stimulus. Mills et al. [25] (2019) sought to test if weak explanations of unknown items created stronger states of deprivation of information. Children aged 7 to 10-years old were asked to rate the quality of answers to questions about unknown items and then were provided with the opportunity to request additional information. The results showed that the more poorly children rated the explanations, the more information they requested. These findings support that one’s deprivation state increases if explanations are circular and weak.

Including peers in interventions to increase or strengthen the behavior of young children has been well documented in behavioral research. Interventions involving peers have been used to teach and generalize social skills in children with ASD [26–28], increase and induce first instances of food acceptance and swallowing in children with feeding disorders [29,30], and improve academic skills in school-aged children [31,32]. We chose to involve peers in our intervention because all the members of our target participant pool observed their peers and modeled their peers’ behaviors in generalized settings.

Although it is reported that, as a norm, children frequently ask questions or request information [33], this may not be the case for all neurotypical children. Post and Walma vander Molen [34] (2018) used a questionnaire to study fourth, fifth, and sixth graders’ perceptions of curiosity as prerequisites to potential curiosity-driven behavior such as asking questions. They found that overall, the participants did not have positive perceptions about the value of being curious in school. These findings support to some extent the argument that primary school settings limit active information seeking activities, as lessons often focus on single correct answers and question asking actually becomes a disruption to a teacher’s pre-planned lesson. It is possible, then, that certain children without native disabilities may not request information about unknown stimuli due to specific instructional histories. There is, however, little research on teaching procedures that target increasing requests for information in children who have mild or no speech and language delays or who have had a limited instructional history with reinforcement for requesting information.

In the following study, we posed several questions regarding the occurrences of children’s requests for information to determine (1) if preschoolers with and without disabilities would request information about unfamiliar objects and pictures when they were presented in four different ways and (2) if there were differences in the numbers of requests for information emitted across four conditions that would be likely to establish the EOs or AOs for asking questions. A total of three out of the four conditions rotated familiar and unfamiliar stimuli to establish a “medium level of uncertainty” (not all familiar, not all unfamiliar) as in the Jirout and Klahr [22] study. In both experiments, we arranged four conditions that might act as motivating conditions for the emission requests for information as a test of the presence or absence of the repertoire or its strength and conducted baseline probes. These were (a) an iPad condition during which the participants and experimenters rotated opportunities to label familiar and unfamiliar pictures on an iPad, (b) a SMART Board condition during which we presented three large unfamiliar pictures on a screen, (c) an individual Show and Tell condition during which we asked participants to label one unfamiliar and four familiar items in repeated occasions, and (d) a group Show and Tell condition was similar to the individual condition during which we asked participants to label one unfamiliar and four familiar items in a group setting,

In the second experiment, children who never requested information were chosen to be participants to test whether an intervention utilizing vicarious reinforcement would function to establish requests for information. Vicarious reinforcement has been defined as “changes in the behavior of people not directly treated by an intervention as a function of treatment contingencies applied to other people” [35] (p. 622). During the intervention, participants (1) observed confederate peers request information about unfamiliar pictures, (2) observed an experimenter provide the correct label of the picture and (3) observed the confederates receive generalized reinforcers in the form of social praise and tokens. Once participants achieved criteria for requesting information about the names of unfamiliar stimuli during the intervention sessions, we conducted return to baseline probes across the four conditions.

2. Materials and Methods

2.1. Experiment 1

2.1.1. Participants

We recruited nineteen 3- to 4-year-old preschoolers to participate in Experiment 1. There were 14 boys and 5 girls; 12 of them were identified as preschoolers with disabilities, and seven were typically developing. Table 1 shows the participants’ detailed demographic information and the related standardized test scores. The psychologists from each participant’s school district conducted the psychological assessments. Thus, the types of assessment tools varied. The participants’ verbal repertoires were assessed by the CABAS® International Curriculum and Inventory of Repertoires for Children from Preschool through Kindergarten (C-PIRK®) [36,37] and Verbal Behavior Development Assessment (VBDA) [38] by the professionals who were calibrated to a standard for conducting the assessment. The participants had various repertoires associated with listener, speaker, reader, and writer verbal behavior functions.

Table 1. Demographical Information and Relevant Test Score of All Participants in Experiment 1 and 2.

Participant	Gender	Age	Diagnosis	Relevant Standard Test Scores
1	M	3 years 8 months	ASD	PSL-5 (12/20/12) Expressive Communication SS 87, 19 percentile
2	M	4 years 1 month	ASD	PSL-5 (04/15/13) Expressive Communication SS 90, 25 percentile
3(B)	M	3 years 7 months	ASD	PSL-5 (01/28/13) Expressive Communication SS 70 WPPSI-III (01/28/13) Verbal IQ SS 77

Table 1. Cont.

Participant	Gender	Age	Diagnosis	Relevant Standard Test Scores
4	M	4 years 4 months	ASD	PSL-4 (04/27/12) Expressive Communication SS 73 WPPSI-III (05/01/12) Verbal IQ SS 77
5	M	4 years	ASD	PSL-5 (10/11/12) Expressive Communication SS 72, 3 percentile
6	M	3 years 9 months	N/A	Boehm Test of Basic Concepts 90% correct, 62 percentile
7(C)	F	4 years 6 months	N/A	N/A
8	F	3 years 4 months	N/A	N/A
9	F	3 years 9 months	N/A	Boehm Test of Basic Concepts 98% correct, 94 percentile
10	M	4 years 1 month	ASD	PSL-5 (08/06/12) Expressive Communication SS 65 WPPSI-III (10/18/12) Verbal IQ SS 84
11(D)	F	3 years 1 month	N/A	N/A
13	M	4 years 4 months	ASD	PSL-5 (01/02/13) Expressive Communication SS 97
14	M	4 years 9 months	ASD	PSL-5 (01/07/13) Expressive Communication SS 78
15	M	4 years 11 months	ASD	PSL-5 (12/14/12) Expressive Communication SS 103
16	M	4 years 4 months	ASD	PSL-5 (06/08/12) Expressive Communication SS 90, 25 percentile
17(A)	M	4 years 9 months	ASD	PSL-5 (01/27/13) Expressive Communication 2.6–3.0 (age equivalent)
18	F	4 years 5 months	N/A	
19	F	4 years 7 months	N/A	

Note. The Preschool Language Scale-5 (PSL-5) is a developmental language skill assessment (PSL-5) [39]. The Preschool Language Scale-4 (PSL-4) is also a developmental language skill assessment [40]. Wechsler Preschool and Primary Scales of Intelligence –III (WPPSI-III) provides intelligence scores in multiple areas for young children based on their age [41]. Boehm Test of Basic Concepts is a developmental assessment on basic relational concepts [42]. Letters A, B, C, and D in the Participant’s Column indicate the participants in Experiment 2.

All the participants attended a publicly funded privately run preschool for children with and without disabilities. The school was located in the suburb of a metropolitan area. All participants were selected from integrated classrooms, which had students with Individualized Education Plans (IEPs) and the others neurotypically developing.

2.1.2. Setting and Materials

We prepared both picture and object stimuli in individual and group settings to test for the participants’ request for information for unknown stimuli. We used the actual names for the unknown pictures in Condition a and b and contrived names for the unknown objects for Condition c and d. For example, the note holder placed in the orange bag was named “oot”. To capture the exact motivation conditions that set the occasion for question asking, we contrived the four conditions. We presented different numbers of unknown stimuli in each condition, and there were 24 total opportunities in total.

- (a) Pictures on iPad. This condition took place in an empty room in the school. There was no table or chair placed in the room. The experimenter and the participant sat on the floor. The experimenter presented the pictures to the participants on an iPad using a pre-installed Keynote app. The probe set included 30 pictures in total, 15 for the experimenter and 15 for the participant. Out of the 15 pictures used, 5 were known to the participants (e.g., dinosaur, book, bed), and 10 were unknown. The participant had ten total opportunities to request unknown information (please see Table 2).

- (b) Pictures on Smartboard. This condition took place in the classroom. The Smartboard (197 × 128 cm) was installed against the wall and connected to the teacher’s desktop. The teacher’s desk was placed next to the Smartboard. Several students’ tables and chairs were set facing the Smartboard screen. There were three total opportunities for requests for information (please see Table 3).
- (c) Individual Show and Tell. This condition took place in the same room that tested for Pictures on iPad. The experimenter prepared five recyclable grocery bags with different colors. Each bag included four known objects (e.g., toy star, toy pig, ball, toy plane) and one unknown object and was presented twice. There were 10 total opportunities for requests for information (please see Table 4).
- (d) Group Show and Tell. The participant and three other peers sat around a big horseshoe-shaped table used for group instruction and lunch/snack time. The experimenter sat in the middle of the table and presented the bags to the students. Each student received a bag with four known and one unknown objects. All stimuli used were different from the ones used in the individual setting (please see Table 5).

Table 2. Picture stimuli used during the iPad condition.

	Experimenter	Participant
1	Truck	Dinosaur
2	Toilet brush	Cable drop
3	Boots	Door jack
4	Radio	Trivet
5	Telephone	Spaghetti measure
6	Star	Cable tie
7	Soap pump	Book
8	Clock	Pig
9	Woody	Mosquito incense
10	Tree	Signal tower
11	Car	Tap wrench
12	Cat/Kitten	Massage ball
13	Pinch mit	Flower
14	Mini saucer	Bed
15	Hamburger	Plumbing brush

Table 3. Picture stimuli used in the SMART Board Condition.

	1	2	3
Novel Stimulus	Melted milk container	Fuzzy angel	Ancient ghost

Table 4. Object stimuli used during the One-to-One Show and Tell Condition.

Bag	Set 1		Set 2	
	Novel Stimulus	Contrived Name	Novel Stimulus	Contrived Name
Yellow	Cookie cutter	Bek	Mental ruler	Berfect
Pink	Dog toy	Tata	LED mouthpiece	Forry
Blue	Spinner	Mig	Lip whistles	Zery
Green	Strainer	Ziz	Hair curler	Zummer
Orange	Note holder	Oot	Massage sponge	Cweet

Table 5. Object stimuli used in the Group Show and Tell condition.

	Familiar Stimuli				Unfamiliar Stimuli	
	1	2	3	4	Novel Stimulus	Contrived Name
Orange	Butterfly	Spinner	Star	Pig	Brillo	Gugi
Yellow	Dice	Giraffe	Leaf	Block	Green top	Mup
Pink	Flower	Ball	Slipper	Dinosaur	Silicon poacher	Pimmel
Blue	Snow	Plane	Ball	Turtle	Juicer	Tay

2.1.3. Dependent Variable and Response Definition

The dependent variable was the number of questions the participants asked to unknown stimuli. We contrived both EO and AO conditions to investigate the participants' functional use of question asking as their request for information. EO conditions were programmed with the experimenter presenting unknown stimuli when the information was needed. AO conditions were programmed with the experimenter presenting known stimuli when the information was not needed.

Data were recorded on the participants' requests for information during the EO conditions. Correct responses were recorded only when the participant emitted the appropriate form of a request for information within 10 s of the antecedent (e.g., *What is this?*). Incorrect responses were any other vocal verbal response (e.g., comments about the stimulus; stating "I do not know"; questioning about the functions "What do you do with it?" "How can you play with it?") or lack of a response within 10 s.

If the participants requested information on the known stimuli (AO conditions), the experimenter prompted them to provide the correct names. All participants then emitted correct names after the teacher prompts. Therefore, we did not consistently record data on the requests for information during AO conditions.

2.1.4. Procedure

The experimenters presented known and unknown stimuli in four conditions to test if the participants asked a question to request for information. Both pictures and objects were used to provide a larger variety of experimental stimuli and to control any possible individual preferences or instructional history. If the participant requested for the name of an unknown stimulus, the experimenter provided the information immediately. If the participant stated, "I do not know" or made comments about the unknown stimulus, the experimenter acknowledged it (e.g., "Okay".) If the participant requested for information other than the name of the stimulus (e.g., function), the experimenter answered: "I am not sure". No intervention was conducted in this experiment.

During the Pictures on iPad condition, the experimenter presented pictures on the iPad to the participant. The experimenter prepared a mix of known with unknown pictures and programmed them in a specific order. The experimenter told the participant, "We are going to look at some pictures on the iPad together. We are going to take turns to say the names of these pictures. I will be the first one, and you will be next". The experimenter held the iPad in hand and swiped the screen to reveal the next picture.

During the Pictures on Smartboard condition, the experimenter led the participant to a classroom and presented a screen-sized picture (i.e., a melted milk container). No other students were present in the classroom at the same time. The experiment pretended to search for documents at a teacher's desk and did not give any vocal antecedent or attempt to obtain the participant's attention to the board. If the participant did not request information about the picture, the experimenter continued with the next slide.

During the individual Show and Tell condition, the experimenter prepared five bags with different colors and asked the participant to show and tell the objects. The experimenter told the participant, "I have five bags here. I want you to tell me the names of the objects inside. You can pick one bag at a time. Once done, put everything back in the bag".

The participant chose one bag at a time, placed all objects from the bag on the table, and named all of them before cleaning up and selected another bag.

During the Group Show and Tell condition, the experimenter asked the participant and four other peers to sit down around a big table. The experimenter then announced the rule to the group “I have five bags here. Each contained some toys. I want you to take a look at these toys inside for one min and then share with your peers what you have there”. She then passed the bags around the table and set the timer for one min. After one min, the student sitting at the end of the table began by describing all objects in his/her bag while the rest of the group were asked to attend to the speaker. All other students then took turns to show and tell their objects.

2.1.5. Interobserver Agreement and Procedure Integrity

Interobserver Agreement (IOA) was conducted by an independent observer taking data simultaneously with one of the experimenters. IOA was calculated by dividing the numbers of point-to-point agreements and disagreements by the total numbers of agreements plus disagreements and multiplying by 100%. We collected 100% IOA for all sessions in the Pictures on Smartboard and the group Show and Tell conditions, 84% of the sessions in the Pictures on iPad condition, and for 58% of the sessions in the individual Show and Tell condition.

2.2. Experiment 2

2.2.1. Participants

We selected four preschoolers (three boys and one girl) from Experiment 1 to serve as participants in Experiment 2. These four participants were chosen because they did not ask questions about any of the novel stimuli during baseline. Participants A and B were diagnosed with ASD, and Participant C and D were neuro-typically developing. Please see Table 1 for all their detailed demographic information and their related standardized test scores.

At the onset of the study, all participants functioned at the listener, speaker, speaker-as-own-listener, beginning reader, and beginning writer levels of verbal behavior [38]. They had the following related verbal behavior developmental cusps and capabilities in their repertoires: bidirectional naming (a verbal behavior cusp and capability that allows one to respond to a novel stimulus as a speaker and with a selection response as a listener upon hearing its name without direct instruction) [21,43], observational learning (a verbal behavior cusp and capability that enables one to learn from observing the instruction of other receive both reinforcements for correct responses and corrections for incorrect responses) [44,45], audience control (a verbal behavior cusp that allows one to engage in certain verbal responses in the presence of certain audiences) [38,46], conversational units (a verbal episode in which both parties function as a speaker and a listener in one single episode) [47], and appropriate self-talk during fantasy play (rotating speaker and listener roles within one’s skin) [48].

2.2.2. Setting and Materials

The pre-and post-intervention probes were identical to Experiment 1. The intervention sessions took place in the participants’ classrooms. The participant sat side-by-side with a peer confederate at a small triangle table. A 13-inch MacBook laptop was placed on the table facing the students. The experimenter sat to the right- side of the table next to the students.

During the intervention, all picture stimuli were presented using Microsoft PowerPoint® and displayed in full-screen mode. Table 6 lists the six sets of stimuli used during intervention sessions. The instruction was blocked into 20 trial sessions. The experimenters organized the stimuli with two background colors for easy identification: blue for peer confederates and red for target participants. The sequence of the presentation of stimuli followed the following pattern: familiar (for Peer), familiar (for Participant), unfamiliar

(for Peer), unfamiliar (for Participant). Peer and Participant took turns to name the pictures until each received ten opportunities.

Table 6. Picture stimuli used during intervention sessions in Experiment 2.

		Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
1	Peer	Helicopter	Buzz	Scissors	Book	Juice box	Cupcake
2	Participant	Diego	iPad	Lamp	Taxi	Bell	Mr. Potato Head
3	Peer (unknown)	Buddhas Hand	Flat bottle	Lamprey	Jiang Jun	Fermented bean curd	Transparent Shrimp
4	Participant (unknown)	Fiddlehead	Lithops	Heat pouch	Niao Qi	Mangosteen	Zhu Jie
5	Peer	Cauliflower	Iron	Ice-cream	Banana	Bathtub	Buzz
6	Participant	Woody	Fan	Elephant	Balloon	Sun	Sponge Bob
7	Peer (unknown)	Red gourd	Lotus Root	Pink Fairy Armadillo	Honeycomb Fungus	Java apple	Ya La
8	Participant (unknown)	Sea Urchin	Mushroomo	Honeycomb briquette	Sea Vootoo	Gang Fruit	Wild Yam
9	Peer	Eggplant	Dora	Tree	Pizza	Pig	Mac & Cheese
10	Participant	Computer	Butterfly	Tooth brush	Toilet	Tree	Mailbox
11	Peer (unknown)	Tota	Prickly pears	Kala Roma	Ya Ya	Dragon Eye	Cottontop tamarin
12	Participant (unknown)	Da Ping	Choko	Balloon plant	Spiky Seeds	Ginseng	Noni
13	Peer	Cupcake	Headphone	Giraffe	Lemon	Lollipop	Battery
14	Participant	Fish	Thomas	Bike	Tooth Brush	Hand	Frog
15	Peer (unknown)	Gac	Broken Machine	Bitter melon	Kivala	Moon cakes	Ring-tailed Mongoose
16	Participant (unknown)	Draft Lens	Wheat Stalls	Bleeding tooth fungus	Purple Melon	Roly-Poly	Bottle Gourd
17	Peer	Flag	Koala Bear	Blueberry	Train	Violin	Box
18	Participant	Horse	Dino	Candle	Boat	Foot	Cow
19	Peer (unknown)	White Radish	Welwitschia	Sand Dollar	Iron Mask	Tapir	Momordica charantia
20	Participant (unknown)	Venus Fly Traps	Copper hot water container	Hot Pot	Baoma	Totoro	Aardvark

2.2.3. Dependent Variable

The dependent variable was the same as in Experiment 1. The EO and AO trials were identical during the pre-and post-intervention probes but were not repeated in treatment.

2.2.4. Design

We used a multiple probe design across participants to evaluate the effects of the intervention. The sequence of the design was as follows: (1) pre-intervention probe 1 for all four participants, (2) pre-intervention probe 2 using the same set of stimuli immediately prior to each participant's entry to intervention to control for their instructional history and maturation, (3) intervention 1, (4) post-intervention probe 1 with the original set of stimuli following mastery in the intervention, (5) intervention 2 when criterion was not achieved in post-intervention probe 1, (6) post-intervention probe 2. The procedure was designed to test for the reinforcement control to asking questions from using generalized reinforcement to the natural reinforcement of asking questions when the information was lacking.

2.2.5. Procedure

Baseline. We used the same procedure as in Experiment 1.

Pre-Training. We selected the participants who requested information in all conditions in Experiment 1 to serve as peer confederates. These peer confederates were taught to request for the name of unknown stimulus using "what is it?" with 100% accuracy. We used different sets of stimuli in pre-intervention training to teach these peer confederates to ask questions.

Intervention. During the intervention, the peer confederate (Peer) and the target participant (Participant) took turns to name the picture stimuli (see Table 3 for detail) on the computer screen. All sessions consisted of 20 trials, with 10 known (AO trials) and 10 unknown pictures (EO trials). The learn unit presentation included the alternation of the AO and EO conditions between Peer and Participant. For example, Peer AO, Participant

AO, Peer EO, Participant EO, Peer AO, Participant AO, Peer EO, Participant EO, and repeat. When one student responded, the other student was asked to attend to the stimuli and observe the response and consequence.

AO Condition. In the AO condition, Peer and Participant were asked to name the known pictures. A correct name was immediately reinforced by vocal praise (e.g., "That's right!" "You got it!"). An incorrect name was followed by the experimenter stating, "No, that's not it", and prompting the student to respond again. A request for information for known stimuli was followed by the experimenter stating, "If you know it, please tell me the name", and another opportunity to respond. A correct name in the second opportunity was followed by vocal praise as well. However, if the student continued to emit incorrect name or request for information to known pictures, the experimenter provided him/her with the correct name and moved on to the next trial.

EO Condition. In the EO trial, Peer was presented a novel picture first and modeled the target behavior of requesting for information using "what is it?". The experimenter immediately provided the name for the unknown stimulus, praised for the question, and put a token in his cup. Tokens had been conditioned as reinforcers for both Peer and Participant prior to the start of the experiment. The back-up reinforcers were predetermined preferred edibles, toys, or activities selected by the student. Participant was then presented with the next unknown picture. If Participant requested for the name, the experimenter provided the same consequence (the name for the unknown, vocal praise and a token). If Participant responded, "I don't know", the experimenter acknowledged "Ok" and moved on to present the next trial. If Participant emitted an incorrect name, the experimenter stated "No, that's not it" and gave her another opportunity to respond. If Participant continued to emit an incorrect name in the second opportunity, the experimenter moved on to the next trial.

2.2.6. Interobserver Agreement

Interobserver agreement (IOA) was conducted by an independent observer simultaneously during the study. 100% IOA was collected for all four participants during all intervention sessions. 100% IOA was collected for 62.5% of the probe sessions for Participant A and 75% of the probe sessions for all the other three participants.

3. Results

3.1. Results from Experiment 1

The participants responded differently to four contrived conditions. In total, each participant asked an average of 2.84 questions (SD = 3.67, range from 0 to 14). A total of seven participants emitted 18 requests for information (M = 0.95, SD = 1.62, range from 0 to 6) in the Pictures on iPad condition, four participants emitted 8 requests for information (M = 0.42, SD = 0.90, range from 0 to 3) in the Pictures on Smartboard condition, 10 participants emitted 18 requests for information (M = 1.32, SD = 1.64, range from 0 to 5) in the Individual Show and Tell condition, and three participants emitted 18 requests for information (M = 0.16, SD = 0.38, range from 0 to 1) in the Group Show and Tell condition.

The total opportunities varied greatly under the four conditions; therefore, we converted the number of requests to percentage data (using the number of requests divided by the total number of opportunities in each condition) so that they would be comparable. The results show that the participants asked similar number of questions in the individual conditions (M = 15%, SD = 0.19) and in the group condition (M = 16%, SD = 0.38), $t(18) = -0.12, p = 0.91$. Similarly, no significant differences were found between the use of picture (M = 23%, SD = 0.10) and object stimuli (M = 42%, SD = 0.12), $t(18) = -1.9, p = 0.07$.

A one-way between-subjects ANOVA was conducted to compare the effect of diagnosis on the mean number of questions among the four conditions. There was no significant effects of diagnosis found on the requests for information in any condition: Pictures on iPad condition ($F(1,17) = 1.15, p = 0.30$); Pictures on Smartboard condition ($F(1,17) = 2.64,$

$p = 0.12$); Individual Show and Tell condition ($F(1,17) = 0.65, p = 0.43$); Group Show and Tell condition ($F(1,17) = 0.02, p = 0.90$).

Similarly, no significant gender effects were found on the requests for information in any condition: Pictures on iPad condition ($F(1,17) = 1.15, p = 0.43$); Pictures on Smartboard condition ($F(1,17) = 2.02, p = 0.17$); Individual Show and Tell condition ($F(1,17) = 1.56, p = 0.23$); Group Show and Tell condition ($F(1,17) = 0.01, p = 0.95$).

In Experiment 2, we sought to test if a peer-mediated intervention would function to increase the emission of requests for names of unfamiliar objects and pictures by four participants who did not ask any questions in the first experiment.

3.2. Results from Experiment 2

Figure 1 depicts the total number of requests for information emitted by the participants during pre- and post-intervention probes. Before the intervention, none of the four participants requested for information during the four conditions. After the intervention, Participant A's number of requests for information showed slow but steady increase: from zero in the pre-probe to two in post probe 1 after Intervention Set 1, five in post probe 2 after Intervention Set 2, to 16 in post probe 3 after Intervention Set 3. Based on his rate of progress, the experimenters made the decision to conduct post probes after mastery of every three intervention sets for the following participants. Participant B asked 4 questions in post probe 1, and 20 questions in post probe 2. Participant C asked 19 questions in post probe one and thus did not require any additional intervention. Participant D asked 11 questions in post probe 1 and 16 questions in post probe 2. Participant A and C required three intervention sets while Participant B and D required six intervention sets to show significant gains in their post probes.

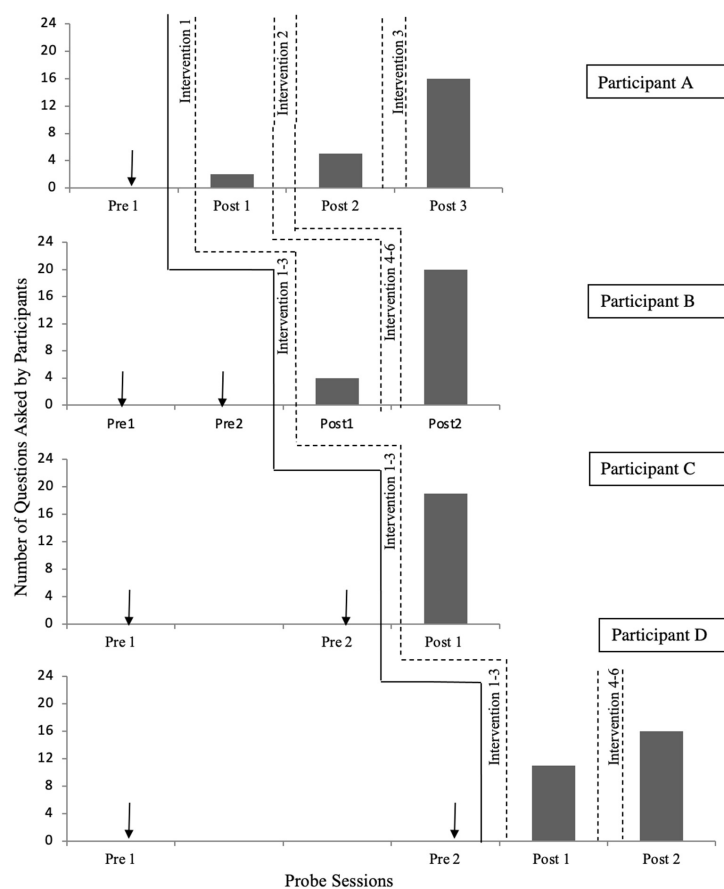


Figure 1. Total Number of Questions Asked by the Participants during Pre- and Post-Intervention Probes.

Figure 2 depicts the number of requests for information across four probe conditions. The participants showed drastic differences in their increased number of requests in multiple areas. While all participants requested for information in Pictures on iPad and Individual Show and Tell conditions, three participants (A, C and D) requested for information in Group Show and Tell condition and only one participant (C) requested for information in Pictures on Smartboard condition. Participant C was the only one who requested information under all four conditions, Participant A and D requested under three conditions, and Participant B under two conditions. Participant B was the only one who requested for information for all 10 opportunities in Individual Show and Tell condition when five unknown stimuli were presented twice while the other participants only emitted requests for the first five opportunities.

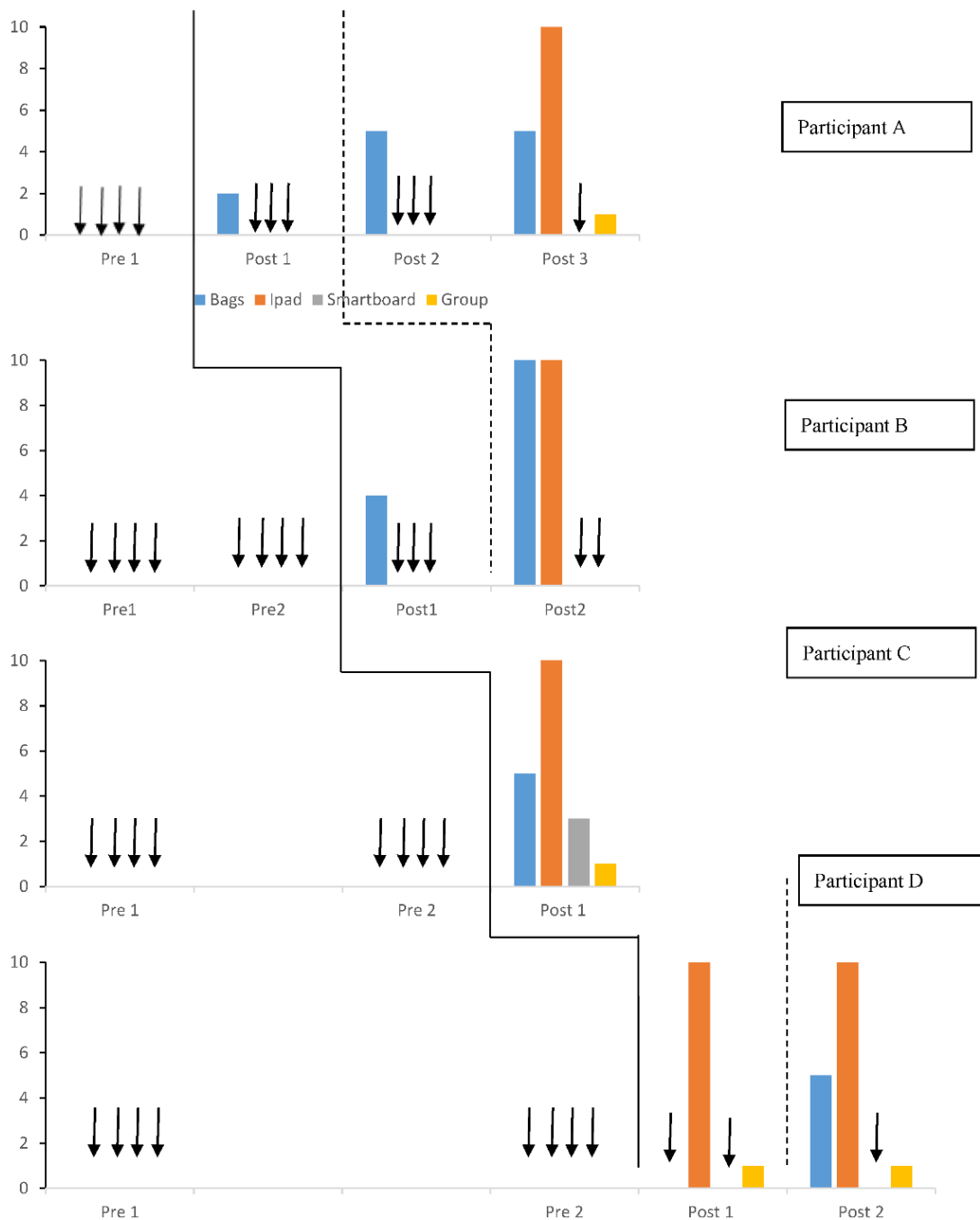


Figure 2. Number of Mand requests for information across four probe conditions.

4. Discussion

The New York State Education Department has published the Prekindergarten Foundation for the Common Core to create a “more cohesive, unified approach to young children’s education” [49] (p. 5). One of the first goals listed in this document reads, “Exhibits curiosity, interest, and willingness in learning new things and having new experiences” [49] (p. 11). One of the ways preschool children “exhibit curiosity” is through asking questions to request information. Children who ask more questions expand vocabulary faster and build more basic concepts. Chouinard [50] explained that question-asking is a problem-solving technique that enables children to fill information gaps, resolve ambiguity and make sense of inconsistencies in their environments. Chouinard found that neuro-typical preschoolers ask many information-seeking questions and continue to ask the same questions until they receive answers. Littlewoods, an online retailer, surveyed 1000 parents and found that their children asked on average 287 questions per day [33]. We can assume that requesting for information is thus a necessary repertoire, common in many children, that enables them to problem solve and establish new relational frames or develop new concepts.

Prior to the intervention, none of the participants asked any questions about unknown stimuli during any of the probe conditions. Following the intervention, each participant did each begin to ask questions about unfamiliar stimuli. The results showed that all of the participants increased requests for information asked as a function of the procedure.

The multiple probe design enabled the researchers to control for maturation and collateral effects on other students, and the data suggested that there was a functional relation between the peer mediated intervention and increases in the emission of requests for information across the four generalized probe conditions. All participants (1) modeled their peers by asking questions in the training setting (intervention conditions), but also (2) asked questions in settings outside of the training setting or in probe conditions. None of the participants had emitted questions in the probe conditions before the intervention. For this reason, we may assume that the behaviors of the participants were not solely the function of a model or the tokens.

Previous studies have been designed to teach requests for information under specific states of deprivation (e.g., withholding an identified reinforcer until a question was asked). The current study was designed to condition the removal of an information gap as a negative reinforcer, or the “need to know”. This is a necessary process if the need to know as we define it is truly in place, and this would mean across environments and regardless of other motivators being present or absent. In other words, the direct reinforcer of alleviating the information gap must be the controlling variable. We argue that the need to know is the learned MO for a learned reinforcer; in this case, the negative reinforcement condition described above.

In the Individual Show and Tell condition, the participants were presented with the same five unfamiliar stimuli twice, or ten possible opportunities. All of our participants emitted questions to request the names of objects when the unfamiliar stimuli were presented for the first time. Therefore, it appears that the information provided by the experimenter served as AOs for the emission of more questions. In other words, the EO’s needed to ask the same questions again was removed for these participants when there was no information gap between what they knew and what they needed to know. It appears this negatively impacted the number of questions asked during this post-probe condition.

The study also compared the effects of the intervention on the participants’ emission of requests in the presence of an EO versus an AO. We arranged both EO (with unfamiliar stimuli) and AO conditions (with familiar stimuli) in all probe conditions except for one (Pictures on SmartBoard). Therefore, the participants were required to discriminate between the two conditions and demonstrate differential responses. It was noted that a few participants requested for information about familiar stimuli (under conditions of AOs) during the intervention in Experiment 2. Based on their instructional history, the function of these requests was not to access more any unknown information but rather to seek social attention from adults. Therefore, the experimenters decided to model the

correct name for the known stimuli without vocal praise. In the end, this strategy, together with the use of tokens and social approvals for requesting for unknown stimuli, taught the participants to name the correct motivation conditions successfully. As evidenced by the results, all participants emitted requests for information under only EO conditions during the probe sessions.

Behavioral measures of “curiosity” have included direct measures of (1) visual preference [51], (2) spontaneous exploration [52], (3) preference for novelty [53], and (4) preference for complexity or the “unfamiliar [54]. We sought to measure the need to know by counting questions asked. It is important to note, however, that some participants’ responses did not meet the operational definition of emitting questions to request the names of unfamiliar stimuli but may belong to the same class of behaviors that may be a possible behavioral repertoire of curiosity. Throughout the experiments, participants vocalized such phrases as “I do not know”, “I do not know what it is called”, “What do you use this for?” and “What do you do with this?” Participants also performed actions demonstrating ways that the objects could be used as well as providing incorrect names. We noted these occurrences but did not count them as correct responses because the pre-established criterion for a correct response was requesting the name of the item. In order to measure whether one has the need to know as a conditioned reinforcer, we may need to expand our definition of what constitutes an attempt to acquire the missing information or measure the actual acquisition of learning (the names of the unfamiliar stimuli) under conditions of deprivation of information. This may be an area of future research.

Our design only allowed for one session of pre-intervention probe data for Participant A. Adding additional probe sessions to Participant A’s baseline would have strengthened the design. However, the other three participants did receive multiple probes before their intervention.

During Experiment 1, 71% of the neurotypical participants asked questions about unfamiliar stimuli, whereas 58% of those identified as having disabilities asked questions. Although these differences were not statistically significant, as reported in the Experiment 1 results section, future research should explore the quantity and quality of instruction in this area for students with disabilities such as ASD and establish improvements in the pedagogy targeting these verbal skills.

There is a growing body of research that suggests stimuli can be conditioned as reinforcers when one is systematically placed in deprivation of those stimuli while he observes a peer gain access to the same stimuli [45]. Future research should focus on the removal of extrinsic reinforcers such as experimenter praise and tokens in order to isolate the acquisition of information or the elimination of the “need to know” as the reinforcer for the emission of questions. Additionally, an additional area of research should investigate if placing participants in a greater state of deprivation of information by initially not providing answers to their questions may function to increase questions across generalized settings.

The intervention used in our study was effective in teaching the four participants to request information about novel stimuli. This study raises the possibility that the “need to know” is a behavioral developmental cusp. The results of this study are promising; however, more behavioral research is needed in requesting information and how this relates to curiosity, and how its presence or absence affects one’s behavior across multiple settings.

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