JUMP START VOCABULARY: TEACHING SHAPE BIAS TO INCREASE EXPRESSIVE VOCABULARY

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ABSTRACT

Tim Brackenbury, Advisor

Shape bias is a lexical principle that suggests shape is the primary feature by which concrete noun labels apply to other objects. It helps children generalize the labels of newly encountered words to other referents. Shape bias typically develops around two-years of age and has been linked with increases in expressive vocabulary. Smith, Jones, Landau, Gershkoff-Stowe, and Samualson (2002), for example, found significant increases in 17-month-olds’ noun vocabularies following an intervention that taught shape bias. The present study applied the same intervention to children between the ages of 20 and 33 months with low expressive vocabularies. The six participants in the intervention group and one participant from the control group were exposed to novel objects, associated nonsense spoken labels, and objects that did and did not match their shape. Pre- and post-treatment expressive vocabularies were measured through the MacArthur-Bates Communicative Development Inventory. The children in the intervention group increased their expressive vocabularies by 18 to 62 words, with the majority of increases being nouns. These results suggest that vocabulary can be improved by teaching this lexical principle, as opposed to targeting specific words.
ACKNOWLEDGMENTS

I would like to thank my advisor for the guidance and knowledge I have received through completing this project. I am also grateful to the members of my committee and the input they provided.

I would also like to thank my loved ones for their support and encouragement throughout writing this thesis and my years of higher education.
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1. Participant Expressive Vocabulary Growth
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INTRODUCTION

By the age of two, children’s semantic skills are rapidly expanding. These young children are highly skilled word learners who produce 200-300 different words, combine words into two word phrases, and use a variety of word types, such as verbs, adjectives, pronouns, and location words (Gleason & Ratner, 2009). Not all two-year-olds, however, achieve these skills. The terms late talkers and late language emergence are used to describe children between the ages of 18 and 30 months who produce fewer words than expected for their chronological age, have receptive language abilities that are age appropriate, and do not have any other diagnoses. In other words, there is not a clear sensory, cognitive, or neurological explanation for the delay in their expressive language abilities. The criteria used for defining the low expressive vocabulary skills of late talkers varies. Researchers and clinicians typically apply cutoff scores based on the child’s expressive vocabulary size (e.g., 50 words or less for a 24-month-old) or standard score criteria on a standardized test of expressive vocabulary (e.g., below the 10th percentile). Current forms of intervention for late talkers include focused stimulation, modeling of single words, imitation of single words, and traditional individual speech-language therapy (Cable & Domsch, 2011). The present study examines the effects of an intervention for late talkers that is based on facilitating their knowledge of the lexical principle of shape bias (Smith, Jones, Landau, Gershkoff-Stowe, & Samuelson, 2002).

Late Talkers

Late talkers are children who have age appropriate receptive language abilities, show communicative intent, engagement, and have adequate play skills but do not have age appropriate expressive language skills. Taylor, Zubrick, and Rice’s (2013) prospective study of 1,766 children revealed that 13.4% of 24-month-old children qualify as late talkers. Because
vocabulary levels predict children’s early grammatical development, late talkers are at risk for later language development problems (Gleason & Ratner, 2009). Delayed language development at the ages of 24-31 months has been associated with weaknesses in language-related skills in adolescence (Rescorla & Turner, 2015). According to the literature, there are two common outcomes for late talkers. The first outcome occurs with about 65% of children who “catch up” with their peers (Taylor, et. al., 2013). In other words, their expressive language skills improve to be within the average range. These children are often referred to as “late bloomers” (Bavin & Bretherton, 2013). The second outcome includes late talkers who continue to display identifiable expressive language impairments. Leonard (1998) found that 25-50% of a Late Talker sample were later identified at school age as having specific language impairment (SLI). Kelly (1998) found that late talkers perform in the mean on some global expressive language measures, but their narrative skills and verb use are significantly below their same-aged peers. Taylor, Zubrick, and Rice (2013) found that 66-82% of the late talkers had lower mean levels of performance in semantic, syntactic, and morphosyntactic measures when compared to typically developing children. According to Rescorla (2009), at the age of 13, children previously diagnosed as late talkers scored below the control group on vocabulary, grammar, and verbal memory measures. Rescorla and Turner (2015) further found that at the age of 17, children previously diagnosed as late talkers scored significantly below the control group on vocabulary, grammar, reading, spelling, and verbal memory measures. However, both studies noted that while their scores were below the control groups’ scores, they still fell within the normal range.

Intervention options for late talkers range from “wait and see,” where no action is taken to address the child’s low expressive language skills, to early intervention (Girolametto, Weitzman,
Cable and Domsch (2011) conducted a systematic review of the treatment outcomes for late talkers. Eleven intervention studies published between 1991 and 2003 met their inclusion criteria for analysis: the research designs consisted of treatment-comparison groups, single group, or single-subject studies with receptive and/or expressive language measures on children with a mean age of 36 months or less. The intervention approaches used in these studies included focused stimulation, modeling of single words, imitation of single words, and other forms of traditional individual speech-language therapy. The potential impacts of these interventions were measured by gains in formal language measures, mean length of utterance (MLU), and target word acquisition. Across the 11 studies, all but one yielded positive large effect sizes for measures of global language skills, such as MLU and standardized tests. Two of the three studies that included standardized measures of expressive vocabulary showed moderate to large effect sizes of treatment (Girolametto, Pearce & Weitzman, 1996a; Robertson & Weismer, 1999). The third such study revealed no significant differences in expressive vocabulary growth between the treatment and control groups (Weismer, Murray-Branch, & Miller, 1993). Of the five studies that directly measured change in participants’ production of target words, two demonstrated significant improvements and one had mixed results (Girolametto, Pearce & Weitzman, 1996a; Girolametto, Pearce, & Weitzman, 1996b; Robertson & Weismer, 1999). The other two studies reported increases in the target word use, but did not control for maturation effects (Lederer, 2001; Whitehurst, Fischel, Lonigan, & Valdez-Menchaca, 1991). Overall, the results of Cable and Domsch’s systematic review show positive treatment effects on the vocabularies of late talkers. However, there were children in each of the studies who either made non-significant gains or no gains at all. Therefore, it is important to
continue exploring other treatment options that would help these children expand their expressive vocabularies.

More recent studies have also found mixed but generally positive treatment results for late talkers. Alt, Meyers, Oglivie, Nicholas, and Arizmendi (2014) studied the effects of an input based treatment on four late talking toddlers. The results of this study suggested that the treatment was effective based on the children’s abilities to learn more target words than control words. Also, the overall increase in their vocabularies suggested generalization of word-learning strategies. DeVeney, Cress, and Reid (2014) studied the effects of two interventions, modeling with expectant pause and modeling with evoked production, on three late talkers. Both methods led to higher productions of the treated words than the control words in all three children. However, the generalizability of these techniques was not seen, as no child produced any of the untrained control words during the sessions. Buschmann, Bettina, Hasselhorn, and Pietz, (2015) studied the effects of the Heidelberg Parent-Based Language Intervention (HPLI) on forty-three late talkers at the age of two and followed up with the children at the age of four. The forty-three children were randomly divided into a control and intervention group. The parents were taught child-oriented techniques, interaction-promoting techniques, and language-modeling techniques to help increase their children’s expressive vocabularies. The results of this study showed that at the age of four, the expressive vocabulary of both groups were within normal limits and did not significantly differ from one another. However, children in the intervention group had received less speech therapy than children in the control group and significantly fewer of them met the diagnostic criteria for SLI (8.7% and 25.7%, respectively). Taken together, the interventions presented here demonstrate that treatment approaches for late talkers that expose and teach them new vocabulary items are successful, especially for target items. Recent advances in another
aspect of semantics, word learning biases, suggests that interventions based on a common word
learning mechanism might also facilitate late talkers’ expressive language use.

Shape Bias

One theory on the differences between children with typical language development and
late talkers involves word learning biases. Word learning biases are techniques children use to
learn new words and aid lexical development (Smith, 2000). They are mechanisms that allow
children to apply a specific principle to learn multiple words at once, as compared to acquiring
them individually; they speed up the word learning process. They include the whole-object
assumption, taxonomic assumption, mutual-exclusivity assumption, and shape bias. Shape bias
is the tendency for children to generalize new object names to other objects that share the same
shape as opposed to other shared features such as color, texture, or pattern (Smith, 2000).
Children’s early vocabularies primarily consist of count nouns (Collison et al., 2014). Count
nouns are nouns that have definable boundaries such that they can be counted numerically, nouns
like cup and ball but not sand or air. Grammatically, count nouns can be made plural by adding
an “s” and can be modified with indefinite articles (e.g., three cups, a ball, *six sands, and *an
air). They are also frequently organized by shape, providing context cues that direct the child’s
attention to the shape of the objects. Therefore, children are provided both syntax and solidity
cues. These cues appear to provide the statistical regularities needed for children to develop
shape bias, suggesting that shape bias is part of ordinary learning. Typically developing children
develop shape bias around two-years of age. They assume same-shaped objects have the same
name, allowing them to immediately generalize words to similar shaped objects. Shape bias
helps typically developing children learn new object names more quickly in one trial with limited
mistakes, instead of learning words through a trial and error process with many trials and mistakes (Smith, 2000).

Smith et. al. (2002) directly examined the potential connection between shape bias and expressive vocabulary development by teaching shape bias to young children before it is typically acquired and measuring its effects on their expressive vocabulary growth. The study included eight male and eight female 17-month-old children. Half of the children were placed in a training group that met individually with an experimenter once a week for seven weeks of training and two weeks of testing. The other eight children were placed in the baseline group and only met with the experimenter for the testing procedures during weeks one, eight, and nine. The first seven weeks were training sessions which consisted of the child and experimenter playing with four three-dimensional (3D) novel shapes identified by the novel names, “wif,” “zup,” “dax,” and “lug.” There were two objects of the same shape per category and each category was played with separately from one another for a duration of five minutes. During those five minutes of play, the experimenter named each exemplar at least ten times. Halfway through the play, the experimenter also brought out a third object that differed from the exemplar objects by shape but matched in either color or texture. On week eight, the children were tested on first-order generalizations. During this testing, the experimenter showed the child one of the trained objects, named the object, and asked the child to find another object by the same name out of a field of three. One object matched the target in color, another matched in texture, and the third matched in shape. On the ninth week, the children were tested on higher-order generalizations. This testing was similar to the first-order generalization testing; however, the objects used during this testing were completely novel to the children, both in shape and name.
The participants’ expressive vocabularies were measured two times. The parents of the children were given the MCDI (Fenson et al., 1993) during Week 1 of the study and again at Week 8.

The results of the first-order generalization testing showed that the children in the training group generalized the trained names of the objects 88% of the time while children in the baseline group generalized the trained names of the objects 36% of the time, approximating chance. The results of the higher-order generalization showed that the children in the training group generalized the novel names to novel objects by shape 70% of the time while children in the baseline group generalized the novel names to novel objects by shape 34% of the time. In other words, the children who received the training performed better on these shape bias tasks than their age matched peers. Finally, the children in the training group had a 256% increase in their expressive noun vocabularies, adding an average of 41.4 object names, as compared to the baseline group that only showed a 78% increase, adding an average of 13.8 object names (Smith et al., 2002).

Based on Smith and colleagues’ work, other research teams have explored the shape bias abilities of children with language impairments. Jones (2003), for example, examined the shape bias abilities of late talkers. The parents of 12 late talkers and 12 children with typical development completed the MCDI – Toddler Form before the experiment. Children with an expressive vocabulary at or below the 30th percentile for their age range were identified as late talkers while those above the 30th percentile were in the control group. Prior to testing the children’s shape bias abilities, Jones established their skills at identifying familiar objects and unfamiliar objects by shape similarity with spoken labels. The children’s shape bias knowledge was tested by presenting four sets of 3D novel objects. One of the objects on the array was similar in shape to the target object, while the other two were highly dissimilar shaped objects.
Novel names such as “dap,” “mek,” “wuz,” and “sim” were given to the target objects. The children were asked to match the target to one of the three other objects on the tray that matched the test object in either shape, color, or texture. The mean frequencies at which the late talkers used same-shape, same-texture, and same-color to identify objects was about 2.8, 3.8, and 1.2, respectively. The mean frequencies at which the children with typical language development used same-shape, same-texture, and same-color to identify objects was about 4.5, 2.5, and 1.1, respectively. The results of this study showed that the late talkers did not show a shape bias as evidenced by their decreased generalizations to objects of the same shape. Due to the fact that the late talkers had a slow rate of new object name acquisitions and did not show shape bias, the importance of shape bias in word learning was supported (Jones, 2003). Because late talkers may be later identified as having SLI (Leonard, 1998), it is of interest to assess similarities in shape bias abilities between children with SLI and late talkers. Using procedures similar to those of Jones (2003), Collison et. al. (2014) tested the effects of shape bias on noun learning in typically developing children and children with SLI and found that children with SLI, like late talkers, do not show shape bias as strongly as their age matched peers.

Shape bias is a strategy seen around the age of two in typically developing children. It allows children to immediately know that noun labels refer to the shape of their object, expanding their vocabulary at a quicker rate (Smith, 2000). However, late talkers are less adept at this ability, which could be an explanation for their decreased vocabulary size (Bavin & Bretherton, 2013). While common therapy approaches for late talkers generally increase their expressive vocabularies, these gains are primarily seen with the trained target words. Therefore, it is important to explore other treatment options, such as a shape bias intervention, that would help children expand their expressive vocabularies for non-target words. Smith et. al. (2002)
found significant increases in 17-month-olds’ noun vocabularies following an intervention that taught shape bias. The present study applied the same intervention to two-year-olds with low expressive vocabularies to test the effects of a shape bias intervention on the expressive vocabularies of late talkers. The following research questions were addressed:

1. Could the procedures from Smith et. al. (2002) be successfully carried out by another group of researchers?

2. Could a shape bias intervention be successful in expanding the expressive vocabularies of late talkers at a greater rate than their prior vocabulary growth?

3. Will the number of new nouns acquired through a shape bias intervention be greater than the number of other new words accumulated in the children’s expressive vocabularies?

4. How will the changes in the late talkers’ expressive vocabularies compare to the changes in the typically developing children’s expressive vocabularies?
METHODS

The eight participants included in this study consisted of seven males and one female between the ages of 20 and 33 months living in northwest Ohio. Two of the eight children were identified by their parents as being Hispanic, five were not Hispanic - Caucasian, and one child’s ethnicity was not provided. Two of the children, the female and one of the males, were twins. All eight children were monolingual speakers of American English. Recruitment began by contacting local child care centers and discussing the study with their directors. Upon approval, copies of the information and consent sheets were dispersed to families by the child care providers. Families interested in the study either contacted the child care staff, who contacted the researchers, or directly contacted the researchers themselves.

The participants were placed into the treatment or control group, depending on their expressive vocabulary skills. The treatment group included five males and one female Late Talker. All six of these children had expressive vocabularies at or below the 10th percentile on the words and sentences form of the MacArthur-Bates Communicative Development Inventory (MBCDI) (Fenson, et al., 2007). None of the participants were reported to have any suspected or identified cognitive or sensory deficits, aside from their low vocabularies.

The control group consisted of two typically developing male children. One of these two children went through the protocol, while the other, the male twin, did not. Like the other participants, however, his expressive vocabulary was measured at the beginning and end of an eight week period. The first child in the control group had an expressive vocabulary in the 50-55 percentile range and the second child had an expressive vocabulary in the 40-45 percentile range on the words and sentences form of the MBCDI (Fenson, et al., 2007).
Following Smith et al.’s protocol (2002), the examiner met individually with each child for approximately 30 minutes a week for eight weeks. During each session, the child and examiner played with the four sets of novel objects displayed in Figure 1. The novel objects were all handmade 3D cuts of Styrofoam that were covered by cloth, paper, paint, or another material. Each set included two objects that were the same shape but different in color and texture, and a third object that was a different shape than the others, but the same as one’s color and the other’s texture. The novel objects were labeled with a nonsense word to help implicitly teach the child shape bias. To demonstrate the shape bias, the examiner used the nonsense label to reference the two objects within the same shape within each set. The labels used across the four sets were “dax,” “lug,” “wif,” and “zup.” No label was given for the object in each set that did not match the others by shape. Instead, it was referred to as “not a __.” The examiner and child played with each set of objects for at least 5 minutes (averaging 6 minutes and 21 seconds). During that time, the examiner used the target word labels while narrating the play (e.g., “The zup is driving the truck.” and “That hit me. It’s not a zup.”). The goal was to use the target labels at least 10 times in reference to the similar shaped objects, while the phrase “not a ___” would be used at least 5 times. On average, the experimenter used the target labels 48 times and the phrase “not a ___” 2 - 3 times during the sessions.
On the eighth week, the child was tested on first-order generalizations and higher-order generalizations. Two practice questions were asked before the testing, using common nouns and objects, to train the children to the testing conditions. Both the first-order generalization testing and higher-order generalization testing included four trials. During the first-order generalization testing (see Figure 2), the examiner showed the child one of the trained objects, named it, and asked the child to find another object by the same name out of a field of three. One object in the field of three matched the target in color, another matched in texture, and the third matched in shape. All three of these objects were different than the ones used during the treatment. For the
higher-order generalization testing (see Figure 3), the examiner showed the child a previously unseen and unlabeled novel-shaped object. Then the examiner asked the child to find another object by the same name out of a field of three. Again, one object in the field of three matched the target in color, another in texture, and the third in shape. To measure the children’s expressive vocabulary growth, another copy of the MBCDI (Fenson, et al., 1993) was given to their parents at Week 7 and returned at the final session.

Figure 2. First-Order Generalization Objects and Labels
Due to the small number of participants, only descriptive statistics were analyzed. Each child’s vocabulary was measured before and after the study with the MBCDI (Fenson et al., 1993), allowing for an analysis of the growth of the child’s vocabulary size. The post-treatment sessions were recorded allowing for the children’s ability to make first-order generalizations and higher-order generalizations to also be measured. Within and between group performances, as well as comparisons to the results from Smith et al. (2002) will be presented.
RESULTS

Expressive Vocabulary Growth

Table 1 shows the vocabulary growth of all eight children. The late talkers are presented in order of their initial expressive vocabulary sizes, from smallest to largest. Over the eight-week period, the late talkers’ added 18 – 62 words to their expressive vocabularies, with an average increase of 45 words. The number of nouns in their expressive vocabularies increased an average of 36, ranging from 16 to 78 nouns. Late Talker 1’s expressive vocabulary grew from 25 to 86 words, an increase of 61 words. Of these 61 new words, 42 were nouns and 19 were other word forms, such as adjectives and verbs. Late Talker 2 showed an expressive vocabulary increase from 29 to 47 words, showing a gain of 18 new words. Sixteen of these words were nouns and two were other word forms. Late Talker 3 increased his expressive vocabulary from 58 words to 120 words. Of these 62 new words, 37 were nouns and 25 were other word forms. Late Talker 4 showed a growth of 46 words, increasing from an expressive vocabulary of 79 words to 125 words. Twenty-four of her new words were nouns while the other 22 new words were other forms. Late Talker 5 started with an expressive vocabulary of 89 words. At the end of the sessions, his expressive vocabulary consisted of 115 words, showing an increase of 26 words. Eighteen of these new words consisted of nouns while the other 8 consisted of other word forms. Finally, Late Talker 6 had a word growth of 57, increasing from 232 to 289 words. This child’s noun inventory grew by 78 nouns and the other forms in the child’s inventory decreased by 21 words. All six children in the intervention group showed increases in their expressive vocabularies, and five of them acquired more new nouns than other word types.
Table 1

Participant Expressive Vocabulary Growth

<table>
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<tr>
<th></th>
<th>Late Talker 1</th>
<th>Late Talker 2</th>
<th>Late Talker 3</th>
<th>Late Talker 4</th>
<th>Late Talker 5</th>
<th>Late Talker 6</th>
<th>Control 1</th>
<th>Control 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total words</td>
<td>25</td>
<td>29</td>
<td>58</td>
<td>79</td>
<td>89</td>
<td>232</td>
<td>116</td>
<td>167</td>
</tr>
<tr>
<td>Posttest</td>
<td>86</td>
<td>47</td>
<td>120</td>
<td>125</td>
<td>115</td>
<td>289</td>
<td>260</td>
<td>374</td>
</tr>
<tr>
<td>Percent Increase</td>
<td>244%</td>
<td>62%</td>
<td>107%</td>
<td>58%</td>
<td>29%</td>
<td>25%</td>
<td>124%</td>
<td>124%</td>
</tr>
<tr>
<td>Nouns</td>
<td>10</td>
<td>19</td>
<td>33</td>
<td>58</td>
<td>46</td>
<td>127</td>
<td>81</td>
<td>106</td>
</tr>
<tr>
<td>Posttest</td>
<td>53</td>
<td>35</td>
<td>72</td>
<td>82</td>
<td>63</td>
<td>205</td>
<td>172</td>
<td>258</td>
</tr>
<tr>
<td>Percent Increase</td>
<td>430%</td>
<td>84%</td>
<td>112%</td>
<td>41%</td>
<td>37%</td>
<td>61%</td>
<td>112%</td>
<td>143%</td>
</tr>
<tr>
<td>Other words</td>
<td>15</td>
<td>10</td>
<td>25</td>
<td>21</td>
<td>43</td>
<td>105</td>
<td>35</td>
<td>61</td>
</tr>
<tr>
<td>Posttest</td>
<td>33</td>
<td>13</td>
<td>48</td>
<td>43</td>
<td>52</td>
<td>84</td>
<td>88</td>
<td>116</td>
</tr>
<tr>
<td>Percent Increase</td>
<td>120%</td>
<td>30%</td>
<td>92%</td>
<td>105%</td>
<td>23%</td>
<td>-20%</td>
<td>60%</td>
<td>47%</td>
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</table>
Over the eight-week period, the two children in the control group increased their expressive vocabularies an average of 175 words, for a range of 144 to 207 words. Control 1 increased his expressive vocabulary from 116 to 260 words, for a total of 143 new words. Eighty-eight of these new words consisted of nouns and 60 were other word forms. Control 2’s expressive vocabulary grew from 167 words to 374 words. His increase of 206 words consisted of 150 nouns and 57 other words types.

**First-Order Generalizations**

Table 2 displays the results of the first-order generalization testing. The children in the treatment group applied the trained names to new instances by shape with an average of 75% accuracy. Late talkers 1 and 2 correctly identified objects by shape with 75% accuracy. Late talkers 3 and 4 identified objects by shape with 100% accuracy. Late talkers 5 and 6 correctly identified the objects by shape with 50% accuracy. For one of the shapes, late talker 5 pointed to each of the three options presented to him. Due to the ambiguity of his response, it was recorded as an incorrect response. The control child chose the shape-matching objects with 75% accuracy.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Late Talker 1</th>
<th>Late Talker 2</th>
<th>Late Talker 3</th>
<th>Late Talker 4</th>
<th>Late Talker 5</th>
<th>Late Talker 6</th>
<th>Control 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correct</strong></td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Incorrect</strong></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Percent</strong></td>
<td><strong>75%</strong></td>
<td><strong>75%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>50%</strong></td>
<td><strong>50%</strong></td>
<td><strong>75%</strong></td>
</tr>
</tbody>
</table>
Higher-Order Generalizations

Table 3 displays the results of the higher-order generalization testing. The children in the treatment group generalized novel names to novel objects by shape 62.5% of the time. Late talkers 1, 4, and 5 correctly identified new objects by shape with 50% accuracy. For one of the shapes, late talker 5 pointed to each of the three options presented to him. Due to the ambiguity of his response, it was recorded as an incorrect response. Late talkers 2, 3, and 6 correctly identified the novel objects by shape with 75% accuracy. The control child extended novel names to novel objects by shape with 25% accuracy.

Table 3

<table>
<thead>
<tr>
<th></th>
<th>Late Talker 1</th>
<th>Late Talker 2</th>
<th>Late Talker 3</th>
<th>Late Talker 4</th>
<th>Late Talker 5</th>
<th>Late Talker 6</th>
<th>Control 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Incorrect</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Percent Accuracy</td>
<td>50%</td>
<td>75%</td>
<td>75%</td>
<td>50%</td>
<td>50%</td>
<td>75%</td>
<td>25%</td>
</tr>
</tbody>
</table>
DISCUSSION

Late talkers are children who do not have age appropriate expressive language skills. Current interventions demonstrate positive effects for most late talkers with treatment approaches that expose and teach them new vocabulary items, especially for target items. However, interventions based on a common word learning mechanism, like shape bias, might also facilitate the expressive language abilities of the late talkers. The present investigation explored the effects of a shape bias based intervention on the expressive vocabulary development of six late talkers.

Replication of Smith et. al. (2002)

The first research question addressed the ability to replicate the procedures from Smith et. al. (2002), which was successful. Forty unique 3D objects were created from Styrofoam and covered by different materials. The four sets of training objects included two objects that were the same shape but different in color and texture, and a third object that was a different shape than the others, but the same as one’s color and the other’s texture. Each set of objects in the first-order generalizations included one of the trained objects and three choices; one of the choices matched the target’s shape, another matched the color, and the third matched the texture. Each set of objects in the higher-order generalizations included a novel object and three choices; one of the choices matched the target’s shape, another matched the color, and the third matched the texture. This process took a great deal of time and planning to identify, organize, and create the different fabrics and colors for each shape. It was important to ensure that the objects’ patterns, colors, and shapes were similar to one of the other objects but different than the other two objects. The creation of the objects was a time consuming aspect and would therefore make it difficult for a clinician to replicate these procedures.
The participants in this study were recruited through local child care centers. The researchers and families worked together to schedule the sessions across an eight-week period. Depending on the family’s preference, the sessions were conducted at the child’s home, their child care facility, or the Bowling Green State University Speech and Hearing Clinic. Scheduling the sessions once a week for eight weeks was difficult. The families were not always available around the same time from week to week. However, careful planning was used to schedule the sessions approximately one week from one another in an attempt to replicate the study as closely as possible.

The children participated well throughout the sessions. Parents were encouraged to participate in the play during the first session to help the child feel comfortable around the researcher. After the first session, the children played with the researcher without hesitation. Most parents did not regularly continue participating in the play after the first session, but all were told they could continue if they desired. Generally, the children were interested in the play and it was not difficult to meet the five minutes of play with each set of objects. In the few instances where the child showed disinterest by walking away from the objects and playing with other toys, the researcher brought the objects over to the child and incorporated them with the other toys.

Each child’s vocabulary was measured before and after the study with the MBCDI (Fenson, et al., 1993). One difficulty encountered when using this measure was that the parents did not consistently mark the same words the first and second times they completed the form. For instance, Late Talker 6 shows a decrease in the number of other word forms from pretest to posttest. It is unlikely that after this study this child was producing less other word forms than before the study. Instead, this difference is likely due to the parents having difficulty
remembering and marking down every word their child was producing. A second difficulty with using the MBCDI was the potential for parental bias on the second administration, because they were not blinded to the intervention being conducted. In other words, the parents may have unconsciously checked more words on the second MBCDI because they knew that their children were in an intervention study targeting expressive vocabulary growth. While this may have influenced the results, having the parents involved in the sessions was determined to be a potentially greater positive influence on the children’s outcomes than the risk of this potential bias.

**Impacts of the Intervention**

The second, third, and fourth research questions all addressed the impact the shape bias intervention had on the late talkers. After completing the intervention, parents reported that they felt they noticed a positive difference in their child’s vocabulary and stated that their child was trying to speak more than he/she had tried to prior to the intervention. All of the children increased their expressive vocabularies by the end of the eighth week, as expected by both the intervention and the expressive vocabulary development of typically developing two-year-olds over a two-month period (Fenson, et al., 2007). Five of the 6 late talkers had noticeably more growth with nouns than other word types. These were the anticipated results because nouns follow the shape bias principle closer than other word types. The six late talkers applied trained names to new instances by shape with an average of 75% accuracy and generalized novel names to novel objects by shape 62.5% of the time. These results are slightly lower than Smith et. al.’s (2002) study in which the children in the training condition extended trained names to new instances by shape with 88% accuracy and generalized novel names to novel objects by shape 70% of the time. Taken together, these results are all in a positive direction but they do not
indicate if the progress the children made was directly due to the intervention or other maturational factors. To explore this issue, the performances of the late talkers in this study were compared with those of the participants in Smith et al.’s (2002) shape bias intervention, the control children in the present study, and the results of prior research on interventions for late talkers.

The vocabulary growth of the late talkers in the present study varied in comparison with those of Smith, et al. (2002). The children in Smith et al.’s intervention and control groups increased their expressive noun use by an average of 41 and 14 nouns, respectively. Three of the six late talkers in the present study added as many or more nouns as their experimental group. One late talker performed between Smith et. al.’s experimental and control groups, while the other two were at the same level as the control group. It is noted that the children in the present study were older and began with larger expressive vocabularies than those from Smith et. al.. To compensate for this, a comparison between the percentage of noun increase was conducted. To do so, the percent increase of nouns used in the children’s expressive vocabularies was calculated with the following equation: \[
\text{percentage increase} = \left( \frac{\text{number of newly added nouns}}{\text{number of nouns on the pre-test}} \right) \times 100
\]

On average, the children in this study showed an increase of 73.5% in their expressive noun vocabularies, which approximates the 78% increase of Smith et al.’s control group. Three of the late talkers in the present study increased the nouns in their expressive vocabularies at rates similar to or below those of Smith et. al.’s control group. Late Talker 3’s 112% increase was above that of Smith et. al.’s control group but below their experimental group. Only Late Talker 1, who had a 430% increase, improved at a higher rate than Smith et al.’s experimental group. The six late talkers increased the number of other word forms in their expressive vocabularies an average of 58%, which was equal to the average increase in Smith et. al.’s intervention group. These results
suggest that the expressive vocabulary growth of the late talkers in this study was similar to that of 17- to 19-month-old children with typical development who did not receive shape bias intervention.

A second comparison was made with the control children in the present study. Due to the small number of late talkers who participated, a control group of late talkers was not included. Instead, the control group consisted of two typically developing children. Of the two children, only one underwent the protocol. Control 1 had a 112% increase in the number of nouns in his expressive vocabulary and Control 2 had a 143% increase in nouns in his expressive vocabulary. As reported above, these changes are slightly higher than the average of 73.5% noun increase from the experimental group. Thus, the late talker group increased their expressive noun vocabularies at a lower rate than the two age-matched peers. This finding is not surprising, as a defining feature of late talkers is slow vocabulary growth as compared to typically developing peers. The late talker’s individual variability reveal that two of them (late talkers 1 and 3) had increases at or above those of the control children. The other late talkers all had smaller increases in noun use.

The final comparison was three previously published studies that also measured intervention change in the expressive vocabularies of late talking toddlers via the MBCDI (Fenson, et al., 2007). These studies all used different intervention approaches than the present study and each other. They also applied treatments that lasted much longer and/or were more intensive than the present research. Alt, Meyers, Oglivie, Nicholas, and Arizmendi (2014) examined the impacts of an intervention based on frequent exposures to target words in multiple contexts. Their four participants were similar in age and initial MBCDI scores to those of the present study (2-year-old late talkers who had produced between 0 and 48 spontaneous words).
The children were seen for two 20 - 50 min sessions across seven to ten weeks. The intensity of the target word presentations was between 5 and 10 times a minute. The four children showed an average increase of 253 words in their expressive vocabularies. Girolameto, Pearce, and Weitzman (1996a) studied the effects of program that trained the parents of 12 late talking 2- and 3-year-olds to use focused stimulation techniques to teach target words. The parent training consisted of eight weekly group sessions lasting two and a half hours, and three weekly home visits whose times were not reported. The late talkers in this study showed an average expressive vocabulary increase of 150.2 words. The third study, Robertson and Weismer (1999), examined the effects of different forms of input on the expressive vocabularies of eleven late talkers. The children were seen in small groups for 75-minute therapy sessions, twice a week for twelve weeks. These eleven children showed an average expressive vocabulary growth of 36.8 words. This is slightly below the average expressive vocabulary growth of 45 words seen in the present study’s late talkers. Taken together, the results of the present study were at or below the results of previous intervention research using the same measure of expressive vocabulary measure. This suggests that the shape-bias intervention may be generally on par with other current interventions for late talkers and offers ideas for changes to the protocol that might improve the outcomes.

**Future Directions**

The results of the present study provide a number of suggestions for future research regarding shape bias intervention for late talkers. One next step would be to include follow up testing at six months or a year later. This would allow the researchers to examine the continued growth of the children’s expressive language and determine if they “caught up” or still fall below the typically developing peers. Future studies should also work to ensure the sessions occur at
consistent intervals throughout the eight weeks. Due to scheduling conflicts, some children completed the intervention in slightly under eight weeks while others completed it in slightly over an eight-week timeframe. Also, future studies could also focus on the inclusion of control measures/participants. The comparison to Smith et. al.’s (2002) control group provided us with valuable information. However, these children were slightly younger than the late talkers and had typical language development. A control group of age-matched late talkers would help better understand the effects the shape bias intervention had on the expressive vocabularies of the children undergoing the intervention. Another direction to consider is increasing and expanding the dosage of the intervention. Late talkers are commonly later diagnosed with SLI and children with SLI typically require a greater dosage of intervention and exposure to learn target forms (Leonard, 1998). Therefore, it would be beneficial to study the effects of an increased shape bias intervention on the expressive vocabularies of late talkers.

While only two of the late talkers showed notable increases in their expressive vocabularies, all six late talkers had an increase in their expressive vocabularies. They also displayed an understanding of the shape bias principle by picking same shape objects with 50-100% accuracy on trained and untrained items. With future modifications, interventions like the one in this study, that teach children a principle to expand their expressive vocabulary instead of specific target words, could have significantly positive results on the expressive language abilities of late talkers.

**Summary**

All six late talkers included in this study increased their expressive vocabularies after completing the shape bias intervention. Three of these children added as many or more nouns as Smith et. al.’s (2002) experimental group, one performed between Smith et al.’s experimental
and control groups, and the other two were at the same level as the control group. While there was variability in the expressive vocabulary growth among the late talkers, their growth was below that of the two age-matched peers in the control group but commensurate with the results of other intervention studies of late talkers using the MBCDI. These findings suggest that the shape bias intervention has potential for improving the expressive vocabulary skills of late talkers, but does not warrant its adoption into clinical practice without further investigation.
REFERENCES


APPENDIX A. HSRB

DATE: September 12, 2014

TO: Tim Brackenbury, Ph.D.
FROM: Bowling Green State University Human Subjects Review Board

PROJECT TITLE: [625760-3] Jump Start Vocabulary
SUBMISSION TYPE: Revision

ACTION: APPROVED
APPROVAL DATE: September 12, 2014
EXPIRATION DATE: June 29, 2015
REVIEW TYPE: Expedited Review
REVIEW CATEGORY: Expedited review category # 4

Thank you for your submission of Revision materials for this project. The Bowling Green State University Human Subjects Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

The final approved version of the consent document(s) is available as a published Board Document in the Review Details page. You must use the approved version of the consent document when obtaining consent from participants. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that you are responsible to conduct the study as approved by the HSRB. If you seek to make any changes in your project activities or procedures, those modifications must be approved by this committee prior to initiation. Please use the modification request form for this procedure.

You have been approved to enroll 10 participants. If you wish to enroll additional participants you must seek approval from the HSRB.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. All NON-COMPLIANCE issues or COMPLAINTS regarding this project must also be reported promptly to this office.

This approval expires on June 29, 2015. You will receive a continuing review notice before your project expires. If you wish to continue your work after the expiration date, your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date.

Good luck with your work. If you have any questions, please contact the Office of Research Compliance at 419-372-7716 or hsrb@bgsu.edu. Please include your project title and reference number in all correspondence regarding this project.