UNIVERSITY OF COLORADO

What Can Children Learn from a Screen?

Danielle Robinson
Psychology Department

Spring 2011

Committee Members:
Eliana Colunga – Faculty Advisor
Willard Moers – SLHS Professor
Robert Spencer – Psychology Honors Council

Abstract: With children media and children's television viewing constantly increasing, people often ask what children are actually learning from the screen. This study looked at two and a half to three year old children, to see how they form generalizations depending on how they were shown and taught novel objects and labels. The project consisted of two different groups; one group was trained on the novel labels through a computer screen without objects in front of them whereas the other group was taught in a live face-to-face interaction with the objects in front of them. Children were immediately tested and tested about a week later to study the generalizations that were made and to see if they retained both the novel labels and the generalizations.

Are Children Capable of Learning From a Screen?

Children receive information from many different sources throughout their daily lives, such as from parents, teachers and even from television. The American Academy of Pediatrics recommends that children not watch TV until they are two years old, however some research has shown that TV may be beneficial when it comes to learning new words (American Academy of Pediatrics, 1999; Rice, Huston, Truglio & Wright, 1990). This project examined if children are capable of learning novel words from a computer screen, in which they would watch a video of a person teaching them new words for new objects. The goal of this project was to determine if children ages two and a half to three years old (30 to 36 months) are capable of learning from a video and have the ability to retain what they have learned for at least a week. This is significantly beneficial to current research because no other researcher has looked at a child's ability to retain information learned from a screen for longer than a few minutes. Previous research has explored the video deficit effect, the idea that children learn less from a video than from an in-person instruction (Zack, Barr, Gerhardstein, Dickerson, & Meltzoff, 2009). The present study will go beyond what previous researchers have looked at by exploring the quality of learning children receive when learning from a screen, if they are able to retain what they are learning and whether or not two and a half to three year children can handle all of this information.

Screen Media vs. In-Person Learning

Through many different studies it has been shown that, in general, children have a difficult time learning from a screen due to a variety of different factors. Conboy and Kuhl (2007), two prominent researchers, tried to teach infants phonetic sounds in one of their studies and demonstrated that infants could only learn phonetic sounds from a live, face-to-face interaction. Through another similar study Kuhl, Tsao and Liu (2003) found that infants taught through a video or audio DVD did not learn the same phonetic sounds as previous infants who were in a face-to-face condition. Through these studies researchers found that social cues played an enormous role in helping children learn the sounds. To many researchers this phenomenon is referred to as the video deficit effect which simply says that "infants learn less from a televised demonstration than from a live demonstration" (Zack et al., 2009, p.1).

However other researchers have shown that simpler parts of language can be learned through an audio-visual DVD (Rice et al., 1990). Rice and colleagues found that children who watched shows like "Sesame Street" were in fact able to learn words from a non-responsive type of interaction. However children learned more words when a parent or another adult watched the show with the child. It was unclear how and why an adult helped increase the amount of words learned, however it is likely that an adult would have encouraged the child to interact with the show and would have provided the needed social responses that were missing from the video.

Kcrmar, Grela and Lin (2007) incorporated children's mothers into their study's videos in an attempt to see if children would learn more when the "actor" had social relevance to them individually. By having the mother of the child in the video children were able to overcome the video deficit effect for word learning. When the video was repeated five times or more over the span of a week, word learning increased. In sum, many researches have done studies that show that children cannot learn from a screen, however no one knows if there is one particular reason behind this phenomenon. Researchers have come up with a variety of reasons in an attempt to explain how and why this video deficit effect occurs.

One proposed explanation for the video deficit effect has to do with the perceptual characteristics of learning from a screen. Zack and colleagues (2009) looked at fifteen month old children and determined that they may be incapable of learning from a two-dimensional screen because often times the images are smaller than real objects, color may be slightly different and aspects of the object may vary. Even through these seem like minute differences to an adult they may be very significant to a child who is still learning about and exploring new objects.

Children learn from a 2D image/show only after they have matured enough to differentiate the similarities and differences between a 2D and a 3D image generally around the age of two and a half (30 months) (Zack et al., 2009; O'Hanlon & Roberson, 2007). Krcmar and colleagues (2007) explained that how a child is taught and shown something affects their ability to apply the learned task to reality. Through this study they found that children were more likely to learn from an adult they were actively paying attention to, whether they were in person or on screen compared to an adult or show that they were not actively paying attention to. Their results suggest that children were capable of learning novel words no matter how they were being taught, that is, at the age of 22 months they have the ability to learn from children's shows. For my study children were shown the objects on the screen twice, once by the experimenter and the second was a still close-up image of the object. This was done to help eliminate the 2D/3D problem as much as possible.

Besides the variations in 2D/3D images, social interaction may be another major factor that causes the video deficit effect in children. Krcmar and colleauges (2007) explained that without some kind of social interaction at an early age language could not be acquired. Through this same study Krcmar and colleagues also implied that social interaction could be beneficial in word learning because it provides a type of arousal that improves memory and the ability to remember facts later. It is unclear how much and why these social cues helped children learn, but it had a significant effect on their overall learning. Also it is unclear whether or not these social cues could be incorporated into a video. Linebarger and Vaala (2010) discovered that:

> onscreen characters can simulate interactivity by speaking directly into the camera as if to engage in a "live" or "face-to-face" type of interaction. Simulated interactivity via explicit prompting routines entails asking the viewer a question, encouraging the viewer to engage in verbal or nonverbal actions, pausing to give the viewer an opportunity to respond, and providing feedback and praise (190).

Therefore it is possible to make on-screen characters seem as if they are interacting and engaging with the child. Many popular shows today have even started incorporating these ideas; however researchers have failed to study them completely and test children's retention of the taught material. The video for this project was made as interactive as possible, for example in the video the experimenter looked directly at the camera and asked prompting questions such as "can you see the elg?" Also to increase the social interaction I was present for both the video and the in-person testing.

Word Learning and Biases

A lot of research has been done looking at how children learn novel words for novel objects and what kinds of generalizations they form. Landau, Smith and Jones (1988) demonstrated that when children are asked to remember and label novel objects they do so more frequently by shape than either size or texture. In one study Landau and colleagues taught children a novel label, such as "dax," for a novel object. At test they presented children with novel objects that matched the trained example in specific features like shape, size, or texture and the children were then asked which object was the "dax". The objects were presented in two different ways, one where the child had to answer yes/no and the other where children had to point to the asked for object. These measures capture how children generalize a newly learned label to other objects, and specifically what features they consider important. No matter how the objects were grouped or changed children still had a tendency to choose the shape match. Children, starting at the age of two, are consistently using the shape of an object, as opposed to the other features such as size, color or material to help guide their labeling and categorization of solid objects (Jones, Smith, & Landau, 1991). When it comes to non-solid objects, the material of an item is very important in guiding children's labeling and categorizations (Soja, Carey & Spelke, 1991). These shape and material biases in word learning have been well established and show that children are sensitive to various factors in how they apply generalizations to newly learned words. Teaching novel labels is a relatively easy and common task yet how a child is taught varies among researchers. My study and a few other studies have attempted to see if these novel labels could be taught to children via a screen. I choose to do this because these biases among children are very clear and proven to exist by many researchers however no one has seen whether or not these biases remain when children are trained via a screen and images of objects were used instead of real objects. This is probably true because screen research, in general, has shown that young children cannot learn from a screen.

CURRENT STUDY

In sum this study will be looking to see if children can learn from a screen and if so what type of generalizations they will make. To see how the generalizations differed across the methods of training, children were put into one of two conditions: video and in person. In both conditions the children were trained on all of the novel words and objects twice (one after the other, until all were taught), then they were tested. Across visits to the lab, children were tested in two ways. In order to see if children were in fact learning the words being taught, I included a two alternative forced-choice task in which children were asked to identify the trained objects when compared to a distractor. To explore the quality of children's learning, that is, how they generalized the trained labels. I examined how children grouped the objects, and to see if there was some sort of pattern behind the way they selected the objects. In order to test word retention, every child was asked to return to the lab within two weeks and they were tested on the same novel words again. This research tested to see whether or not children are capable of generalizing novel objects and are able to retain novel labels over a certain period of time when they are taught novel labels through a screen compared to a live, face-to-face interaction. The goal of this research was to answer the question: Are children's generalizations different based on the way that they were trained and will they maintain their generalizations over time? I plan to show that it does not matter how a child is trained, their generalizations will be the same. I think that the generalizations will be the same because the objects used were clearly identified as being solids in both the video and the in-person condition and therefore a clear shape-bias should be present. I also plan to show that children will maintain their generalizations over time, regardless of the way that they were trained. Again I think that the generalizations will remain the same over time because the objects are not changing and because there are clear shape matches, therefore their shape bias should still be clear and present.

Method

PARTICIPANTS:

The participants for this study were 26 typically developing toddlers ranging in age from 30 to 36 months old (*M*=33.32, *SD*=1.81). Participants were randomly assigned to one of two between-participant conditions: video training (*n*=13) or in person training (*n*=13). There were a total of 13 girls and 13 boys; two girl's data and one boy's data were not completed so only their first visit data were used for the analysis. All of the children were recruited from a database containing children in the Boulder and Denver area, and all parents that came in were given a brief summary of the study, signed a consent form and completed a television viewing survey. The survey results reported that the average hours of television watched a week was 1.67, with a range of no television viewing to six and a half hours.

DESIGN:

Children were taught six novel nouns for six novel objects, either by video or in person. Then children's learning of these words was tested in two ways: to test whether they had learned the name of the exact object and could generalize to a shape match, children were tested in a forced choice task. To test the quality of their generalizations children were tested with a free choice sequential test. Each of these measures was obtained both immediately after training and about a week later. All testing was done in person. For the free choice sequential testing trials, and forced choice tasks, all objects were presented in different orders to control for any possible order effects. Training trials were presented via an adult speaker on a computer screen, and via an adult in person, as a between subjects independent variable. The scores collected from the free choice sequential testing trials as well as the forced choice task were collected as measures. The main dependent variable of interest in the forced choice task was the child's ability to correctly choose the target object. The dependent variable in the free choice sequential testing trials was the order of choices.

MATERIALS:

Stimuli were created in the lab by the experimenter, with the exception of the familiarization set. The familiarization set, used to familiarize children with the testing procedure, included a tennis ball (the target), a green bouncy ball, a yellow flat circle with holes in the side and an orange clip. The testing sets all had a target, a shape match, a texture match and a color match.

The novel labels used in this study were *elg, gub, nork, ife, zeb,* and *lug*; each of these labels had a corresponding object (see Figure 1).

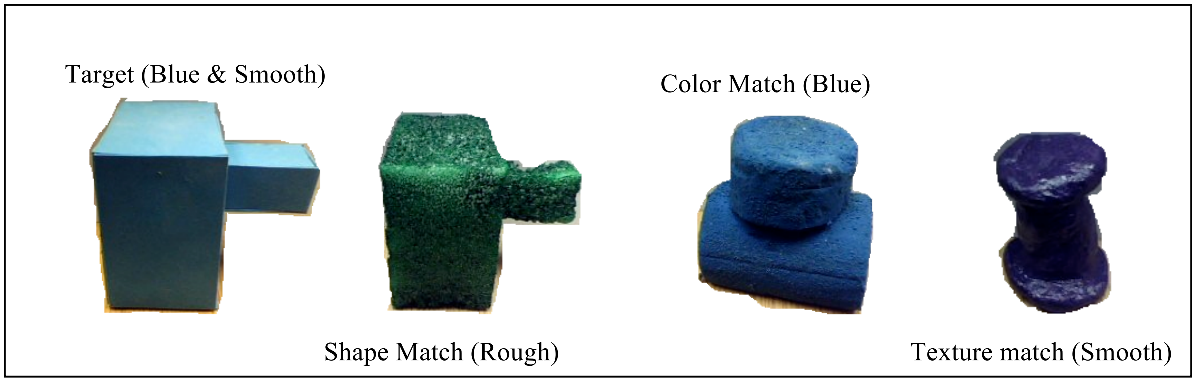


Figure 1 shows a sample set (the elg set). In every set there was the target, a shape match, a color match and a texture match. Each one of these matches matched the target in shape, color or texture.

The same sets and labels were used for both the video and in person conditions, where each object was labeled three times in one showing and then repeated after all of the objects had been shown.

PROCEDURE:

This study took place in a quiet room at the University of Colorado. The parents were asked to fill out a survey regarding their child's television viewing habits as well as a consent form. During this time the child and the experimenter would become comfortable with each other. Then everyone would go into an adjoining room where the study took place. Depending on whether the children was watching the video or watching the adult in person, the following steps would be slightly different.

Adult on Computer Screen: If the child was in the video condition, they would come into the second room with a computer screen sitting in front of a chair, in which the child was then placed. The video showed the experimenter placing the novel objects onto a table one at a time and rotating them so that at least two different angles were shown. While turning the object the experimenter would say: “This is my elg. Can you see my elg? That’s my elg”. Then there was a still close up image of the object shown for three seconds, without being labeled, and then the experimenter showed the next object; this was repeated until all six objects were shown. While the video played I sat quietly behind the screen; only speaking if the child became distracted. At the end of the familiarization set, I would pause the video and place the familiarization set onto the tray and ask the child to find the “ball”. After they found one ball I would ask “is there another ball?” After they selected the second ball I would again ask “is there another ball?” If the child handed me any other object I would say “nope that’s not a ball, so that stays on the tray”. Then I would take the tray away and replay the video, this time allowing each stimuli to be shown twice before starting the testing trials. If I noticed that they were not watching the video I would say “watch the video”, if the child tried to ask me questions during the video I would again say “watch the video”. Once the video was completed I began the free choice sequential testing by putting each individual set one at a time onto the tray and asked the child to find the novel objects. For each set I would say “Can you find the elg (or other novel names)?” once the child selected an object I would say “Can you find another Elg?” I would continue this process until the child said there were no more elgs or all of the objects had been selected.

Adult in person: In the live adult in person condition the children were shown the objects in person during the training session as well as tested in person. Like the video condition every object was shown and labeled twice before the testing started.

Both Groups*:* Both groups of children were tested the same way (in person) but trained differently and were asked to come back into the lab within two weeks to be tested again in the adult in person condition. The children all had a forced-choice task at the end of testing, during both their first and second visits. This task was included to see whether or not children were actually learning the novel labels that corresponded to the novel objects. For this task, two objects were placed onto a smaller tray with a small divider in the middle. During the child's first visit they were shown a target object and a distractor object (a shape match from a different set), and asked to hand the target object to the experimenter. For example the target Elg might be on one side and a shape match for the Nork might be on the other side, the experimenter would ask the child to point to or hand them the Elg (see Figure 2).

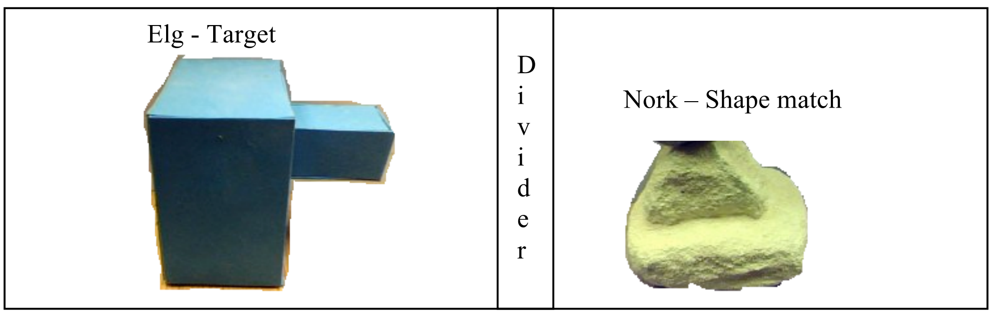


Figure 2 shows a sample forced choice task, where the object being asked for was done for both the target or shape match and the distractor object was a shape match from another set. This was repeated for all six target objects as well as shape matches (during the second visit).

Second Visit: During the children's second visit they were not re-trained or reminded of the novel labels. Instead they were shown the familiarization set (ball set) and asked to find the balls without being shown the ball by itself first or having the ball be labeled. After they had successfully selected the two balls from the familiarization set they were shown the free choice sequential testing object sets, one after the other until all six sets had been shown. Like the familiarization set they were not show the novel objects or told the names again, they were simply shown the entire set and asked to find the "elg" or other novel objects. After this was completed they completed two forced-choice tasks, one asking for the target object (the same one completed during the immediate test at the first visit) and another one asking for the shape match object. For the shape match task the shape match was asked for and put next to another distractor object (this time a target object from a different set). For example the Elg shape match might be on one side and the target for the Gub might be on the other. The experimenter would ask the child to hand them the Elg. This test was done to see if the children were actually learning the appropriate labels, were remembering them and were able to generalize that label to other objects with the same shape as the originally trained novel object (target).

MEASURES:

Bias Score: For the testing phase of the study, data was collected from sequential touching. The children's first choice was given the value of three, the second choice a value of two and the third choice was given the value of one. These values were then divided into either a shape or a material category. In order to get a bias score I took the total shape score and subtracted it from the total material score; if the score was positive the children had a shape bias, if the score was negative then the children had a material bias. The highest possible bias score would be a score of thirty.

Forced Choice Score: For the forced choice task, if the children selected the correct object they got a score of one; if they selected the incorrect object they received a score of zero. Both the target and shape forced choice tasks were scored the same way for both the first and second visit. The highest possible score would be a score of six.

Results

The purpose of the analysis was to see if children were completing the forced-choice task above chance, and if there was a difference between conditions (video or in person) or with the type of forced choice task (shape or target). The goal behind the analysis of the forced-choice task was to determine whether or not children were actually learning the novel labels that were taught in the task both immediately and over a delay. Children's bias score were assessed to see if they differed across conditions (video or in person) as well as across visits. To further break down the bias scores, children's individual shape and material scores were separated to see if there were differences across visit and condition; this was mainly done for the second visit. The purpose of this was to see if and how children's generalizations changed with the way they were trained over time.

Forced Choice Task:

The forced choice task was done to see what children learned about the novel objects. A 2 (condition: video or person) x 2 (visit: first or second) mixed model analysis of variance (ANOVA) was conducted for the forced choice target task. This analysis showed that nothing was significant, either on its own (condition: ($F(1,39)=0.93$, $p=0.34$; visit: ($F(1,39)=0.05$, $p=0.83$)) or as an interaction ($F(1,39)=0.00$, $p=0.99$). A planned comparison t-test showed that the forced choice target choices were significantly above chance when broken down by visit (visit 1: $t(23)= 4.63$, p= 0.001; visit 2: $t(17)= 3.41$, p=0. 0.002). For the forced choice task, for both visits and for both the shape and target conditions, the chance score was three correct out of six. Another planned t-test was done to see if the scores for each condition were above chance (see Figure 3a and 3b).

Figure 3a shows the forced choice target results for both the first and second visits, broken down into conditions (video or in person). The red line is showing the chance score, in which both the first and second visit are above chance.

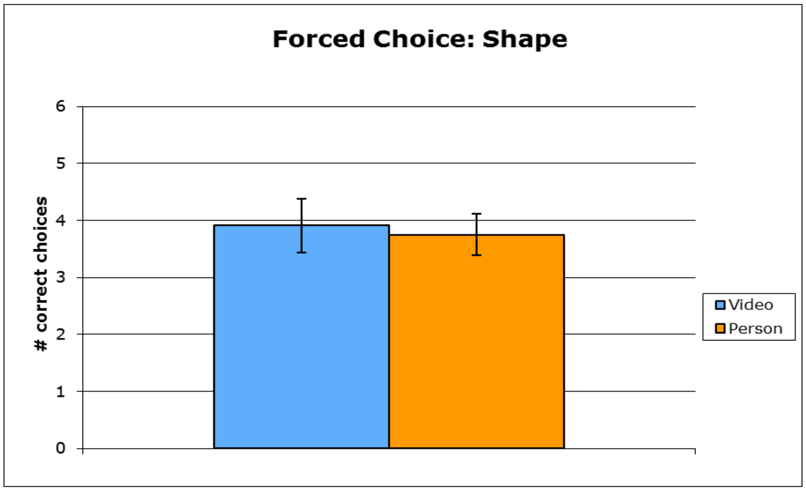


Figure 3b shows the forced choice shape results for the second visit broken down into conditions (video or in person). The red line is showing the chance score, in which both conditions are above chance.

The average scores for both conditions (video and in person) for the first visit forced choice task was M=4.136, SD=1.39; for the second visit the average M= 4.35, SD=1.46. For the second visit shape forced choice the average was M=4.05, SD=1.39. All conditions, when separated across visits and conditions, were significantly above chance (all $t>2$ and $p \leq 0.05$), except for the video condition in the shape choices, which was marginally above chance (t (10) = 1.91, p=0.09). This means that children were not randomly selecting the objects but were selecting the correct object most of the time. Therefore children identified the taught target item by name, and were also able to generalize those novel names to the shape matches.

Bias Scores:

Bias scores, computed from the free choice sequential task, were analyzed to see what features children were using to generalize novel names to new objects. Bias scores were submitted to a 2 (condition: video or in person) x 2 (visit: first or second) ANOVA. When condition and visit were looked at individually, the main effects were not significant (condition:

F(1,39)=0.18, *p*=0.68; visit: *F*(1,39)=0.005, *p*=0.94). However the interaction between condition and visit was significant (*F*(1,39)=4.37, *p*=0.04), meaning that children's bias scores were changing across visits and also by the groups in which they were originally trained. When looking at the graph of the bias scores (Figure 4) this interaction seemed to be driven by differences between the video and in person groups at the second visit.

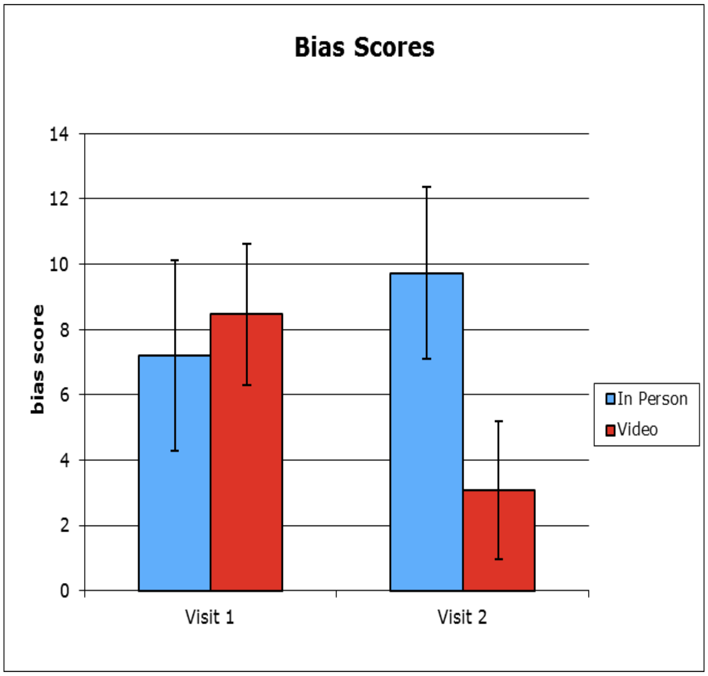
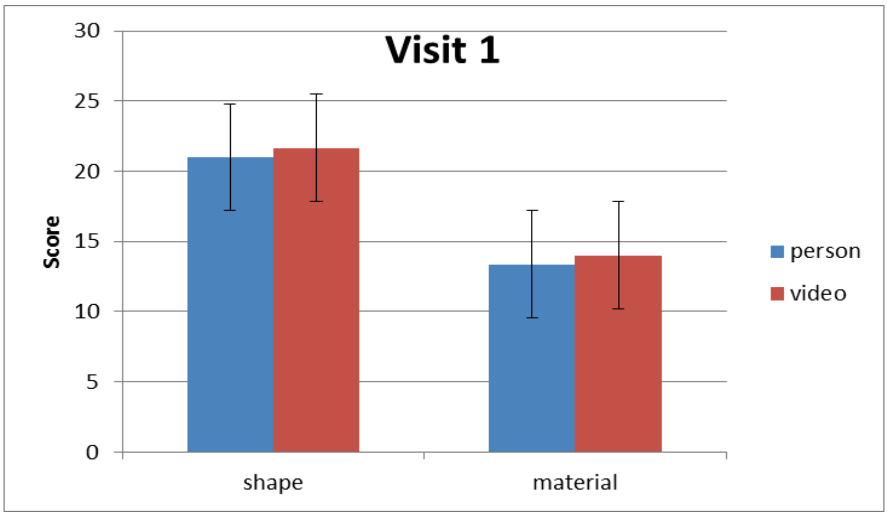


Figure 4 shows the overall bias scores for both conditions and for both visits.

A post-hoc t-test confirmed that differences between these training conditions at the second visit were significant (*t*(20)=2.409, *p*=0.026).

Shape vs. Material Scores:

To further explore the significant interaction between conditions and visit the bias scores for each individual child were broken down by shape and material scores, that is the number of objects chosen that matched in shape and the number chosen that matched in other features (i.e., material). This break down can further be seen in Figure 5a and 5b. Because the bias score differed between the video and in person conditions as seen specifically in the second visit, the next analysis focused on shape and material scores from the second visit only. A 2 (condition: video or person) x 2 (bias breakdown: shape or material) mixed model ANOVA, showed that condition on its own was not significant however the shape/material main effect was significant ($F(1,38)=14.32$, $p=0.001$). Also the interaction between condition and shape/material was marginal ($F(1,38)=3.56$, $p=0.07$).

A) 

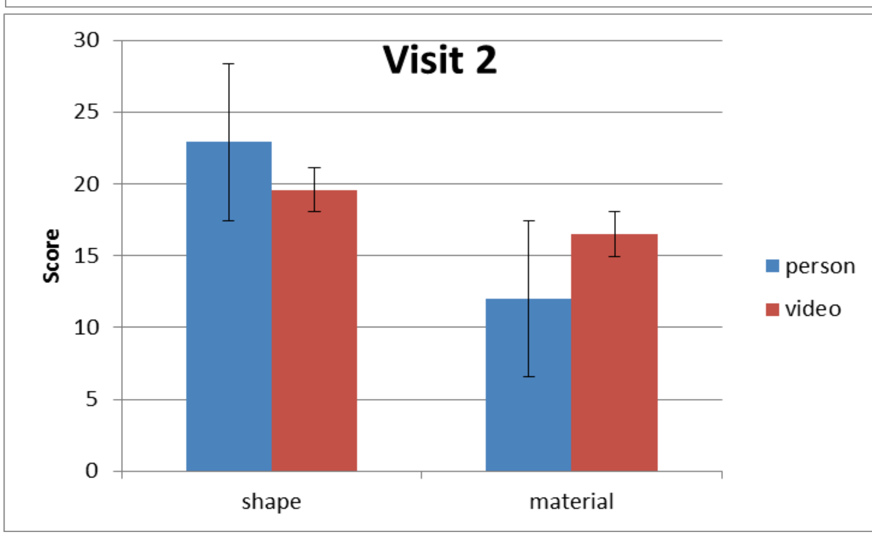
B) 

Figure 5a and 5b shows the breakdown of shape and other measures for the first and second visits. This break down was done to see what was causing the major change in the overall bias score graph for the second visit.

This break down shows that no matter how objects were learned, by the second visit children chose an equal number of shape matches. However, children in the video condition tended to choose more of the material, non-shape matching objects than children in the in person condition as shown by a marginal effect in a post-hoc t-test (t (18.05)=1.87, p=0.08), with a mean for the video condition of M=16.5 and a mean for the person condition of M=13.1.

Discussion

Past researchers have conflicting ideas about whether or not children are capable of learning from a screen; however the general consensus has been that very young children are not able to learn from a screen (Zack et al., 2009; Kuhl et al., 2003; Conboy et al. 2007). Previous researchers have failed to show whether or not children are able to retain information that has been presented to them via some kind of screen. The main goal behind this study was to determine if children could in fact learn novel words from a screen and were able to maintain that information over a set period of time at the age of two and half to three years old. Another goal was to see if there were differences in the quality of children's learning, whether they were trained in the screen or in person condition.

As the results show children were in fact retaining the information they learned from the screen and were still maintaining their shape bias over time. The shape bias was pretty equal for both conditions, video and in person, for the first visit; however at the second visit the children in the video condition showed a weaker shape bias. The shape bias was shown because two different measures were done. The forced choice measure did not reveal significant differences but the bias measure showed subtle differences between conditions. The bias measure was able to get at the quality of learning and children's retention ability. The forced choice measure also showed that children were learning the words but the bias measure revealed that they were learning them differently. In general children had consistent scores for the immediate recall, but by the second visit I started to see that the way they learned the novel words had an effect on their recall. By the second visit children's quality of learning from the in person condition and the video condition were different; this could not have been seen if the children were only tested in one way.

The children who were trained via the video were categorizing objects but in a less coherent way, especially as shown in the delayed testing, compared to the children trained in person. As stated in the results, both groups were attending to the shape of an object equally in the immediate testing. However the children in the video condition were using shape categories less during their delayed testing, and in fact they were choosing the shape and material matched objects equally. Perhaps this is because the video gave less information about the object such as the color or material, and therefore children were not making clear distinct choices. However these indistinct choices were made only during the delayed visit, meaning that the video was able to give enough information to allow children to choose shape matches in an immediate test but not enough information to retain and use in a delayed test.

The children in the in person condition may have attended to the shape categories because they were able to obtain more information from the objects from seeing it in person and being allowed to touch the objects during training. Shape biases may also have been stronger for this group because children had the social interaction that many researchers have argued help children learn novel labels. Overall children were able to learn new words from a screen but the quality of their learning was not as strong as the children in the in person condition, particularly in terms of the categories they retained over a delay. This could indicate that while children can learn words from a screen, the way in which they apply or generalize that information at a later time may be different from the way a child might generalize information learned in person.

In sum, this study shows that children are capable of learning new words from both a screen and in person, but the quality of their learning is different. The children who learned new words in person maintained what they learned over a delay and were able to make generalizations; whereas the children who learned new words via a screen were not able to retain that information over a delay nor did their generalizations stay as strong.

Although these results are novel and important, it is important to consider some limitations of the study. First off objects could have been a little more "factory" made with sharper edges and the novel words should not have sounded similar to one another. Also there should have been another shape match in the free choice sequential testing sets to clearly show the children that they were to select the objects that were similar in shape; with two matches and two distractors it might not have been as clear that they were only supposed to pick the shape matches. Another way that the data could have been more significant would have been to use a slightly older age group, this way the children should have not had any problems learning from the video or retaining the information over a delayed period of time.

Future Research

For future studies researchers should look at more realistic children educational videos. For example a talented computer programmer could make an actual show that taught children novel names for novel objects, in a similar format to an existing children's show. This is kind of done in many of the current children educational shows but no one has seen whether or not it is possible for children to learn novel names from these same shows. Another idea that should be looked at is to send home a few variations of these videos that teach the same novel words and see if by showing the same video over and over again but in different ways has a better outcome then only one viewing or multiple viewings of the same show. The different ways would be similar to a children's series, such as *Dora the Explorer* that is the same format every episode but teaches new words and concepts during each episode. This is an important topic to look at because more and more children are watching television for a majority of their day and producers need to know how to make that television viewing beneficial for their education.

Therefore there is plenty for researchers to continue to investigate in how and what effects television has on children's overall learning. This research would also be extremely beneficial to parents because many parents want to know whether television viewing is beneficial or harmful for their children.

References

American Academy of Pediatrics. (1999). Media education. *Pediatrics, 104,* 341-343.

Conboy, B. T., & Kuhl, P. K. (2007). Early speech perception. In *On Being Moved From Mirror Neurons to Empathy*. Retrieved July 25, 2010, from http://ilabs.washington.edu/kuhl/pdf/Conboy&Kuhl_2007.pdf

Krcmar, M., Grela, B., & Lin, K. (2007). Can Toddlers Learn Vocabulary from Television? An Experimental Approach. *Media Psychology*, 61-63. doi: 10.108/15243260701300931

Kuhl, P. K., Tsao, F., & Liu, H. (2003). Foreign-language experience in infancy: Effects of short-term exposure and social interaction on phonetic learning. *Proceedings of the National Academy of Sciences*, *100*(15), 9096-9101. Retrieved July 25, 2010, from http://ilabs.washington.edu/kuhl/pdf/Kuhl_etal_2003.pdf

Landau, B., Smith, L. B., & Jones, S. S. (1988). The Importance of Shape in Early Lexical Learning. *Cognitive Development*, 299-321. Retrieved from PsycINFO.

Linebarger, D. L., & Vaal, S. E. (2010). Screen media and language development in infants and toddlers: An ecological perspective. *Developmental Review*, 176-202.

O'Hanlon, C. G., & Roberson, D. (2007). What constrains children's learning of novel shape terms? *Journal of Experimental Child Psychology*, 138-148. Retrieved from PsycINFO.

Rice, M. L., Huston, A. C., Truglio, R., & Wright, J. (1990). Words from "Sesame Street": Learning Vocabulary While Viewing. *Developmental Psychology*, *26*(3), 421-428. Retrieved from PsycINFO.

Soja . N .N . . Carey, S ., & Spelke, E .S . (1991)- Ontological categories guide young children's inductions of word meaning : Object terms and substance terms . Cognition . 38, 179-211.

Zack, E., Barr, R., Gerhardstein, P., Dickerson, K., & Meltzoff, A. N. (2009). Infant imitation from television using novel touch screen technology. *British Journal of Developmental Psychology*, *27*, 13-26. doi: 10.1348/026151008X334700