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Can Toddlers Learn Vocabulary from Television? An Experimental Approach

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This study was inspired by the rise in television targeting toddlers and preverbal infants (e.g., Teletubbies*,* Baby Mozart*). Overall, we investigated if very young children who are in the early stages of language acquisition can learn vocabulary quickly (fast map) from television programs. Using a fast mapping paradigm, this study examined a group (n = 48) of toddlers (15–24 months) and their ability to learn novel words. Utilizing a repeated measures design, we compared children's ability to learn various novel words in 5 different conditions. These included the presentation and identification of a novel word by an adult speaker via live presentation when the toddler was attending (i.e., joint reference), an adult via live presentation when the toddler was not attending, an adult speaker on television, and an edited clip from a children's television program (*Teletubbies*). Overall, the toddlers were most successful in learning novel words in the joint reference condition. They were significantly less successful in the children's program condition. Furthermore, there was a significant interaction between age and condition on children's performance. Both younger (15–21 months) and older (22–24 months) participants identified the target objects when they were taught*

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This research was conducted while the first author was an assistant professor at the University of Connecticut.

the novel word by an adult speaker; however, it appeared that children under the age of 22 months did not identify the target item when they were taught the novel word via the television program.

More than a generation of children have grown up watching *Sesame Street* and other educational programs. Ample evidence exists that preschoolers can learn skills from number recognition to new vocabulary words from these programs (Rice, Huston, Truglio, & Wright, 1990). However, modern programs are beginning to target even younger children (PBSKids.org, 2003). Infants are exposed to *Baby Einstein* (Boccella, 2003) and toddlers watch *Teletubbies*. Given the recent rise in programs targeting toddlers and preverbal children, little research has investigated the impact of television on these youngsters (see DeLoache, 2000; Barr & Hayne, 1999; and Schmitt & Anderson, 2002, for some notable exceptions). Therefore, it is becoming increasingly important to ask what impact exposure to television at an early age has on the language development of children. Although this study will only address one aspect of development (initial word acquisition), it is important to determine what factors are most influential during this period of language development.

Most toddlers follow a predictable sequence as they develop language. At around 12 months of age, they begin to produce their first words. By about 24 months, children are using 50 or more words to express themselves. From this point, word acquisition continues at a rapid pace as they experience what has been called the vocabulary spurt (Goldfield & Reznick, 1996). Children can learn up to five new words a day during this period of development (Bloom & Markson, 1998). It is thought that many factors influence children's ability to learn new words. These factors range from interactive mediums such as caregiver-child communication to passive ones such as television (e.g., Baldwin, 1994; Bedore & Leonard, 2000; Costa, Wilkinson, McIlvane, & Gracas de Souza, 2001; Kay Raining Bird & Chapman, 1998; Naigles & Hoff-Ginsberg, 1998; Rice, 1983; Rice & Haight, 1986; Tomasello, 1992; Wilkinson, Dube, & McIlvane, 1996). The purpose of this study was to investigate factors that may influence vocabulary acquisition in a group of young children ranging in age from 15 to 24 months and to examine the use of television as a medium for teaching novel words to toddlers. Although research has examined the influence of television on children's vocabulary learning, little research has examined the impact on children in the early stages of language acquisition. This study utilizes a fast-mapping approach to test toddlers' ability to learn a novel word in one of five conditions: via an adult speaker on television, via a television program targeting toddlers, via an adult in vivo, via an adult in vivo with a distraction, and in a no word control condition.

TELEVISION, LANGUAGE LEARNING AND PRESCHOOLERS

Although it is clear that young children can learn a variety of behaviors from television, such as aggressive acts (e.g., Huesmann & Miller, 1994) and letter and number recognition (Rice et al., 1990), there is still some debate regarding the effectiveness of television in teaching language to young children. For example, preschoolers between the ages of 2 and 5 years have been shown to acquire new words by watching television (Rice, 1983, 1984). However, it appears that children do not effectively learn grammar from television (Selnow & Bettinghaus, 1982). Furthermore, research has not adequately focused on the ability of children to acquire language from television during the early months of life when the foundations for communication are being built. There are several reasons for this lack of research. First, it is more difficult and time consuming to test very young children. Second, until the last decade, television was designed mainly for children who were already verbal. Thus, it lacked the external validity required to ask what effect television had on preverbal children.

One frequently studied program is *Sesame Street*. *Sesame Street* is the longest running children's television program, having been on the air since 1969 (Bogatz & Ball, 1970). Targeting preschoolers between 3 and 5 years of age, this program was originally designed to help prepare children for school. It taught letter recognition, numbers, and simple skills such as matching and sight reading of single syllable words (Ball & Bogatz, 1970). Similar programs in the 1970s and 1980s also targeted preschoolers and young school age children. Programs such as the *Electric Company*, or *3,2,1, Contact* attracted children as young as 3, and in some cases, as old as 12 (Corder-Bolz, 1980). However, the 1990s ushered in new programs targeting even younger children. As a result, children younger than 12 months spend an average of 80 min per day in front of a screen and 2-year-olds spend approximately 2 hr (Rideout & Hammel, 2006).

One example of a program that targets very young children is *Teletubbies*. It features four colorful nonhuman characters with television sets nestled in their midriffs. The program targets viewers as young as 12 months of age. According to the program's Web site, the Teletubbies speak a play language that "accurately mirrors the early speech of a one-year-old child" (PBSKids.org, 2003). In addition, an adult narrator who uses grammatically correct speech occasionally provides voiceovers. With the tremendous popularity of programs such as *Teletubbies* that target very young children, it has become important to understand what very young children learn from these programs. For example, we might ask if novel words can be acquired from television by this age group.

When toddlers hear child-directed speech from either an adult caretaker or from television, it may be sufficient for them to learn new words. However, it is also possible that the visually based world of television with its rapid pace

does not offer the proper input for initial word learning to occur. In addition, Troseth (2003) suggested that 2-year-old children cannot find a toy when they have just watched it being hidden via a video monitor; however, they can readily find it when they watch through a window. Therefore, 2-year-olds may be incapable of accurately associating the two-dimensional world of television with their three-dimensional experiences. In other words, due to either the fast pacing of the programs or the limitations of the toddler's ability to understand television, it is possible that television cannot teach words to this age group. Nevertheless, it does appear that children younger than 2 attend to television (Linebarger & Walker, 2005). Despite this, it is unclear if they comprehend what is seen on television. Due to the paucity of research on two year olds' comprehension of television, it is necessary to consider the research on slightly older children and speculate how younger children might differ.

ATTENTION AND COMPREHENSION

Quite a bit is known about preschoolers' attention to and comprehension of television stimuli. Considerably less is known about how much toddlers understand television (see Schmitt & Anderson, 2002, for an exception). Overall, preschoolers are quite attentive to television (Anderson, Field, Collins, Lorch, & Nathan, 1985), paying attention to it (i.e., eyes on screen) even in the presence of attractive toys or other playmates (Alwitt, Anderson, Lorch, & Levin, 1980). Furthermore, children are more visually attentive when the stimulus includes bright colors, fast pacing, and frequent changes in the visual stimulus. Preschoolers are also attentive to the auditory aspects of television stimulus (i.e., singing voices) that may rejuvenate the flagging visual attention of a young viewer.

Until recently, very little was known about the attention of even younger children to television. Linebarger and Walker (2005) utilized a longitudinal survey design to track family communication and television viewing in a sample of 6- to 30-month-old toddlers. On average, parents reported that their children began to pay attention to television at approximately 9 months of age. Other research has demonstrated that by the age of 2, children are paying attention to both programs and commercials, although for almost half of their viewing time, they are also engaged in a secondary activity (Schmitt, Woolf, & Anderson, 2003). Among children of this age, however, it is unlikely that plot devices (such as scary music to indicate that a frightening event will occur soon) hold their attention, because evidence suggests that even slightly older children (e.g., 4-year-olds) have a poor understanding of them (Beentjes, 2001). Instead, attention is probably driven by formal features of the medium. Berlyne (1960) initially identified "automatic" attention eliciting characteristics including intensity, contrast, change, and movement.

Because television includes these features, even infants attend to the screen to some extent (Barr & Hayne, 1999). Therefore, it appears that very young children, beginning at approximately 9 months of age, do attend to television. However, it is unclear what they comprehend and learn from it.

Again, research on preschoolers may provide a starting point for our understanding. Among 3- to 5-year-olds, attention and comprehension are related, but not in a way that indicates that more attention automatically leads to greater comprehension. For example, children who are visually attentive (measured by time looking at a televsion screen) have better visual comprehension and recall (Rollandelli, Wright, Huston, & Eakins, 1991). Similarly, auditory attention is positively related to comprehension and recall of auditory material (Anderson & Field, 1983). This is often taken to mean that attention guides comprehension. However, this notion has been repeatedly challenged (e.g., Lorch, Anderson, & Levin, 1979). Rather than attention predicting comprehension, it appears that the relationship is somewhat circular. That is, initial attention is necessary to ensure comprehension; however, continued comprehension is needed for further attention to occur (Lorch et al., 1979). Specifically, when either an audio track becomes less comprehensible (e.g., Spanish language for non-Spanish speakers) or a visual stimuli degrades (e.g., becomes snowy), attention decreases. This decrease in attention is then followed by a decrease in comprehension. When material becomes comprehensible again, attention increases and comprehension returns to its previous levels. This suggests that attention and comprehension are codependent, with one offering feedback to the other. Among preschoolers, attention continues as long as the stimulus remains comprehensible. However, it is worth noting that both lack of comprehension and habituation can decrease attention. When a program has been watched so many times that it no longer offers a challenge to preschoolers' comprehension, attention may also flag (Rice, Huston, & Wright, 1982).

In terms of younger children, when comprehension may be quite low, it is unclear how attention and comprehension are related. Is it likely that, for toddlers, like their preschool counterparts, attention and comprehension are somewhat circular and at least some comprehension is necessary for attention? Or, is there reason to believe that attention is due solely to exciting visual stimulus without any real comprehension? Evidence from studies on working memory may offer some insight. This research suggests that very young children (less than 30 months) may have difficulty preserving multiple forms of input such as music, visual stimuli, and language when they are presented simultaneously (e.g., Case, Midian Kurland, & Goldberg, 1982; Fisch, McCann Brown, & Cohen, 2001; Lee Swanson, 1996). Even with high levels of attention, the processing system may become overtaxed. As a result, information is lost from working memory before it can be processed and stored in long-term memory. Nevertheless, attention can be maintained with changes in the stimulus. Parents may help children maintain attention by highlighting

relevant information by using both joint reference and child-directed speech during parent–child interactions. These optimal learning situations may increase the probability that information will be stored in long-term memory. In the case of television viewing, toddlers may enjoy watching television and may attend to it due to the consistent changes in the visual and auditory stimulus. However, they may be unsure just what, in the milieu, to focus on. If this is the case, attention and comprehension may be unrelated until some amount of stimulus comprehension, perhaps provided by other sources, is achieved.

LANGUAGE ACQUISITION

Fast mapping is a phenomenon that has been used to describe children's rapid acquisition of words (e.g., Baldwin, 1994; Bedore & Leonard, 2000; Bloom & Markson, 1998; Cary & Bartlett, 1978; Goldfield & Reznick, 1996; Kay Raining Bird & Chapman, 1998; Wilkinson et al., 1996). In short, it refers to the idea that after only one exposure to a novel word children are able to hypothesize its meaning from the context it was heard and can understand that word at a later point in time (e.g., Bloom & Markson, 1998; Kay Raining Bird & Chapman, 1998; Wilkinson et al., 1996). Toddlers typically demonstrate this by selecting the correct object, one that they previously "fast-mapped" from an array of unfamiliar objects. Children as young as 13 months have demonstrated this ability. For example, Kay Raining Bird and Chapman (1998) found that toddlers between 13 and 16 months were able to learn the name of novel objects following only four repetitions of that word, although many learned after only one. They concluded that relatively few word repetitions were necessary for young children to develop an initial representation of a word's meaning.

Although young children can rapidly acquire the meaning of novel words, it is still unclear how they are able to accomplish this. One way that this may occur is through children's use of pragmatics, or social transactions, associated with the learning environment (Wilkinson et al., 1996). For word learning to occur, the caregiver must provide the child with highly salient (i.e., child-directed speech) and varied opportunities for the child to associate the novel word with a particular object (e.g., Baldwin, 1994; Golinkoff, Hirsh-Pasek, Mervis, Frawley, & Parillo, 1995; Naigles, Fowler, & Helm, 1993; Naigles & Hoff-Ginsberg, 1998). It is important that the child is focused on a particular novel object as the caregiver names it. Baldwin (1994) reported that children with larger vocabularies had mothers who were more likely to use joint reference when labeling an object than children with lower vocabularies. This joint reference ensures that competing information such as background noise or extraneous visual information does not interfere with the child's focus during word learning. This is important for young chil-

dren at the beginning stages of language development. It is thought that this pairing of both verbal and visual information provides an integrated representation of the caregiver's intended message (Langton & Bruce, 2000). This allows children to filter out extraneous information and focuses them on the relevant information. In the case of language acquisition, the object being labeled becomes the focus of attention for both the caregiver and the child. Therefore, it is likely that joint attention on an object, or joint-referencing, can help in children's acquisition of a novel word. Therefore, we predict that

H1: More toddlers will learn novel words when participating in adult–child interactions with joint reference than when participating in adult–child interactions where the adult and child are focused on different objects.

In addition, and as argued earlier, children's programs may in fact offer too much stimulation to be comprehensible to toddlers. Furthermore, because television as a medium cannot attune and adjust to the specific verbal needs of a child, as an adult is apt to do, it is possible that children's programs are not ideal as language teachers. Therefore,

H2: More toddlers will learn novel words when participating in adult–child interactions with joint reference than when words are introduced through a television program.

Despite differences in performance across the conditions listed, it is likely that attention to the television program will be high. Recall that the vivid formal features attract attention somewhat automatically even for very young children (Berlyne, 1960). Therefore,

H3: Children will be more attentive to a television when shown segments of the children's program in comparison to a video of an adult introducing and playing with objects.

What will the relationship between attention and comprehension be? On one hand, attention in preschoolers is positively related to comprehension and learning. On the other hand, we have argued that high attention is somewhat automatic and may be unrelated to comprehension and learning in toddlers. Although the bright colors and high pitched music that is characteristic of children's programs may help gain the attention of the child, it is not clear that this level of stimulation is optimal for learning. Specifically, the child must be able to focus on a single relevant piece of information and not be distracted by extraneous information. Therefore, although attention may aid in the learning of novel words from the program, it is not clear that this will occur. Therefore, we ask,

R1: Is there an interaction between attention and word exposure environment, such that the most learning occurs among children with high attention to the stimulus and least learning occurs when there is little attention?

Because it is unclear in this study if greater attention on the part of toddlers is indicative of greater comprehension overall, or simply an artifact of the vivid formal features, we ask if a more global measure of comprehension, such as vocabulary size, can predict word learning across conditions. In other words, children with larger vocabularies may be able to better process the narrator in the *Teletubbies* and other similar programs. This larger vocabulary may then aid in children's ability to follow the dialogue and to learn the novel word. Furthermore, as children age, they may become better at focusing on the relevant stimulus, making the adult speaker even more beneficial as compared to children's programs. Therefore, we might ask,

R2: Will there be an interaction between vocabulary size and word exposure environment on learning across the different conditions?
R3: Will there be an interaction between age and word exposure environment on learning across the conditions?

METHOD

Design

This study utilized a repeated measure design, including five learning trials, rotated to control for order effects: via an adult speaker on television, via a television program targeting toddlers, via an adult in vivo, and via an adult in-vivo with a distraction. An additional control trial, via video monitor, was utilized to insure the child's ability to identify a real object initially seen on a monitor. The age of the child in months, parental report of child's vocabulary and attention to the screen (when appropriate) were also measured. The main dependent variable of interest was the child's ability to correctly choose from an array of objects, indicating learning of a novel word during the teaching trial.

Participants

The participants for this study were 48 typically developing toddlers ranging in age from 15 to 24 months ($M = 20.47$, $SD = 2.78$). Two children were omitted from the study because they were unwilling to complete the experimental tasks. Of the remaining 46 participants, 18 were girls and 28 were boys. According to parental report, all of the children had normal hearing

and vision, and had a negative history of medical or neuromotor difficulties. In addition, all children were from a variety of ethnic backgrounds, but were being exposed to English as their primary language at home. Children were excluded from participation if the primary language spoken at home was not English. All the children were recruited from daycare centers located in Northeast Connecticut and all participating children's parents signed a consent form approved by the University Institutional Review Board.

The parents were asked to fill out the Language Development Survey (LDS: Rescorla, 1989) prior to their child's participation in the experiment. There were several reasons for using the LDS. First, it provided information about the children's expressive vocabularies and general rate of word acquisition. Second, this information could be used to determine if the participants were achieving developmental milestones at a normal rate for children within this age range, thus excluding children who may be at risk for language impairment. The children produced between 2 and 295 words (M = 117.96, SD = 107.27). All children were within normal limits for vocabulary development.

Procedures

The experiment was completed in a quiet testing room at the University of Connecticut. The sessions lasted between 20 and 25 min. Before the experiment began, the experimenter (the second author) and the toddler played with age appropriate toys. The purpose of this warmup period was to familiarize the toddler with the experimenter and the testing room. Once the child was comfortable with the experimenter, the child was seated on the parent's lap at an adult-sized table that was placed in front of a 19-in. color television monitor. The television monitor was at the child's eye level, approximately 4 ft away. The experimenter sat at the table 90 degrees to the left of the child. A graduate assistant sat ninety degrees to the right of the child and across the table from the experimenter. The assistant's role was to entertain the child between the experimental conditions and to distract the child when necessary.

Before the experimental conditions were administered, the children completed three practice trials using familiar objects (e.g., horse, pig, car, truck). The purpose of the practice trials was to ensure that the children understood the experimental task. The experimenter placed three familiar objects on the table, naming each item as it was set in front of the child. Once all three objects were placed on the table, the experimenter asked the child to identify one of the familiar objects by using either a command or question (e.g., Which one is the piggy?). Verbal praise was used as reinforcement when the child identified the correct toy. If the child did not respond, the question or command was repeated a second or third time. All 46 children pointed to the objects named during the practice trials.

Next, each of the experimental trials was run. Trial order was rotated to control for order effects. All experimental sessions were video taped and coded at a later time to determine whether the child was attending during the exposure of the novel words, to time the children's attention to the video trials, and to code for reliability. The camera was seated on a tripod and located to the right of the television. The camera was focused on the child's upper body and face so that the experimenter could determine to which direction the child's attention was focused and the objects to which the child pointed. Prior to initiating the experiment, the parents were instructed not to assist the child with identifying the objects by pointing or naming them. However, the parents were told that they could hold out their hand to receive the requested object if the experimenter said, "Give the _____ to mommy."

Stimulus Materials

Target and distracter items. The experimental items consisted of 25 objects that the children might have seen previously but were unlikely to know the names. The objects were placed into five groups with five objects per group. For each group, one object always served as the target to which a novel word was taught. The other four objects served as distracters. Five different nonsense words were used to label the target objects. They were composed of consonants and vowels that develop early in children's language and consisted of a CVC syllable shape. The words used were *sas*, *doot*, *keeg*, *bem*, and *mope*. For each participant, the nonsense words were randomly assigned to the word learning conditions. For example, in the joint reference condition, *sas* would be used to label the target object for one child, then another child might hear *doot* for the target object, and so forth. The target objects and distracters used for each condition can be seen in Table 1.

Videos and in vivo stimuli. Five experimental conditions corresponding to each object set were included in the study. The five experimental conditions were labeled as follows: (a) adult in video, (b) children's program, (c) joint reference, (d) discrepant reference, and (e) no word. The child was exposed to three video (adult in video, children's program, no word) and

TABLE 1 Novel Object Stimuli

Condition	Target object	Distracter objects
Adult in video	Plant sprayer	Flashlight, pot holder, candle, spatula
Television program	Periscope	Basting brush, coaster, coat hanger, picture frame
Joint reference	Note paper clip	Fridge magnet, tea towel, canister, spoon holder
Discrepant reference	Whisk	Coaster, dishwasher sponge, goblet, tape measure
No word	Feather duster	Soup ladle, can opener, yarn spool, coat hanger

two direct interaction (joint reference, discrepant reference) conditions. In two of the video conditions, objects and their associated novel words were introduced to the children using the television monitor. In the third video condition, the children were shown an object, but no word was paired with the object. In the direct interaction conditions, objects and their associated novel words were introduced directly by the experimenter using both joint reference and discrepant reference. The experimental conditions were presented in random order to each child.

Each condition consisted of a teaching and testing phase. During the teaching phase, the target object was presented to the child and labeled five times within a 3-min period. A neutral sentence frame was used to label the objects (e.g., Here is a *sas*. See the *sas*.). The testing phase was administered 30 sec after the completion of the teaching phase. The child was then asked to identify the labeled object (e.g., Show me the *sas*, or Give the *sas* to mommy). Children were credited for word-learning if they identified the object labeled during the teaching phase of the task.

Adult in video condition. The children were shown a video segment of an adult (the second author) playing with five objects (plant sprayer, flashlight, pot holder, candle, and spatula). The video segment consisted of the adult seated behind a table. The adult removed the objects from a drawer in the table one at a time and held them for approximately 2 sec before they were placed on the table in full view of the camera. The adult picked up each object and placed it back on the table at least once. During the length of the video segment, the adult picked up the target object (plant sprayer) and named it using a novel word (e.g., Oh here is a doot) five times at random intervals. At the end of the video segment, the tape was stopped and a blank screen appeared on the television monitor. The child's attention was drawn to the experimenter by saying, "Look at the toys I have." One at a time, the experimenter removed the same five objects from a box and placed them on the table in front of the child. The child was given 30 sec to examine and play with the objects before the experimenter asked the child to find the target object using the novel word introduced in the video (e.g., Give me the doot). The experimenter gave the child verbal praise (e.g., Yeah, you did it) for pointing to or handing *any* object to the experimenter. The response was scored as correct only if the child identified the plant sprayer. If the child did not respond, the experimenter gave the child another verbal prompt. If the child still did not respond, the experimenter scored the item as no response and administered the next experimental item. The test phase was identical across all the conditions.

Television program condition. The children were shown a 3-min video segment of the *Teletubbies* television program. The video consisted of several sections from an episode of the *Teletubbies* program edited together. Other than editing for length, the visual material was unchanged from the original material. In the clip, three of the sections contained a clip where a periscope

emerged from the ground. As the periscope emerged, the experimenter's voice was dubbed into the soundtrack to provide a novel word (e.g., Oh here is a keeg). It is relevant that the voiceover was designed to be both similar to the actual voiceover used in the children's program in terms of pacing, tempo, and pitch. In addition, the voiceover was similar to the other conditions. This is because the same person was used for the children's program voiceover and for other conditions. In total, the novel word was used five times in conjunction with the appearance of the periscope (target object). At the end of the video segment, the tape was stopped and a blank screen appeared on the monitor. The child's attention was drawn to the experimenter by saying, "Look at the toys I have." The test phase was then administered.

Joint reference condition. The experimenter obtained the child's attention by calling the child by name or saying, "Look, I have some toys." The experimenter removed five objects (paper clip, refrigerator magnet, tea towel, canister, and spoon holder) from a box one at a time and placed them on the table in front of the child. The child was shown the objects in a way identical to the adult in video condition. However, a novel word was produced only when the child was attending to the target object. Following the teaching phase, all the objects were rearranged on the table in a random order and the child was given 30 more sec to examine the objects. The testing phase was then conducted.

Discrepant reference condition. The experimenter obtained the child's attention by calling the child by name or saying, "Look, I have some toys." The presentation of objects was identical to the joint reference condition except that, while the child examined the objects, the graduate assistant distracted the child by shaking a toy dog that made a whining sound. While the child's attention was focused on the toy dog, the experimenter picked up the target object (whisk) and named the target object using a novel word (e.g., I have a mope). The target object was labeled randomly five times during the 3-min period while the child was attending to the toy puppy. The testing phase was then conducted.

No word condition. The no word condition was designed to determine whether the children were able to associate an object seen on television with an object in the real world. The children were shown a 60-sec video segment of an adult (the second author) playing with a target object (feather duster). The video consisted of the adult seated behind a table while holding and moving the target object across the table in a brushing motion. The target object was always in view during the entire video clip. The adult did not speak during the video clip. After the video played for 1 min, the experimenter paused the video so that the feather duster appeared in a still mode on the television monitor. The child's attention was drawn to the experimenter by saying, "Look at the toys I have." The experimenter removed five objects (feather duster, ladle, can opener, yarn spool, and

hanger) one at a time from a box and placed them on the table in front of the child. The target object was the feather duster and the four other items served as distracters. The child was given 30 sec to examine and play with the objects. The experimenter requested that the child find the target object (e.g., Give me this one), while pointing to the feather duster on the television monitor. The experimenter gave the child verbal praise for pointing to or handing any object to the experimenter. A correct response was given if the child identified the feather duster.

Measures

Word learning. Word learning was scored as correct by the experimenter if the child selected the correct object from the object array. Interrater reliability was determined by having an independent observer examine the children's responses to the learning trials. Four toddlers' experimental sessions were randomly selected and viewed by an undergraduate student. The student reviewed the videotapes from these experimental sessions and recorded the children's responses to the experimenter's request for an object using the novel words. The student's observations were compared to those of the experimenter. The experimenter and the observer demonstrated good reliability (kappa = .84) agreement in their judgments of which item toddlers selected.

Attention. Two measures of attention were recorded. First, during the experimental trials for the joint-reference and discrepant reference conditions, the experimenter determined if the child was attending or not and waited for the correct moment to demonstrate and name the object. Using the video tapes of the experimental sessions, a graduate student and an undergraduate student independently assessed children's attention. Again, reliability was good (kappa = .85). Second, during the television trials (adult in video and children's program) attention to the television monitor was timed and the proportion of time that children spent watching the monitor was assessed by one graduate student and one undergraduate assistant. Again, reliability was good (kappa = .85).

RESULTS

First, to test children's ability to perform the task, we asked them to select an object that they saw on the television screen from an array of objects presented to them when no words were used to label that object (no word condition). Overall, children in the no word condition could perform the task (M = .78, SD = .42). Therefore, children between the ages of 15–24 months are able to associate an object on the television screen with one

in the real world. That is, they could move between two-dimensional and three-dimensional representations.

Hypotheses 1 and 2

Next, we tested the effect of condition on children's ability to select the correct object. Because the experiment was conducted as a repeated measures design, we used a repeated measures analysis of variance (ANOVA) to test the main effect of condition, overall. Despite the use of a dichotomous dependent variable, repeated measures ANOVA is both more conservative and accounts for within-subject correlations, making it an appropriate analysis in this case. Overall, there was a main effect for condition on children's word learning, $F(1, 41) = 13.25$, $p < .05$, $\eta^2 = .08$. Hypothesis one had predicted that more children would perform significantly better in the joint reference condition as compared to the discrepant reference condition and this was supported. In the joint reference condition, children chose the correct object approximately two thirds of the time ($M = .67$, $SD = .47$) as compared to about 40% in the discrepant reference condition ($M = .43$, $SD = .50$) and this difference was significant ($p < .05$). We also predicted that children in the joint reference condition would do better than the children's program condition. This difference was also significant ($p < .05$) with participants in the children's program condition performing more poorly than they had in any other condition ($M = .40$, $SD = .49$). Furthermore, children in the adult in video condition, responded correctly about half the time ($M = .53$, $SD = 50$). Although no predictions were made regarding the comparison between performance in the children's program condition and performance in the adult in video condition, this difference was also significant ($p < .05$), indicating that the television itself did not seem to cause the difficulties for the children. Rather, it appeared that the children had difficulty learning from the children's program. In sum, learning from the children's program was similar to learning in the discrepant reference condition and learning from an adult speaker on television was more similar to learning in the live joint reference condition.

Hypothesis 3

In addition to asking about children's performance in the various conditions, we also investigated the role of attentiveness in the various conditions and its impact on word learning. We predicted that children would be more attentive to the children's program condition than they would to the on-screen adult (adult in video condition). A paired sample t test revealed that this hypothesis was not supported, $t(44) = .76$, $p > .05$. Children attended to the children's program 85.62% ($SD = 13.01$) of the duration of the clip and attended to the clip of the adult speaker 83.60% ($SD = 19.08$) of the time.

Therefore, despite its vivid formal features, children were not more attentive to the children's program than they were to the on-screen adult speaker.

Last, we asked three research questions regarding the interaction between condition and (a) attention, (b) vocabulary size, and (c) age on children's performance. For these analyses, we first conducted a median split on the variable of interest (e.g., attention, vocabulary size, age), then used that variable as a between subjects factor and used condition as the within subjects factor in a repeated measures ANOVA.

Research Question 1

This question asked if there was an interaction between attention and condition. Recall that we measured attention twice, once for the adult in video condition and once for the children's program. Therefore, we utilized a median split on each attention variable and identified the children watching the adult on television as low or high in attention to the adult, and children watching the children's program as low or high in attention to the children's program. This resulted in four groups. We then utilized t tests as a fairly conservative test. Performance on the fast mapping task was significantly higher ($p < .05$) for children who were highly attentive to the videotaped adult speaker ($M = .65$, $SD = .49$) as compared to children who had low attention to the children's program ($M = .29$, $SD = .49$), low attention to the adult speaker ($M = .41$, $SD = .51$), or high attention to the children's program ($M = .48$, $SD = .51$). Therefore, it appears that attention to the adult speaker is more beneficial than attention to the children's program.

Research Questions 2 and 3

Our second and third research questions asked if there was an interaction between condition and (a) vocabulary size and (b) child age on performance. To answer these questions, we used the dichotomized vocabulary and the dichotomized age variables (between-subject), along with condition (within-subject) and tested performance. We ran one repeated measures ANOVA to address both questions simultaneously. First, concerning vocabulary size, we found a main effect for condition, $F(3, 37) = 3.51$, $p < .05$, $\eta^2 = .08$. There was also a significant interaction between condition and vocabulary size, $F(3, 37) = 2.43$, $p = .05$, $\eta^2 = .06$. Specifically, pairwise comparisons showed that children with high vocabularies did significantly better than their low vocabulary counterparts across all conditions, except the joint reference condition. In the joint reference condition, children learned equally well regardless of their vocabulary level ($p > .05$). Interestingly, children with low vocabularies did as well in the joint reference condition as those with high vocabularies who watched the children's program (see Table 2 for means and standard deviations).

TABLE 2 Means and (Standard Deviation) for Condition by Vocabulary and by Age on Word Learning ($N = 43$)

	Vocabulary			Age	
	M	*SD*		*M*	*SD*
Condition					
Adult on video	.53	.50			
Low vocabulary	.21[a]	.48	Younger	.50	.47
High vocabulary	.76[b]	.46	Older	.55	.50
Discrepant reference	.43	.50			
Low vocabulary	.24[a]	.44	Younger	.40	.43
High vocabulary	.59[b]	.50	Older	.43	.39
Joint reference	.67	.47			
Low vocabulary	.57[b]	.51	Younger	.52	.50
High vocabulary	.77[b]	.43	Older	.93[c]	.49
Television program	.40	.49			
Low vocabulary	.24[a]	.44	Younger	.23[a]	.48
High vocabulary	.59[b]	.50	Older	.62[b]	.45

Note. $N = 43$. Pairwise comparisons were only conducted for all pairs within a column. Different superscripts reflect a significant difference ($p < .05$) only within that column. [a] and [b] indicate statistically different means in the table.

In terms of the dichotomized age variable, approximately half ($N = 20$) were older (22–24 months) and approximately half ($N = 26$) were younger (15–21 months). In addition to striving for equal samples in the two age groups, we identified the cutoff because, as described later, it is at 22 months that children seemed to begin fast-mapping from children's programs. Prior to that age, only six children successfully fast-mapped in the children's program condition. In comparison, 11 younger children successfully fast-mapped in the joint reference condition. It appeared, then, that benefits from watching the children's program did not begin until the child was somewhat older. Again, there was a main effect for condition, $F(3, 37) = 3.51$, $p < .05$, $\eta^2 = .08$, and there was a significant interaction between age and condition, $F(3, 37) = 4.67$, $p < .05$, $\eta^2 = .11$. Using pairwise comparisons (see Table 2), we found that older children in the joint reference condition performed significantly better than either younger or older children in the children's program condition. In addition, older children watching the children's program performed significantly better than younger children watching the children's program.

DISCUSSION

Summary of Findings

This study examined the ability of a group of toddlers to learn novel words from television. In particular, we compared the children when novel words

were presented via television (i.e., the children's program and video of adult speaker) with direct adult-to-child interactions (i.e., joint and discrepant reference). Overall, children identified the target words most successfully in the joint reference condition. Furthermore, their performance in the children's program condition was similar to their performance in the discrepant reference condition despite their high attention to the children's program. In fact, higher attention to the adult speaker seemed to aid in learning, whereas higher attention to the children's program was less beneficial. Lastly, we found that there was a significant interaction between age and condition and between vocabulary size and condition on children's performance. Specifically, both younger and older toddlers are able to perform the fast mapping task when they receive the information from an adult speaker; however, it appears that until children are approximately 22 months old, they are not fast mapping from material presented on the children's program. Similarly, smaller vocabularies acted to hinder children's learning from the children's program and from the discrepant reference condition, but smaller vocabularies did not seem to hinder children's word learning in the joint reference condition or the adult in video condition. Therefore, the combination of small vocabularies and younger viewers seems to make it particularly difficult for children to learn from children's programs and from discrepant labeling. Instead, all children learn better from an adult to whom they are paying attention, and to some extent it does not matter as much if the adult is "live" or on television.

Limitations, Implications, and Future Research

Although the results of this study are intriguing, there are several limitations that must be kept in mind. First, due to difficulties in recruiting participants in the targeted age range, the sample was necessarily small. This results in two specific problems. The first problem is that there is a greater likelihood of type II error. The second problem is that it is unclear to what extent this sample is representative of the general population. Given that the parents needed to bring the child to the lab to be tested, it is likely that this group of parents was particularly vigilant. It is possible that rapid word learning in the general population, whether from the adult or from children's programming, occurs somewhat later than found among the present sample. Future research should be conducted that examines both a larger and a more representative sample.

Second, due to the age of the participants, it was difficult for them to maintain attention over a longer testing period. Therefore, we measured only one trial in each of the conditions. This problem was perhaps compounded by the use of only one instantiation of each condition, which could possibly create single message effects (Jackson, 1992). For example, if several *Teletubbies* clips had been created, each introducing a different "novel object,"

our results may be more valid. Certainly, multiple trials with multiple message exemplars would increase validity; however, this certainly requires testing over several days, rather than during one, extensive trial. This kind of research would be valuable. In addition, research that uses multiple message exemplars might also be used to investigate what formal features facilitate learning in toddlers. If, in fact, toddlers continue to watch television, it would be extremely beneficial to understand what kinds of formal features, indeed what kinds of stimuli, best suit their educational needs.

Third, as recent research has shown, very young children do watch television. In Linebarger and Walker's (2005) longitudinal study of 6- to 30-month-old children, although 6-month-old children did not appear to watch very much television, by 12 months, they were watching an average of 1 hr per day. Therefore, this study would have benefited from a measure of children's television viewing and future research should assess parental reports of children's television exposure.

Despite these limitations, there are several interesting results with both practical and theoretical implications. From a theoretical perspective, this study lends some evidence that toddlers can recognize and "use" the two-dimensional images on television as "real." The results of this study showed that children in the no word condition could identify an object on the screen from one they had seen in real life. These results are consistent with findings of DeLoache (2000), who examined children's understanding of the relationship between two-dimensional images and those presented in three dimensions in real life. Furthermore, even when we collapsed across age groups, children's performance in the adult in video condition was somewhat similar to their performance in the joint reference condition. Therefore, very young children seem to be able to understand the two-dimensional space of television and "use" it to perform tasks.

From a practical perspective, it seems clear that, during the early stages of language acquisition, including children who have fewer than 50-word vocabularies, toddlers learn more from an adult speaker than they do from a program such as *Teletubbies*. Not only was performance markedly different among the joint reference, the videotaped adult speaker, and the children's program conditions, but there was an interesting age and vocabulary effect as well. Specifically, children younger than 22 months did not seem to accurately fast map from the children's program, whereas they were readily able to fast map from the adult speaker. Why would this be the case? There are at least three possible explanations.

First, it is possible that young children do attend to children's programs—and the data do support that notion—but they do not know specifically what to focus on. Unlike an adult speaker who might gesture and look at the object as they name it, the vivid formal features of children's programs may serve to dilute the attention of the child. In other words, children may not know precisely where to focus their attention. However, by the time

children are 22 months, they may better be able to focus and may know more about language, and therefore may be better able to know what is being named on the television screen.

A second related possibility is that the amount of sensory information in children's programs may be too great for young children to process. Because the amount of visual information in the stimulus clip was identical to the original and the auditory information was similar, it is likely that the stimulus tape was ecologically valid. Furthermore, the children may have attended to the novel word used to describe the periscope, but because of their limited ability to efficiently process and store the auditory information, it decayed from working memory before it could be sent to long-term memory. Results of this type have been found with older preschool children and school-age children (e.g., Fisch et al., 2001; Lee Swanson, 1996), but we may assume that this also applies to toddlers.

Finally, a third possibility may have to do with the puppet-like characters. During early language learning, young children use multiple strategies to learn a novel word. Not only do they attend to the named object, but they may focus on the face of the speaker to see where she or he is looking, or to watch the formation of the word by the speaker. In the case of a nonhuman character, facial movement simply does not match word formation with any great precision, thus masking important information. Is all of this to say that children cannot learn novel words from television? No; earlier research on older children (i.e., ages 2–7) has demonstrated that vocabulary learning is possible (e.g., Rice, 1984; Rice et al., 1990). However, our results suggest that word learning occurs only later, beginning perhaps at 22 months.

Which explanation is most compelling? Are children unsure of where to direct their attention? Are they overloaded in terms of stimulus input? Are the needed visual cues (e.g., movement of the oral mechanism) absent, hindering word learning? Given that attention is high to children's programs, but learning is not, omnibus attention is unlikely to help ensure word learning from children's programs for preverbal children. Furthermore, given that attention to the adult who appeared in the video (adult in video condition) does seem to help learning, even very young children appear to fast-map from a television screen. One difference is that the adult in the video is not overly vivid. It is easy for the child to focus on the nonverbal cues presented by the adult such as pointing, showing, or using facial expressions. Furthermore, older children seem to fast-map from children's programs despite the presence of extraneous stimuli; it does not seem to preclude word learning. Rather, consider that even children with smaller vocabularies can fast-map from the adult speaker and from the adult in the video. Therefore, although larger vocabularies help in continued word learning, it is obviously not a necessary condition for word learning to occur. Instead, optimal learning seems to take place when very young children know where to focus

their attention. This improved attention can be aided by development in the child, such as vocabulary growth. However, for very young children, it is likely aided by optimizing and clarifying the stimulus input.

The results of this study have important implications for language acquisition. It appears that mere exposure to language is insufficient for teaching language to initial language learners. Rather, children must be actively engaged in the process with responsive language teachers. Furthermore, they must know what, in the milieu, to focus on. Because television is not able to respond to a particular child, another strategy to enable initial language learning may be to minimize the amount of stimulus made available for very young children in a program. Earlier research in language learning certainly shows that low stimulus input, such as an adult speaker, is quite effective at helping very young children to fast map (e.g., Rice, 1983, 1984). Furthermore, research on preschoolers, television, and comprehension suggests that some amount of comprehension is necessary to maintain attention and continued attention is needed to further comprehension. In the world of toddlers, it is possible that a certain level of comprehension must be achieved from other sources before the world of television can be understood and for attention to be maintained. In other words, toddlers may need some baseline language comprehension before television becomes an "educational" medium.

In summary, this study supports the idea that prelinguistic or newly verbal children are more likely to learn vocabulary from an adult rather than from television. However, as more television programs geared toward young children are developed, parents should be aware that very vivid programs may entertain preverbal toddlers, but these programs may not be adequate language teachers. Furthermore, parents and program producers alike might recognize that the vivid displays that are appealing to adults may be too stimulating for toddlers if learning is the ultimate goal. As always, the developmental stage of the child must be deeply considered when producing the highest quality programs for them.

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