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Children's Use of the Shape Bias in the Presence of Different Instructions, Object Types, and Emotion Cues

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CHILDREN'S USE OF THE SHAPE BIAS IN THE PRESENCE OF DIFFERENT INSTRUCTIONS, OBJECT TYPES AND EMOTION CUES

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ABSTRACT

This study explored the prevalence of the shape bias in children when faced with multiple perceptual cues. Three-to six-year-olds were shown three-dimensional objects and two-dimensional representations of these objects, half of which had emotional faces depicted on them. Of interest was whether attention to emotion would alter children's bias towards the shape of the object and how dimensionality and instruction type would affect the children's choices. The older children were equally likely to use emotion matches as shape matches, but this was not the case for the younger children, who were almost exclusively focused on shape. The non-lexical instructions induced shape matches more than the lexical instructions. It was also found that the two-dimensional representations of the objects elicited shape choices more often than the actual three-dimensional objects, especially in the non-emotion conditions.

CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Introduction

Around the age of two, the number of words in a child's vocabulary increases tenfold within a year (Gathercole, 2002; Samuelson, 2002). This language-learning phenomenon is very rapid, especially when compared to adults who spend hours studying in hopes of mastering a foreign language. Ongoing research has attempted to explain how children learn specific words for different objects and what enables them to do so at an efficient rate for novel objects. Some have suggested that children must possess various word-learning mechanisms that make the word learning process easier (e.g., see Smith, 2005 for a review). However, there has been considerable debate over the language-learning mechanisms that young language learners use to limit their many options when labeling an object.

When children are first learning to name objects, they tend to overextend names of objects (e.g., a pomegranate is an apple), but it is unclear what aspect of the objects are causing the children to overextend a name (Gelman, Croft, Fu, Clausner, & Gottfried, 1998). It could be that they are generalizing based on shape (both a pomegranate and an apple are round objects) or taxonomic relatedness (the fact that a pomegranate and an apple are both fruits that we eat). Gelman et al. found that both shape and taxonomic relatedness may play a role in children's naming processes. That is, children may be biased by perceptual features, such as shape, texture, or color, or they may be influenced by broader object categories such as "type of animal" or "type of furniture."

Theories of the Shape Bias

Landau and her colleagues (1998) have argued that early word-learning involves perceptual processes, meaning that children are attending to a perceptual feature to categorize objects, with shape being an important factor in lexical acquisition (Landau, Smith, & Jones, 1998). Beginning with an early study by Landau, Smith, and Jones (1988), an attempt was made at determining how children limit categories of objects. During this study, object sets were constructed consisting of a target object that was first shown to the children; they were then presented with three other objects, each matching the target object on one feature alone. One object matched the target object on shape (but not texture or color), one object matched the target on texture (but not shape or color), and one object matched on color (but not shape or texture). The target object was named by the experimenter with a nonsense name, such as "dax," and the experimenter asked the child to pick the other "dax" in the set. Of interest was what objects children were matching to the target object; either shape, texture, or color. The results of this study found that children generalized the nonsense names (i.e., "dax") based on shape. Landau, Smith, and Jones (1988) concluded that shape was a reliable cue to object categorization since an inclination towards shape held even when there were extreme deformations on other components of the objects, such as size (Smith, Jones, & Landau, 1992). This inclination towards shape was termed the *shape bias.*

Since this pioneer study, much research has been done on the *shape bias* as a word-learning strategy. The shape bias has been found in numerous studies (e.g., Diesendruck & Bloom, 2003; Imai, Gentner, & Uchida, 1994; Jones, 2003; Landau, Smith, & Jones, 1992; Jones, Smith, & Landau, 1991), and several of the experiments have manipulated different variables to test the strength of children's reliance on shape. Although different aspects of the original study have been changed, the same basic model has been used, where children are presented with a target object and sets of objects matching the target on different features.

Because the shape bias has been replicated by many researchers, theories of how this bias came about have been formed. The origins of these specific word-learning heuristics cannot be precisely determined, but two major theories of the origins of the shape bias have been formulated and will be tested in the current research: the *attention-learning account* and the *shape-as-cue account*.

Attention-Learning Account of the Shape Bias

The *attention-learning account* focuses on the lexical influence on shape decisions. Specifically, the *attention-learning account* suggests that a link between names in a language and shape exists, placing an emphasis on count nouns (Smith, 2000; Smith, 2005). Count nouns are nouns occurring in the singular form preceded by *a(n)* (a dog walked across the yard), or in the plural form preceded by *some,* or by no article (some dogs walked across the yard, dogs walked across the yard). Additionally, the English language distinguishes between count nouns and mass nouns. Count nouns can be preceded by a number (five dogs walked across the yard), but mass nouns cannot (*five* *waters* would not make sense). Importantly, solid objects are usually named by count nouns (Gathercole, 2002; Schelletter, 2002). Indeed, a link has been found between the number of count nouns in a child's vocabulary and the use of shape to generalize names to similarly shaped objects (Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999). In fact, Samuelson and Smith (1999) found that about 67% of children's early noun vocabularies refer to solid objects that can be categorized by shape. Children may recognize the similarities in shape between solid objects, and this may contribute to the vocabulary spurt in young children (Gershkoff-Stowe & Smith). In the English language, count nouns tend to be correlated with solid, shape-based categories, while mass nouns tend to refer to material-based categories (Samuelson & Smith, 1999).

Gershkoff-Stowe & Smith (2004) tested this assumption in a longitudinal study across six months designed to determine a temporal relation between attention to shape and noun acquisitions. By measuring attention to shape in the laboratory and rate of noun acquisition in other domains, the researchers noticed that increased attention towards shape in the laboratory was accompanied by an increase in new nouns outside of the laboratory. Although causal connections cannot be made between noun learning and attention to shape, the results from this study indicate that the shape bias develops and increases with age (Gershkoff-Stowe & Smith). Smith (2000) suggests that the shape bias is contextually cued by learned correlations between words and objects, leading to the formation of categories organized by shape. Consistent with these findings, children have been found to be proficient in the use of count nouns before mass nouns (Gathercole, 2002).

The examination of other languages and bilingual children may also help to explain where language comes into play during categorization. For instance, because the English language emphasizes the use of count nouns, a strong positive correlation between count nouns and the use of the shape bias has been found in monolingual, English-speaking children (Samuelson & Smith, 1999). Bilingual children learning two languages that both place an emphasis on count nouns may use the shape bias more often (Schelletter, 2002).

Alternatively, bilingual children learning both English and Spanish may not use the shape bias as much, or in the same way as monolinguals, because the Spanish language does not distinguish between count and mass nouns (Gathercole, 2002). Consequently, any noun can be singular or plural, without language forcing a distinction between these types of nouns. Although bilingual English/Spanish-speaking children still understand the distinction between solid objects and substances, they may use the shape bias in English more often than in Spanish. It may be that children learning both English and Spanish may develop either distinct language rules for each language or complementary rules that might aid in development (Gathercole, 2002). For instance, bilingual children may have separate systems for learning dual languages. Bilingual children may learn one language as having a mass/count noun distinction, while the other language does not have this distinction. Consistent with this notion, an observable difference was found in a recent study in which bilingual English/Spanish-speaking children were more likely to use shape than monolingual, English-speaking peers, especially when tested in English (Davidson, Raschke, Dunkel, & Linares, under review).

Bilingual children may be using shape as a strategy in the language that shape is most useful as a cue during word-learning.

In order to explain the possibility that children, regardless of bilingualism, are using perceptual features such as shape to learn words, an *attention-learning account* has been proposed (Smith, 1999). The *attention-learning account* argues that children operate via “dumb attentional mechanisms.” This type of mechanism would allow children to recognize correlations between perceptual properties of objects and certain words (Smith, Jones, Yoshida, & Colunga, 2003). For example, two similarly shaped objects might lead a child to generalize the name of one object to the other unknown object. Attention to shape may be beneficial for young language learners. Specifically, it has been found that children defined as “late-talkers,” those with a vocabulary below the 30th percentile for their age group, are biased towards texture in word-learning studies (Jones, 2003). Instead of putting together objects that matched on shape, these children were paying attention to the texture of the objects and basing their decisions on this visual and tactile feature. In other words, when presented with a target object named with a nonsense name (e.g., “This is a wuz”) and three other objects, one matching on shape, one matching on texture, and one matching the color of the target object, the late talkers more often than the typically-developing talkers extended the nonsense name (“wuz”) to the object matching the texture of the target object. Although no causal inferences can be made from this research, it may be possible that “late-talkers” have developed an attentional mechanism that works to inhibit efficient language growth (Jones, 2003; Jones & Smith, 2005).

This speaks to the significance of the shape bias in children's early word learning, with the possibility that different attentional biases can hinder efficient word-learning (Jones, 2003). Some children may be directing their attention to different aspects of objects when extending novel names to objects. While English-speaking children who are developing language at a typical rate may have a bias towards shape categorization, children who start talking at a later age may be developing a texture bias that does not aid language formation.

This does not mean, however, that texture does not play a part in categorization of objects, depending on the type of object used. Soja, Carey, and Spelke (1991) found that when substances, such as peanut butter, were used instead of solid objects, children focused on the texture of the substances to categorize them. It may be that children are using texture-based decisions because this is the only aspect of the object that stays consistent. In other words, peanut butter or play-doh does not keep a consistent shape, so the children categorized based on the most salient feature, which would be texture. Thus, children may categorize objects differently, depending on the situation and type of objects used.

Indeed, in a study by Landau and Leyton (1999), line drawings of objects were shown to children with either angular and rigid, or curved with "wrinkles," around the edges. The object drawings then appeared to undergo shape changes through a series of pictures. When asked to generalize names to the objects in the series, children in the rigid condition were less likely to generalize names to any of the shape changes, even slight ones. Conversely, when asked to generalize names in the "malleable" condition, characterized by angular and wrinkly edges, participants were more likely to extend the name to some of the shape changes, but not all of them. The children used perceptual cues to determine the range of shape and motion change within the objects, having more flexibility in decisions involving drawings with malleable properties.

In a recent study (Davidson et al., under review), the type of object was intentionally manipulated to investigate further how children react to specific types of shape. Although all solid objects were used, the target objects were varied to incorporate geometric shapes (e.g., square), organic shapes (e.g., "blob" shape), and letter-like shapes (e.g., an R-shape). It was found that children were more likely to extend a nonsense name when the target object was an organic shape. It may be that the children already have names represented for the geometric and letter-like shapes; they may know that a rectangle shape is named "rectangle" or the R-shape is an "R," and thus may be less likely to extend it in novel name-learning tasks. This shows that children's extension of novel names to other objects may be more rigid than once thought.

In addition to the actual shape of the objects used in shape bias experiments (e.g., rigid, organic), the instructions used in the task may also affect children's use of the shape bias. The *attention-learning account* predicts that the shape bias will specifically be brought about in conditions where objects are named. However, Davidson et al. (under review) found that children utilize shape more so in non-lexical (i.e., non-naming) conditions than in the naming conditions. Furthermore, when the object named was a familiar, geometric shape, name generalizations were even more conservative**.** In the current research, two naming conditions will be used, the *general naming* and the *proper* *naming* condition. In the *general naming* condition, children will be asked to extend a nonsense name from a target object to one of the other objects in the set ("This is a tib"). Additionally, the *proper naming* condition will be conducted in the same manner, except that a proper name will be used ("This one is named Tib"). The non-lexical instructions include asking the child which object *goes with* the target or are of the same *kind*.

Shape-as-Cue Account of the Shape Bias

Alternative to the *attention-learning account*, a *shape-as-cue account* has been proposed (Diesendruck, Markson, & Bloom, 2003), suggesting a relationship between count nouns and similarly-shaped objects is not due to a direct, perceptual association. This relationship instead exists because children believe that count nouns refer to object kinds; therefore, shape will be a reliable cue to a "kind" category (Diesendruck et al., 2003). At a young age, children are competent language learners and are said to understand conceptual associations (Diesendruck et al., 2003). If children are able to form abstract concepts, they may be able to categorize objects by kind. If this is true, children will be able to generalize names of objects beyond the immediate information available (such as shape or texture) and form broader categories of kind. Specifically, the name of an object determines its membership to a certain kind of object categorization. Count nouns would be relevant in this type of categorization because they refer to object categories (Diesendruck et al., 2003).

Conceptual information may be overriding shape when children are categorizing objects and learning novel words. For instance, Booth and Waxman (2002) claim that conceptual information more often organizes children's word learning categories than superficial perceptual features. According to the “dumb attentional mechanism” model, the child is a passive component of this mechanism, with attention drawn to only superficial features. In contrast, evidence for conceptual information permeating children’s word learning can be found in studies conducted by Booth, Waxman, and Huang (2005), where novel name extensions were mediated by conceptual knowledge given to children during presentation of the objects. For instance, when objects were described to one-and-a-half-year-olds and two-year-olds as animate kinds, the children tended to extend words on the basis of shape and texture. An animate object would be described as an object that “has a mommy and daddy who love it very much.” When the objects in the experiment were described as artifacts, the children extended novel words on the basis of shape. An artifact would be described, for example, as an object “made by an astronaut to do a special job on her spaceship.” This may provide evidence that even very young infants are guided somehow by expectations in word meaning from rudimentary conceptual knowledge (Booth & Waxman, 2003; Booth et al., 2005; Landau et al., 1998).

Functional Information Account and the Role of Conceptual and Perceptual Information on Shape Bias Use

Further research concerning children’s use of conceptual information on word-learning tasks has found that the specific functional use of the object may override children’s reliance on shape. When provided, functional information may override any shape bias that children are inclined to. With this in mind, Smith (2005) concluded that shape similarity develops over time from learning functional categories. Other researchers have found that attention to functional properties when generalizing names becomes increasingly important with age (Imai et al., 1994; Nelson, 1999; Truwax, Krasnow, Woods, & German, 2006). In a study by Truwax and colleagues, three- and four-year-olds were presented with sets of objects, as in previous word-learning studies, but in addition to shape, color, and texture matches, children were given explicit verbal information about shape similarities and function similarities between the objects. Conditions in which the shape and function matches were explicitly demonstrated decreased the reliance on shape. In conditions where the functions were not explicitly demonstrated, children relied on shape when extending novel names. In this study, regression analyses suggested a trend towards becoming less shape biased with age, as knowledge accrues about function. Furthermore, evidence such as this suggests that children may rely on shape matches when no other salient information is present. It may be that shape is a perceptual cue that children pick up on very early, but may give way to attention to cues that are deeper and more conceptual in nature (Deak, Ray, & Pick, 2002). Younger children may not fully understand this yet; thus, function information may play a larger role with development (Landau et al., 1998; Smith & Samuelson, 2006).

The question that arises is whether perceptual and conceptual knowledge are forming simultaneously or, rather, perceptual knowledge leads to deeper, conceptual knowledge about objects. Smith (2005) suggests that children become more shape-biased with age, whereas others argue that children rely on perceptual features such as shape when first learning words, but eventually come to learn information about object function and the intent of its creator (e.g., Rakison, 2005; Sheya & Smith, 2006; Truwax et al., 2006). Others believe that children, even young infants, are able to form abstract concepts and utilize this information more and more with age (e.g., Hespos & Spelke, 2004; Mandler, 2000). Taking the middle ground, Quinn & Eimas (2000) suggest that both perceptual processes and rudimentary conceptual knowledge develop and children use both types of information simultaneously to learn new words.

Social-Pragmatic Account of the Shape Bias

In addition to the previously discussed explanations of the shape bias, several researchers have suggested a *social-pragmatic account.* Young children's knowledge may be underestimated because several studies have shown that children attend to multiple environmental cues. Specifically, children may be sensitive to speakers' intent when extending novel names to objects (Akhtar, Carpenter, & Tomasello, 1996; Diesendruck et al., 2003; Diesendruck, Markson, Akhtar, & Reudor, 2004). This has been termed the *social pragmatic account*, where children are said to use their understanding of other people's minds to understand a speaker's intent when learning the names of objects (Diesendruck et al., 2004; Saylor & Troseth, 2006). Children are sensitive to others' knowledge states and can understand that speakers tend to comment on objects that are new to them (Akhtar et al.). In a study by Akhtar and colleagues, children and their mothers were able to play with three nameless toys. The mother then left the room while the child played with a fourth nameless toy. When the mother returned, she examined all four toys and exclaimed, "Look, I see a modi!" and the children were to pick which object they thought was the "modi." Results showed that children extended this nonsense name to the object that was novel to the adults (the fourth toy). This implies an understanding of adults' knowledge states, since the children were able to understand that adult speech can be influenced by the novelty of an object (Akhtar et al.). In other words, the children picked the object that the adult had not seen because they seemed surprised to see that certain toy.

Conversely, Samuelson and Smith (1998) argued that children are mainly guided in word interpretation by mechanisms such as perception, attention, and memory. The experimenters made the presentation of the fourth toy contextually novel by moving to a different location and allowing the children to play with it in this new location. They found that the novel location was the most attention-grabbing and children extended the novel name to the object presented in this location (Samuelson & Smith, 1998). This is contradictory to the results of Akhtar et al. (1996), because the children did not need an understanding of an adult's knowledge state to label the novel object. They chose to label the object with the given novel name by picking the object that was most salient in their minds, which was the contextually novel location where the fourth object was presented. In other words, the results showed that the novelty of the new location was the key to children's choice of word extension.

Diesendruck et al. (2004) clarify their view on the *social-pragmatic account* by replicating Samuelson and Smith's (1998) study, but changing whether or not the move to a different location to play with the fourth object was deliberate or accidental and whether the experimenter or a puppet did the naming of the object (e.g., "Can you give me the teega?"). For instance, when the fourth toy was to be presented, the experimenter either deliberately moved to a new location or made it look accidental by dropping the toy and telling the child that they were going to move to a new table since they were already there. The results from this study showed that children responded differently to the deliberate and accidental moves, suggesting that they encoded the moves differently and responded accordingly during the object naming trial (Diesendruck et al., 2004). For instance, the children in the accidental move did not consistently label the fourth toy (presented in the new location) with the nonsense name provided by the experimenter.

Does the Shape Bias Exist: Final Commentary on the Shape Bias Literature

Regardless of the various accounts given to explain the shape bias, some question whether or not a shape bias truly exists. Cimpian and Markman (2005) present evidence for the absence of a shape bias. They argue that any evidence towards a shape bias is an artifact of the experiment conducted, meaning that the shape bias may not be a true word-learning strategy children utilize. To provide evidence that the shape bias is not ecologically valid in everyday learning, in six experiments, they found that a shape bias can easily be eliminated by using more complex objects that do not overemphasize shape. In experiment one, it was shown that children aged three to five years only chose based on shape when objects were presented in isolation containing simple-shaped objects. The main purpose of experiment two and four was to eliminate the forced-choice procedure used in most word-learning studies. Indeed, the elimination of forced-choice greatly reduced children's shape matches, even when the objects were simple-shaped objects. The experimenters found that children seek the object that matches the target object based on taxonomical relatedness, even when a forced-choice procedure is employed (see experiment 4, specifically). It may be that children are categorizing based on "kind," even when they have the "safe" option of picking none of the above (Cimpian & Markman).

Additionally, in experiment five, one of the objects matched the target at a superordinate level (e.g., target is purse and superordinate match is paper bag) as opposed to the basic level (e.g., target is square-shaped purse and basic level match is a different shaped purse) matches in experiments three and four. It was predicted that children would choose based on shape only because they were not familiar with superordinate categories and shape similarities seemed to be the best alternative. In experiment six, the same procedure was used (superordinate level matches), but a "none of the above" option was included to detect a possible reduction in shape matches that were induced in experiment five. The results supported this prediction, with three- to five-year-old children picking shape matches at chance levels. Overall, the results from Cimpian and Markman's (2005) work suggest the shape bias could be induced by experimental procedures, such as using simplistic objects that overemphasize shape matches and the exclusion of alternative options (i.e., "none of the above"). Although controversial, since preschoolers may have difficulty with identifying superordinate level categories, this may be a problem during testing if these types of categories are used in the procedure (Cimpian & Markman). In turn, children may be choosing based on shape when that is the only alternative they are able to comprehend.

Consistent with Cimpian and Markman's (2005) notion of the shape bias as an experimental artifact, it may be that most past studies presented the objects in an artificial way. Specifically, in some past research, stimuli sets have been objects drawn onto cardboard and bound into a booklet (see Landau & Leyton, 1999). This seems like a diminished replica of what children encounter on a daily basis, because it eliminates dimensionality, depth, and texture. It has been hypothesized that simple, two-dimensional stimuli sets overemphasize the relation between the target object and the shape match in a set (Cimpian & Markman). It may lead children to think they are being taught shape terms since this might be the salient property in line drawings. Consequently, the present research will compare three-dimensional object sets to line drawings of the same objects to see which type of object elicits an inclination for shape more often.

In past studies, the addition of eyes to the objects used in word-learning experiments has caused children to pay less attention to shape (Jones et al., 1991). That is, the addition of eyes to objects may shift children's attention away from shape. Eyes tend to make the objects more animate and alive, and children attended to multiple similarities such as shape *and* texture (Jones & Smith, 2002; Smith & Samuelson, 2006; Yoshida & Smith, 2001). Eyes are perceptually salient to young children, so they will be used in this study, along with different facial expressions to see if children will focus on emotion categories instead of shape categories. In conjunction, Diamond and Carey (1977) discuss a developing trend in young children's attention toward faces.

Children tend to have a strong bias towards attending to emotion because emotion recognition is a developing skill that continues to improve over time. Consequently, this emotion bias may override similarities in shape. The addition of eyes to objects has been used in past studies (Jones et al., 1991) without the entire face. To further this research, the current study will put an entire face on the objects to see if children's attention can be pulled away from the strong inclination towards shape shown in past studies. Young children tend to have an emotion bias, and the importance of emotion in children's everyday lives will be discussed.

Development of Emotion Recognition

According to the literature, emotion recognition develops at a very early age, and the ability to recognize different intensities of emotion increases with age, so children become more efficient emotion identifiers in time (DeSonneville et al., 2002; Fabes, Eisenberg, Nyman, & Michealieu, 1991; Herba, Landau, Russell, Ecker, & Phillips, 2006; Widen & Russell, 2004). Even infants can mimic facial expressions of others (Harris & Saarni, 1989). This helps to create an attachment between the infant and caretaker; infants learn this form of communication by facial movements early in life. They may not understand their emotions, but they soon understand what a smile or crying can do to those around them. Infants have been shown to categorize emotional expressions early in life, with experiments demonstrating these abilities in infants as young as three months of age (Bornstein & Arterberry, 2003; Kotsoni, de Haan, & Johnson, 2001). Within the first six months of life, infants have been shown to discriminate between happiness and surprise and anger, while sadness seems to be more difficult to distinguish from happiness (de Haan & Nelson, 1998).

Around the age of two, children start to acquire emotion words that can be matched with certain facial expressions (Smiley & Huttenlocher, 1989). By at least age three, children are successfully able to identify the basic emotions of happiness, sadness, and anger, regardless of whether it is through a voice channel or a face channel alone

(Denham, 1998; Stifter & Fox, 1987). Emotion descriptive language emerges around 20 months of age. From the second to the third year, children's verbal expressivity increases significantly, especially that concerning emotional information, which may help to increase understanding of causes and consequences of emotions (Malatesta-Magai et al., 1994; Ridgeway, Waters, & Kuczaj, 1985; Smiley & Huttenlocher, 1989). Although they may not be making the connection between internal states and facial expressions at first, children can successfully identify the emotion depicted in a facial expression early on (Harris & Saarni, 1989; Smiley & Huttenlocher, 1989). Preschoolers are first able to recognize happiness, followed closely by anger and sadness, so these three basic emotional faces are to be used in the present stimuli sets (Camras & Allison, 1985; Lewis, 1993).

Importance of Emotion Recognition

Consistent with the above-mentioned findings, it has been found that there is a set of emotions that is universally recognized by humans, and these are termed "basic" or primary emotions (Harris & Saarni, 1989; Izard, 1992). The basic emotions of happiness, anger, and sadness can be displayed by facial expression, and they are recognized by a majority of children around ages two to three (Harris & Saarni, 1989; Smiley & Huttenlocher, 1989). These emotions have been found to be universally recognized (Ekman, 1992), but self-conscious emotions, such as embarrassment or pride, are not as easily recognized by facial expression alone. Even though emotion and cognition work as a team to create an experience embedded with emotion, prototypes for each emotion begin to form early in infancy with rudimentary conceptual understanding (Harris & Saarni, 1989).

Although research has shown that very young infants are able to distinguish facial expressions (e.g., Bornstein & Arterberry, 2003; de Haan & Nelson, 1998; Kotsoni et al., 2001), young children also show signs of learning the situational cues that may lead to a specific emotion (Widen & Russell, 2004). In fact, evidence shows that young preschoolers are more inclined to focus on another's facial expression, as opposed to situational factors that may have elicited the emotional expression (Gross & Ballif, 1991; Widen & Russell). With age though, children begin to direct their attention towards situational factors that are associated with a particular emotion and emotional expression. This developing capacity for situational factors allows for recognition of more complex emotions, such as embarrassment or pride (Davidson, 2006). Younger children tend to focus on expressive cues from others to identify emotional states. This causes difficulty for younger children when complex emotions are displayed by others that cannot be easily interpreted by facial expression alone. Even though younger children may understand situational cues, they do not utilize this knowledge until around 8 years of age (Fabes et al., 1991). In fact, it has been found that younger children (around 3-4 years) do not easily identify causes of emotions (Fabes et al.).

Emotion Recognition in Young Children

Research has shown that children pay the most attention to defining facial features to recognize emotion, with the eyes being the most important, followed closely by the mouth (Adolphs, 2006; Gross & Ballif, 1991). In fact, by about two months, infants tend to look at the eyes on a face more often than any other facial feature (Langton, Watt, & Bruce, 2000). It could be the high contrast between the eyes and the face that keep infants' attention, but they seem to be a key component in emotion recognition. It may be that the eyes attract infants' attention due to movement, but studies have shown that it is not due to low-level perceptual functioning, but rather a developing attraction to a particular component of the eyes (Langton et al.).

Additionally, children learn to recognize emotion in the same way they would learn a word concept, by categorization (Gross & Ballif, 1991). For instance, children may categorize all faces with a mouth turned up at the corners as "happy" even though they do not all look exactly the same (Markham & Adams, 1992). This suggests that emotion is an important factor in different learning strategies. Thus, emotion may be a salient factor that children are attending to when categorizing objects, and the addition of emotional faces to the objects in the current study may pull children's attention away from shape or texture. Since studies have found evidence of very young infants, aged 3 months and older, discriminating between different emotional expressions, emotion recognition may be a salient part of infants' learning. Although controversial, infants have shown evidence of categorization of positive and negative facial expressions by about 10 months of age (de Haan & Nelson, 1998).

The current research project allows for identification of basic emotions (happy, sad, and angry) since they are distinguishable through perceptual facial expressions. Also, because the youngest children in this study may not be able to comprehend complex emotions such as guilt and pride (Davidson, 2006; Denham, 1998), only basic emotions will be used so that the children of all ages will understand.

The current research project will be conducted with preschool and kindergarten children (3-and 4-year olds and 5-and 6-year-olds) to examine the strength of the shape bias under different conditions. As in previous shape bias studies, the children will be presented with a target object and three additional objects, each one matching the target object on one feature. Furthermore, two different types of objects will be presented to the children. They will see a set of two-dimensional line drawings of objects and, on a separate day, they will see the same set of objects in three-dimensional form made of various materials such as cardboard, felt, and styrofoam.

Traditionally, the additional objects in the sets match the target object on either shape, texture, or color. In the present study, emotional faces have been added to the object sets to see if children will categorize the objects based on emotion rather than shape. Different instructions have been used in the past, either lexical (naming the target object and asking for another object with the same name) or non-lexical (asking the children to find the other object that *goes with* the target or the other object that is the same *kind*). The lexical naming instruction has been said to induce the shape bias more often than non-lexical instructions (Smith, 2000). To test this theory further, a new type of lexical instruction, the *proper naming* instruction, has been added to the current experiment to see how it will affect categorization. It may be that an object named with a proper name ("This is Tib") may focus the children's attention on the emotion displayed on the objects. In other words, the objects may seem more animate.

By using different linguistic instructions during object presentation, the present research will compare the *attention-learning account* with the *shape-as-cue account* of the shape bias. Diesendruck and Bloom (2003) found support for the *shape-as-cue account* during lexical (naming) instructions and also when categorizing by *kind*. According to Diesendruck and Bloom, finding an object of the same *kind* motivates children to search for another object from the same category. Conversely, the *attention-learning account* predicts that only lexical (naming) instructions will induce the shape bias in children. Although the current study will not directly assess the *functional information* and *social pragmatic accounts*, it will work to control all environmental cues to novelty. These interpretations of a shape bias in childhood inform us that children are sensitive to social cues from experimenters, which may not have been taken into account in early word-learning studies.

Additionally, this research will focus on an age group that has recently learned to distinguish and verbalize about different emotions, between the ages of three and four, and also an older age group of five to six years to see change across age. In doing so, the present research will assess how a developing language and emotional recognition system work to aid in word-learning and categorization.

Hypotheses

1. Overall, it is hypothesized that in the Emotion Condition, the occurrence of the shape bias will be less prevalent than in the Non-Emotion Condition. This hypothesis is based on children's ever-increasing attention to emotion, which would serve to distract from shape cues when categorizing objects.

2. Specifically, in the Emotion Condition, children's use of the shape bias will be less frequent when the objects are three-dimensional and labeled with a proper name ("This is Tib"). That is, these two factors may decrease reliance on shape because the objects may be seen as more animate and the focus will be on the emotion faces, as opposed to shape alone. Specifically, the eyes will make the objects more animate, shifting attention towards multiple categories, such as emotion or texture because shape is no longer a consistent cue for animate objects (Jones & Smith, 2002).

3. Based on previous findings, the present research sought to compare the *attention-learning* and *shape-as-cue accounts* of the shape bias. According to the *attention-learning account*, lexical (naming) instruction will induce a reliance on shape when extending names. If the shape bias is stronger in the naming conditions (general naming and proper naming), then this is support for the *attention-learning account.* The strength of this will be tested with the *proper naming* instruction, a new type of instruction that has not been used in past studies. If the shape bias is used in both types of lexical instructions (both general naming, *This is a tib,* and proper naming, *This one is named Tib*), then this is further support for the *attention-learning account.* According to the *shape-as-cue account*, in addition to lexical instruction, the shape bias will be displayed in non-lexical instructions involving *kind* comparisons, although broad non-lexical instructions such as, "Which one goes with this one?" will not induce a reliance on shape. According to this account, the shape bias will be most frequent when children are instructed with lexical instruction (general naming and proper naming) *and* when asked to find another object of the same *kind.* This account predicts less frequent use of the

shape bias when children are instructed to find another object that *goes with* the target object. Based on recent findings (Davidson et al., under review), it is predicted that children in the non-lexical conditions will rely on shape more than those in the lexical conditions.

4. Furthermore, in the Non-Emotion Condition, the older children (5-and 6-year-olds) will be more likely to use shape than the younger children (3-and 4-year-olds). Although past research has been controversial as to the development of an inclination towards shape, this prediction was made because young children have an inclination towards faces, especially eyes (Langton et al., 2000).

5. Shape may be a more salient cue when categorizing two-dimensional objects as opposed to three-dimensional objects. Therefore, when comparing two-dimensional line drawings and three-dimensional objects, collapsed across instruction type, it is hypothesized that the two-dimensional line drawings will induce the shape bias more often than the three-dimensional objects.

CHAPTER II

METHOD

Participants

The participant pool totaled 160 children, recruited from preschools and elementary schools in and around Chicago, Evanston, and Skokie, IL. Eighty three- to four-year-olds (mean age 4.2, age range 3.1-4.11) and eighty five- to six-year-olds (mean age 5.9, age range 5.0-6.11) participated. Monolingual, English-speaking children from similar SES backgrounds, lower-middle to middle-class were recruited. In each age group, an equal number of boys and girls from racially diverse backgrounds were sought by sampling from various neighborhoods.

Materials and Procedure

Receptive Language Proficiencies. In order to measure children's receptive language proficiency, children were tested on the Peabody Picture Vocabulary Test-PPVT-III (Dunn & Dunn, 1997) up to Plate 60. The children were only tested up to Plate 60 because this is the cutoff for the 7-year-olds.

Object Sets. Three-dimensional objects were constructed from various materials such as styrofoam, cardboard, felt, and wood to create two practice sets and six experimental sets. Two-dimensional line drawings of the objects were also created, which were presented in the same manner as the three-dimensional object sets. To create the two-dimensional sets, photographs were taken of every object and changed through

Photoshop software using a “photocopy” filter. This captured the object shape and texture exactly, acting as an effective comparison group to the three-dimensional object sets. A sample of the actual objects used in the present research is shown in the Appendix. Children viewed both the two-dimensional sets and the three-dimensional sets, but on separate days (approximately 48 hours apart).

Procedure. Children were assigned to one of two conditions: objects with emotional faces on them (Emotion Condition) or objects without faces (Non-Emotion Condition). Within the Emotion Condition object sets, there was a target object with a certain shape, texture, and clay emotional face. Three other objects were in each set, with one object matching the target on shape alone, one object matching on texture alone, and one object matching on emotional face. In the Emotion Condition, only three basic emotion faces were used- happy, sad, and angry. Two of the target objects depicted happy faces, two depicted mad faces, and two depicted angry faces. In the Non-Emotion Condition, the objects were exactly the same as in the Emotion Condition, but without clay faces on them. One object matched the target on shape alone, one object matched the target on texture alone, and one object matched on no feature.

Children were tested individually by a researcher in a quiet room of their school. Each child was administered the PPVT-III. The child was then administered two practice sets of objects in order to familiarize them with the experimental materials. After the practice sets, the child was shown the experimental objects in a counterbalanced fashion, one set at a time. In both the practice and experimental sets, the child first viewed the target object for about five seconds, then the child simultaneously viewed the following three objects for about five seconds each. This spacing and time was used so that the child was able to process each object individually. Each child viewed both the two-dimensional sets and the three-dimensional sets on separate occasions approximately 48 hours apart. Each child received only one type of instruction throughout the experiment: *general naming*, *proper naming*, *same kind*, or *goes with* instruction, as described below.

In the Non-Emotion Condition, the same procedure was used except that children viewed the two-and three-dimensional objects without emotion faces on them. Instruction type was the same across sets and on both days of testing.

Instructions. In the *general naming* instruction, after children were shown a set of objects one at a time, they were directed towards the first object (the target object) and told, “Look at this. It’s a (nonsense name). See, it’s a (same nonsense name). This is a (same nonsense name).” Children were then directed towards the following three objects and asked, “Which one of these is also a (same nonsense name)?” They were also asked, “Which one is not a (same nonsense name)?” The nonsense names used for the target objects were bab, yad, fid, dat, tib, zop, yeb, and tay.

In the *proper naming* instruction, children were shown a set of objects one at a time. They were directed towards the target object and told, “Look at this. Its name is (proper name). See, its name is (proper name). This one is named (proper name).” Children were then directed towards the three objects following the target and asked, “Which do you think is also named (proper name)?” They were also asked, “Which one do you think is not named (proper name)?" The proper names used to name the target objects were Bab, Yad, Fid, Dat, Tib, Zop, Yeb, and Tay.

In the *same kind* instruction, the children were shown all the objects in a set, starting with the target object. The experimenter then pointed to the target object by saying, "Look at this. See this." The experimenter then pointed to the following three objects and asked, "Which one of these is the same kind like this (pointing to the target)?" They were also asked, "Which one of these is a different kind?"

In the *goes with* instruction, the presentation of the objects was the same as in the *same kind* instruction, except that the experimenter asked the children, "Which one of these (pointing to the three test objects) goes with this (pointing to the target)?" Children were also asked, "Which one of these doesn't go with this?"

In total, each child viewed eight sets (two practice, six experimental) on the first day of testing and eight sets (two practice, six experimental) on the second day of testing. Children's responses were recorded by trained researchers. A total of sixteen responses will be obtained on the first day of testing and sixteen responses will also be obtained on the second day of testing.

CHAPTER III

RESULTS

Children's Overall Use of Object Features (i.e., shape, texture, emotion) in the Emotion and Non-Emotion Conditions

Children's individual pattern of responses in the emotion condition was analyzed using a chi-square test. Of initial interest was whether children in the emotion condition would select objects on the basis of shape, texture, emotional expression, or randomly (no clear cut pattern of choosing). The results of this test revealed that children did not select on the basis of shape, texture, or emotional expression equally often, χ^2 (3) = 104.60, $p \leq .001$, see Table 1. However, different patterns emerged for the younger and older children. Follow-up chi-square tests with Bonferroni correction revealed that 3-and 4-year-old children were more likely to respond on the basis of shape than on the basis of emotion or texture χ^2 (1) < 5.77, $p \leq .02$. In contrast, follow-up chi-square tests on the 5- and 6-year-old children's data revealed that they were equally likely to choose on the basis of shape or emotion and were more likely to choose on the basis of shape or emotion than texture (or to choose randomly), χ^2 (1) < 8.05, $p \leq .01$, see Table 1.

In the non-emotion condition, the overall chi-square test revealed that younger and older children in this condition did not use shape, texture, or random matching equally often, χ^2 (2) $\geq$ 47.28, $p \leq .001$. Follow-up chi-square tests (using Bonferroni correction) showed that younger and older children used shape cues more often than texture or random matching, χ^2 (1) $\geq$ 10.92, $p \leq .001$, see Table 1.

Table 1

Proportion of Children Responding with Shape Matches, Texture Matches, or Emotion Matches Across Emotion and Non-Emotion Conditions

	Shape	Texture	Emotion	Random
Emotion Condition				
3-4 year olds	.60	.05	.25	.10
5-6 year olds	.43	.10	.43	.05
Non-Emotion Condition				
3-4 year olds	.65	.33	-	.03
5-6 year olds	.68	.28	-	.05

Note. Data are collapsed across linguistic instruction and dimensionality.

The Effects of Linguistic Instruction and Object Dimensionality on Children's Use of Shape Matches in the Emotion and Non-Emotion Conditions

In order to assess how linguistic instruction and dimensionality affected younger and older children's use of shape in the emotion and non-emotion conditions, a mixed-model ANOVA was conducted on the data using the proportion of shape matches as the dependent variable. Age (three- and four-year-olds, five- and six-year-olds), Condition (emotion, non-emotion), and Linguistic Instruction (general naming, proper naming, same kind, goes with) were between-subjects variables, and Object Dimensionality (two-dimensional, three-dimensional) was a within-subjects variable.

Because no significant differences were found between the *proper naming* (M = 0.51, SD = .35) and *general naming* (M = 0.42, SD = 0.36) instructions, $t(76) = -1.18$, ns, these types of instructions were collapsed into a *lexical* (naming) instruction category. Likewise, because no significant differences were found between non-lexical *goes with* (M = 0.65, SD = 0.36) and *same kind* (M = 0.67, SD = 0.37) instructions, $t(76) = -0.18$, ns, children's responses in these conditions were collapsed to form the variable *non-lexical* (non-naming) instructions. Thus, the Linguistic Instruction variable used in the subsequent ANOVA consisted of two levels, *lexical* and *non-lexical*.

To ensure adequacy of inferential statistics, the data were checked for missing values, outliers, and normality of distribution. No missing data were found. Levene's test of equality of error variances was nonsignificant, $F(7, 151) > 1.22$, ns. The assumption that the variances are equal across groups was upheld, as Levene's test was nonsignificant.

When the standardized scores for the raw PPVT scores were examined, one outlier was detected, as one participant scored significantly lower than the other participants on the PPVT ($z = -4.11$). Therefore, that child's score was removed from the analysis. Additionally, frequency analysis determined that the distribution of the PPVT scores was negatively skewed. However, square root transformations made the distribution more negatively skewed, and log transformations made the data positively skewed; therefore, no advantage was seen to transforming the data (Tabachnick & Fidell, 2007). Consequently, raw PPVT scores were used in the subsequent ANCOVA analysis. Note, however, that when PPVT scores were used as a covariate in the ANCOVA, no additional findings were revealed, nor did they alter the pattern of findings from the original ANOVA, thus unadjusted mean PPVT scores are reported.

Results from the ANOVA revealed a significant two-way interaction of Dimensionality (two-dimensional, three-dimensional) X Condition (emotion, non-emotion), $F(1,151) = 6.58$, $p \leq .05$, partial $\eta^2 = .04$, a marginally significant Condition X Age interaction, $F(1, 151) = 3.28$, $p = .07$, a main effect of Dimensionality, $F(1, 151) = 7.61$, $p \leq .01$, partial $\eta^2 = .05$, a main effect of Linguistic Instruction (lexical, non-lexical), $F(1, 151) = 10.99$, $p \leq .01$, partial $\eta^2 = .07$, and a main effect of Condition, $F(1, 151) = 7.13$, $p \leq .01$, partial $\eta^2 = .05$ (see Table 2).

Table 2

Mean Shape Matches Collapsed Across Emotion and Non-Emotion Conditions

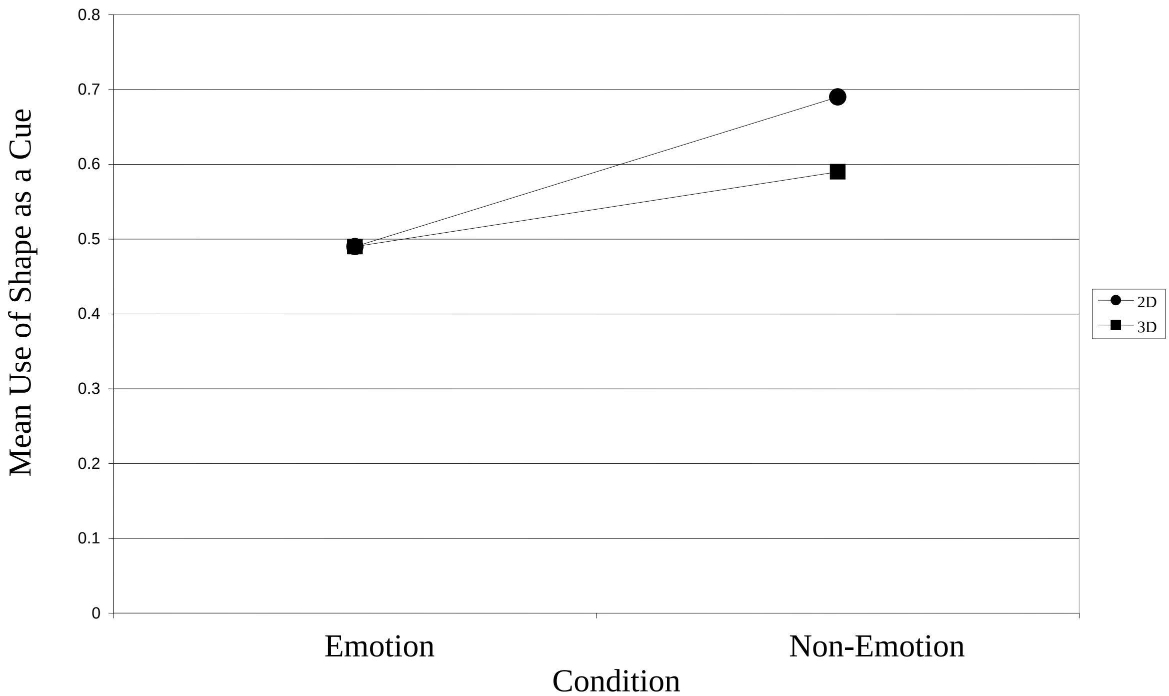
	Mean Shape Matches	
	Two-Dimensional	Three-Dimensional
Linguistic Instruction		
Lexical	.51 (.36)	.43 (.39)
Non-Lexical	.67 (.36)	.64 (.40)
Age Groups		
3-4 year olds	.60 (.35)	.55 (.39)
5-6 year olds	.58 (.39)	.52 (.43)

Note. Standard deviations are in parentheses.

Follow-up assessment of the Dimensionality X Condition interaction with Bonferroni corrections revealed that within the emotion condition, mean shape matches were not significantly different between the two-dimensional (M = 0.49, SD = 0.04) and three-dimensional (M = 0.49, SD = 0.04) sets of objects, but the means differed significantly within the non-emotion sets, $t(78) = 3.54$, $p \leq .01$, see Figure 1. When presented with two-dimensional objects without emotional faces on them, children were more likely to match objects on shape (M = 0.69, SD = 0.33) than when the objects were three-dimensional (*M* = 0.59, *SD* = 0.37). The two-dimensional objects without faces on them induced the shape bias the most, see Figure 1.

Figure 1.

Mean Use of Shape as a Cue Depending on Condition and Dimensionality

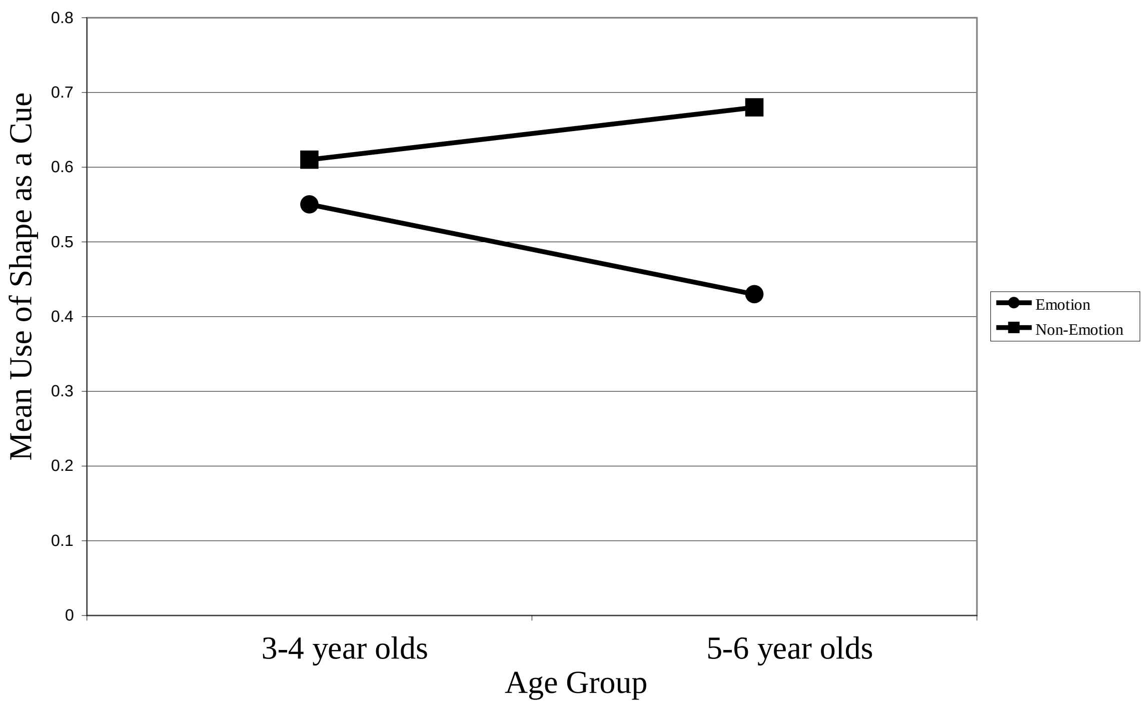


To investigate the marginally significant Condition X Age interaction, follow-up tests were conducted on the data, using Bonferroni correction. It was revealed that for three- and four-year-olds, there was no significant difference between the emotion and non-emotion conditions in their use of shape matches, $F(1, 77) = 0.42$, ns (*M* = 0.55, *SD* = 0.36; *M* = 0.60, *SD* = 0.34; emotion and non-emotion conditions, respectively), see Figure 2. However, for the five- and six-year-olds, a significant difference was found between the emotion and non-emotion conditions, $F(1, 78) = 9.14$, $p \leq .01$, partial η^2 =

.11, see Figure 2. The five- and six-year-olds matched on shape significantly more often in the non-emotion condition (*M* = 0.68, *SD* = 0.32) than in the emotion condition (*M* = 0.43, *SD* = 0.41). These results are consistent with the nonparametric (chi-square) findings, suggesting that the five-and six-year-olds do not use shape matches exclusively.

Figure 2.

Children's Mean Use of Shape as a Cue Depending on Condition and Age



Finally, a main effect of Linguistic Instruction (lexical, non-lexical) was found. Children who heard non-lexical instructions (i.e., same kind, goes with) during object presentation were more likely to use shape matches (*M* = 0.66, *SD* = 0.04) than children who heard lexical (general naming, proper naming) instructions during presentation (*M* =

0.47, *SD* = 0.04). That is, the non-lexical instructions were more likely to elicit use of shape as a cue than lexical instructions.

CHAPTER IV

DISCUSSION

The shape bias refers to the tendency to focus on shape categories when categorizing objects or extending novel names from one object to another (e.g., Diesendruck & Bloom, 2003; Imai et al., 1994; Jones et al., 1991; Jones, 2003; Landau et al., 1988; Landau et al., 1992). Several different perceptual features of an object (e.g., shape, texture, size) can serve as a cue to match objects or generalize novel names from one named object to another, unnamed object. In the face of conflicting perceptual cues, children may be limiting the problem space by attending to shape. In one of the initial studies on the shape bias, Landau et al. (1988) found that children were biased by the perceptual feature of shape, with attention to this feature overriding other salient perceptual cues, such as color or texture. Even when size was manipulated and made salient by making the target object and another object with a different shape both extremely large, children still had a tendency to use shape as a reliable cue to object categories (Smith et al., 1992). By matching a small object to a much larger object with the same shape, the children emphasized the importance of shape in their word learning, even when size may have been the most salient perceptual feature.

Of particular interest in the present research was whether an emotion bias, or a tendency to pay attention to emotional information, would override a shape bias. The rationale for such a test came from past studies showing that when eyes were included on novel objects in shape bias studies, children in the “eye” condition shifted their attention towards features of the objects other than shape, such as the objects’ texture, or the combination of shape and texture (e.g., Jones et al., 1991). It may be that features, such as eyes, make inanimate objects appear more animate. Because animate objects can move, perhaps there is less focus on rigid aspects of the objects such as shape (Jones & Smith, 2002; Landau & Leyton, 1999; Smith & Samuelson, 2006; Yoshida & Smith, 2001). Instead, texture would then be the most consistent feature of an animate object, while shape would continuously change with movement. Past studies have shown that children are indeed able to categorize objects into *artifact* and *animal* categories, knowing that shape matters only for the artifact categories, while other features characterize animal categories (e.g., Smith, 2000; Jones et al., 1991).

It may not be surprising that even young children pay attention to the eyes on objects because young children attend to defining facial features, such as the eyes and mouth, from the earliest months of life. By a mere two months of age, infants tend to look at the eyes on a face more often than any other facial feature, suggesting that early in visual processing, children utilize eye gaze direction to translate social information from others (Adolphs, 2006; Gross & Ballif, 1991; Langton et al., 2000). Whether it is the contrasting effects of the eyes and face, or the rapid movement of eyes that hold infants’ early attention, they nonetheless seem to be affected by this facial feature, using it to recognize and distinguish different emotional expressions.

Children also learn to recognize differing degrees of emotion in a similar way to a word concept, by categorization (Gross & Ballif, 1991). For instance, all faces with a mouth turned up at the corners would be broadly categorized as *happy*, even though they do not all curve up to the same degree (Markham & Adams, 1992). Thus, emotion may be a salient factor that children are attending to when categorizing objects.

Given that past research has found that the eyes alone affected children's use of shape matches (e.g., Jones et al., 1991; Landau & Leyton, 1999), it was reasoned that a full face with eyes, nose, and mouth (and sometimes eyebrows), would further shift children's tendency away from focusing exclusively on the shape of the object. Of interest was whether children would pay more attention to the emotional features on the objects, ignoring the shape of the object, when making object matches. So, for example, when given the following instruction: "This is a *yeb*. Which one of these is also a *yeb*?" children might rely on an emotion match, choosing an object with the same emotion on the face as the target (e.g., both happy faces) rather than choosing an object with the same shape (e.g., both oval shapes). The results of the present research showed that five-and six-year-old children were equally likely to match on emotion and shape, whereas three- and four-year-old children did not, matching more often on shape. None of the children, however, showed a propensity to match on the basis of texture, in contrast to past studies using eyes on the objects (e.g., Jones et al., 1991). However, in those studies, an emotion match was not available.

In addition to examining whether emotion matches might override shape matches when faces were added to the objects, of interest was how the specific linguistic instruction that accompanied the objects would affect children's emotion, shape, or texture matches. Past studies have shown that linguistic instruction can affect children's use of shape matches (e.g., Diesendruck & Bloom, 2003; Smith, 1999; Smith et al., 2003). In a seminal study exploring the role of linguistic instruction type on children's shape matches, Diesendruck and Bloom (2003) found that two- and three-year-old children used shape as a matching cue in the presence of lexical instructions (i.e., "This is a *dax*. Can you find another *dax*?"), as well as instructions that ask the children to find another object that is the *same kind* as the target object, although this was found significantly less often in a *goes with* condition. Diesendruck and colleagues suggested that lexical (naming) instructions as well as *same kind* instructions motivate children to search for *kind* categories, bringing evidence that the use of shape as a cue is not unique to naming tasks, as the attention-learning account has suggested. However, shape matches were less likely in the *goes with* condition because, according to Diesendruck and Bloom, these instructions were too vague and did not effectively tap into children's knowledge of *kind* categories.

In the present research, it was predicted that the effect of linguistic instruction may have an even greater affect on children's choices when emotion is included on the objects. Referring to an object by name, particularly when the object has an emotional expression on it, may increase children's tendency to pay attention to the emotional information provided and, subsequently, increase children's use of emotion matches. That is, it was predicted that children viewing the emotion objects would be less likely to use shape cues when tested in the presence of lexical (naming) instructions, especially those involving proper names. However, it was found that across both emotion and non-emotion object sets, the lexical (naming) instructions decreased reliance on shape as a cue overall, as compared to the non-lexical (non-naming) instructions. Children used shape cues equally often in the presence of the same kind and goes with instructions, and even more so than children that heard the proper naming and general naming instructions. This evidence suggests that children's use of the shape bias can be dependent upon linguistic instruction and whether the object contains other salient cues.

Consistent with the present results, additional research has found that children were more likely to make shape matches when given *same kind* and *goes with* (non-lexical) instruction, and less likely to make shape matches when given *naming* instructions (Davidson et al., under review). Davidson et al. suggested that in the *same kind* and *goes with* conditions, the standard for the children's responses may be less stringent, only requiring the children to pick another object that is similar to the target object. In these less stringent conditions, a cue that is salient to the children (e.g., shape) may be more readily and consistently used. In contrast, in the *naming* conditions, children might assume that the novel name is a proper name and therefore use a cue that matches the perceived animate nature of the object, such as the emotion matches on the objects. Past studies have shown that in such situations where the experimental objects are perceived to be animate, the children rely on other cues in addition to, or in lieu of, shape cues, namely texture cues. In the present study, the older children relied on emotion cues equally as often as shape cues, suggesting that other features and cues become increasingly relevant to children.

Additionally, the specific type of object may interact with linguistic instruction. For example, Davidson et al. found that when the target object presented to the children was systematically controlled (i.e., geometric, organic, or letter-like), children were more likely to extend the novel name to a similarly-shaped object when the target object was organically-shaped (e.g., a “blob” shape or a mound of hardened clay), than when the target object was geometric or letter-like in shape. Davidson and her colleagues suggested that geometric and letter-like objects resulted in less shape matches than organically-shaped objects because the former are more familiar objects to young children (i.e., letters and basic shapes have a more readily available label). Indeed, past research with children, as well as adults, has shown that shape matches are less frequent with objects that are familiar to the participants than with objects that may not have a readily available label or name (e.g., Gelman et al., 1998, Landau et al., 1998).

Although familiarity was not tested in the present study, the dimensionality of the stimuli (i.e., two-dimensional, three-dimensional) did affect children’s use of the shape bias. Namely, it was found that the two-dimensional representations of the objects resulted in children using shape cues more often than with the three-dimensional objects. This was particularly true in the non-emotion condition (without faces on them). Consistent with Gelman et al.’s (1998) notion that two-dimensional representations could accentuate shape during experimental shape bias tasks, past studies using two-dimensional line drawings as stimuli to test the prevalence of the shape bias may be overemphasizing the relation between the target object’s shape and the proceeding object matching on shape (e.g., Gelman & Ebeling, 1998; Gelman et al., 1998; Landau & Leyton, 1999). In a similar vein, Cimpian and Markman (2005) also provided evidence that an inclination towards shape may be an artifact of, or may be enhanced by, the experimental conditions. By using more complex experimental objects and eliminating forced-choice procedure, they found that three-to five-year-old children's bias towards perceptual shape cues was significantly reduced.

Finally, the present research explored whether older children would be more or less inclined to use the shape bias (i.e., match on shape). Past research is equivocal on the effects of age on the shape bias. On the one hand, some researchers have suggested that an inclination towards shape is an early-emerging strategy that children use when learning new words, instead of relying on conceptual information that may be just as important (e.g., Bloom, 2000; Graham, Kilbreath, & Welder, 2004; Hespos & Spelke, 2004; Mandler, 2000). From this point of view, dependence on shape cues is eventually overridden by conceptual information, such as function of the object (e.g., ability to carry something, such as a purse) or creator's intent (e.g., Rakison, 2005; Sheya & Smith, 2006; Truwax et al., 2006). A shape bias may be found in younger children because they may not yet understand superordinate conceptual associations yet, so the shape information provided in shape bias studies may be the only relevant information. However, as some research has shown, functional properties of objects (e.g., ability to contain liquid) eventually come to play a greater role in children's word-learning strategies (Deak et al., 2002).

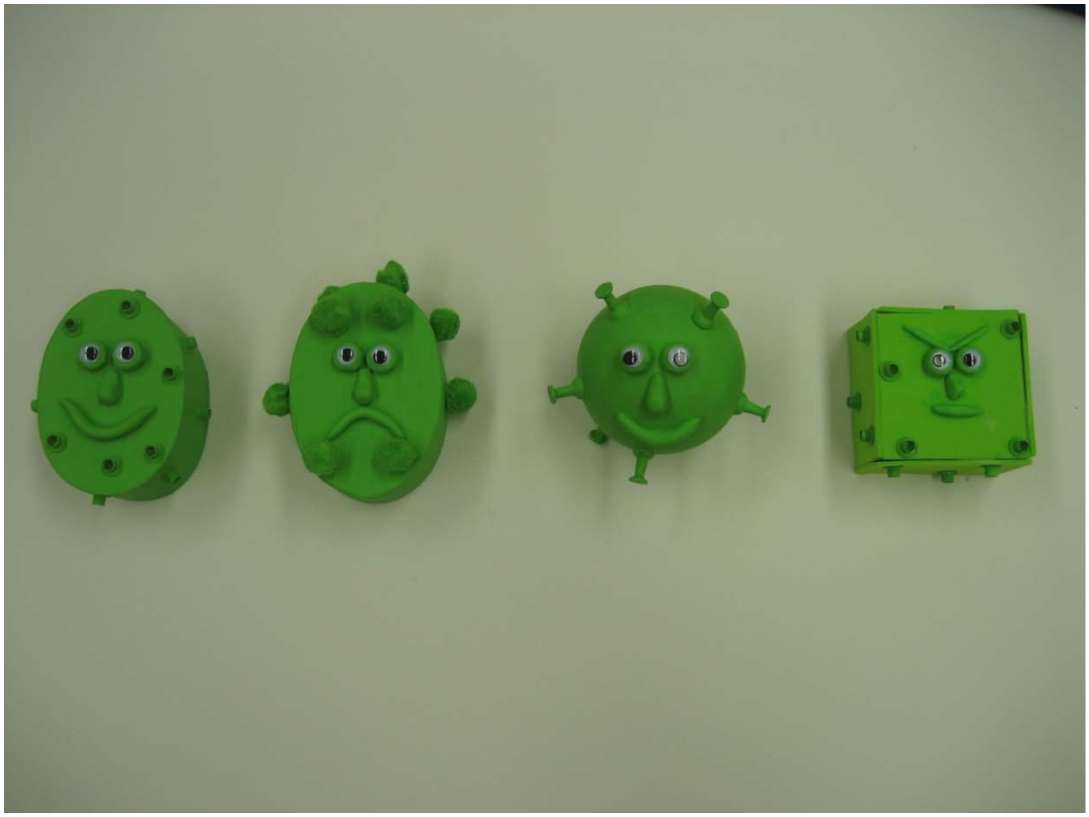
On the other hand, children may become more shape-biased with age, as the perceptual associations between shape and object categories are learned with experience (e.g., Smith, 2005). Evidence for this conclusion was found in a longitudinal study determining a link between increased attention towards shape cues when extending novel words in laboratory experiments and increased acquisition of nouns outside of the laboratory setting (Gershkoff-Stowe & Smith, 2004). This suggests a causal link between count noun use and the shape bias, with the development of attention towards shape corresponding closely with children's rapid acquisition of words that occurs around the second year of life (Landau et al., 1988; Samuelson & Smith, 1999). This account of shape use suggests that children learn to use shape cues and eventually expand on these object representations in more abstract ways (Smith, 2005). Shape is still a relevant cue to object categories with age and experience, however, it is used in an abstract way as children experience different types of objects in the same broad categories (e.g., stuffed chair to rocking chair). Still, others have suggested that perceptual and conceptual processes are inseparable from the beginning. It may be that children, even at a young age, pick up on both perceptual and conceptual cues (however rudimentary) to categorize objects or to extend novel names (e.g., Mandler, 2000; Quinn & Eimas, 2000).

In the present research, it was found that three- to six-year-olds were equally likely to use the shape bias in the non-emotion condition. However, while younger children continued to match more frequently on shape in the emotion condition, the older children were equally likely to match on shape and emotion. It may be that the shape bias is an early "default" strategy, as the youngest children in this study used shape matches almost exclusively, even in the presence of conflicting emotional cues. That is, shape may be a useful strategy for young children when first presented with word learning or categorization tasks; however, shape may not be as important for more advanced word learners. Byers-Heinlein and Werker (2009) suggest that social pragmatics develop in children that influence word-learning heuristics. As children become more experienced with attending to and interpreting social cues, a tendency to direct attention towards other cues, such as the emotional expressions presented on the objects, may become increasingly important to children's decisions. However, the younger preschoolers may not yet be influenced by the facial expressions on the objects.

Contrary to past findings, the results of the present study bring evidence that attention to shape is perhaps more contingent upon experimental conditions. Specifically, children's use of the shape bias can be affected by linguistic instruction and dimensionality, with some conditions (e.g., *goes with* instructions and two-dimensional shapes) increasing the likelihood of shape matches. As others have recently noted (Cimpian & Markman, 2005, Gelman et al., 1998), researchers should be aware of experimental conditions that may affect the prevalence of the shape bias in experimental studies.

APPENDIX A:

SAMPLE SET OF OBJECTS



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The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the Committee with reference to content and form.

The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Master of Arts.

______________________________ ______________________________

Date Director's Signature