The Effects of Language Complexity on Natural and Emotion Concept Formation in Early Language Learners

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THE EFFECTS OF LANGUAGE COMPLEXITY ON NATURAL AND EMOTION CONCEPT FORMATION IN EARLY LANGUAGE LEARNERS

by

Stephanie Eileen Jett

Abstract of a Dissertation Submitted to the Graduate School of the University of Southern Mississippi in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

December 2014
ABSTRACT

THE EFFECTS OF LANGUAGE COMPLEXITY ON NATURAL AND EMOTION CONCEPT FORMATION IN EARLY LANGUAGE LEARNERS

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The present study investigated the role of language complexity in natural and emotion concept formation ability in young children (two- to five-year-olds). Language complexity was measured by selections from the Brigance Diagnostic Inventory of Early Childhood Development II, and concept formation was assessed at three levels of abstraction. The natural concepts were presented as two alternative discriminations on a touch-screen computer, as follows: subordinate level (lions versus tigers), basic level (cats versus dogs), and superordinate level (animals versus nonanimals). The following emotion categories were discriminated: subordinate level (anger versus sadness), basic level (positive [happiness and positive surprise] versus negative [anger and sadness], and superordinate level (emotions [happiness, surprise, anger, and sadness] and neutral faces).

It was predicted that higher language complexity scores would be related to higher performance on the concept discrimination tasks. Results showed no support for the language as an augmenter hypothesis, providing some support for the assertion that concept formation is an innate ability, not dependent upon language. Additionally, there was no support found for the Circumplex model of emotion recognition with performance on the subordinate and superordinate level of abstraction tasks exceeding that on the basic level discrimination. Interestingly, results indicated that females outperformed males on the emotion concept discriminations, suggesting possible differences in
socialization between male and female children and/or an evolutionary predisposition for females to interpret facial expressions more accurately than males from an earlier age.
THE UNIVERSITY OF SOUTHERN MISSISSIPPI

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Stephanie Eileen Jett

A Dissertation
Submitted to the Graduate School of the University of Southern Mississippi in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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DEDICATION

I dedicate this project to my family and friends who have given me their unyielding love and support in all I have done and will do. I would specifically like to express my appreciation and love for my mother, Carole Jett, as without her love and guidance, I would not be where I am today. Mom, this is for you!
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CHAPTER I
INTRODUCTION

Humans exist in a highly complex perceptual environment and are constantly exposed to information that must be processed. In the case of infants and very young children, the vast majority of information encountered is novel and must be processed and stored in memory for later use. Familiar, as well as novel, information is organized into units in order to reduce the amount of information that has to be processed, stored, and later recalled; these units are termed concepts (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). Concepts are mental representations of information formed during the process of categorization.

One mechanism that has been hypothesized to underlie the sorting of information into groups during categorization is of the analysis of shared features. These features could be observable, such as common physical features, or unobservable, such as warm versus cold-blooded. The concepts that result from the process of categorization could be physical concepts, which include natural categories (e.g., animals), or social concepts, such as concepts for processing and detecting emotions. The exact manner in which these concepts are formed and utilized by the organism has remained a topic of interest for the past several decades (Gelman & Markman, 1987; Markman & Wisniewski, 1997; Quinn & Tanaka, 2007; Rosch, 1975; Rosch et al., 1976).

Language Affects Cognition

Language has been suggested to influence concept formation throughout development (Davidoff, 2001; Gelman & Coley, 1990; Gelman & Markman, 1987; Mandler, 1992; Plunkett, Hu, & Cohen, 2008; Russell & Widen, 2002; Yoshida & Smith,
2005; Zhang & Schmitt, 1998) and is a mechanism by which highly complex cognitive abilities are molded and made possible (Wolff & Holmes, 2011; Zhang & Schmitt, 1998). Wolff and Holmes (2011) point out that although it is currently recognized and accepted that thought is a separate entity from language (that is, they are not inextricably linked), the extent to which language shapes thought is still highly debated (Davidoff, 2001; Franklin, Clifford, Williamson, & Davies, 2005; Majid, Bowerman, Kita, Haun, & Levinson, 2004; Plunkett et al., 2008; Russell & Widen, 2002; Saalbach & Imai, 2007).

*Sapir-Whorf Hypothesis*

One popular hypothesis that seeks to explain the role of language in cognition is the *Sapir-Whorf Hypothesis*. Originally, this hypothesis suggested that the language one speaks governs how that person thinks, making some ways of thinking possible and some impossible depending upon the structure of the language one speaks. In other words, language *determines* cognition, implying that cultures that speak different languages will think inherently differently. This version of the hypothesis has become known as *Linguistic Determinism* and is considered the *strong version* (Wolff & Holmes, 2011).

Evidence supporting this approach comes from work with human infants showing that, up until the age of approximately six months, infants can recognize and distinguish all phonemes present in all languages. However, between the ages of six to nine months, this ability begins to disappear and is completely gone by the age of approximately twelve months. The child is left with the ability to distinguish and recognize only the phonemes present in their native language (Werker & Desjardins, 1995). This auditory specialization alludes to the possible importance of the language that one is exposed to *before* being capable of producing language.
Further support for linguistic determinism has been found in research involving the categorization of colors. Davidoff (2001) found that the categorization of colors differed between speakers of English and Berinmo (Papua New Guinea). These results suggest that the linguistic terms used for different colors in a particular culture can affect how we categorize colors, perhaps even how we perceive colors (Davidoff, 2001). However, the empirical support for Linguistic Determinism is not conclusive. Many argue that language may have an impact on thought, but its role is less deterministic and more augmentative in nature (Wolff & Holmes, 2011).

A weaker version of the Sapir-Whorf hypothesis, the Linguistic Relativity Hypothesis (LRH), has gained more empirical support. The LRH suggests that language shapes thought by making some ways of thinking easier and some more difficult based on the structure of the language one speaks (Lindquist, Barrett, Bliss-Moreau, & Russell, 2006). LRH and Linguistic Determinism differ in that the strong version comes very close to stating that thought is impossible without language and the LRH simply dilutes Linguistic Determinism. The LRH implies that, while thought may be possible without language, this form of thought is inherently different than thought that occurs with language. However, the LRH still implies that speakers of different languages inherently think and perceive the world differently (Zhang & Schmitt, 1998). Empirical support for the LRH has been reported in research on color categorization and perception (Masharov & Fischer, 2006; Thierry, Athanasopoulos, Wiggett, Dering, & Kuipers, 2009; Winawer et al., 2007), spatial frames of reference (Gallistel, 2002; Majid et al., 2004), concepts of time (Boroditsky, 2001), numerical processing (Pixner, Moeller, Hermanova, Nuerk, & Kaufmann, 2011), and most importantly for the current project, categorization and
concept formation (Gelman & Markman, 1987; Plunkett et al., 2008; Yoshida & Smith, 2005; Zhang & Schmitt, 1998) and the perception of emotion (Lindquist et al., 2006; Russell & Widen, 2002; Widen & Russell, 2003).

Wolff and Holmes (2011) suggest, however, that the interaction between language and thought is more complex than can be explained by just a strong or weak version of the Sapir-Whorf hypothesis. The authors assert that whereas Linguistic Determinism has not been empirically supported, several other manifestations of the LRH have been hypothesized with reasonable supporting evidence to be discussed in the following sections.

**Thought with and after language**

Despite the lack of empirical support for Linguistic Determinism and the debates regarding the role of language in shaping thought, it would be difficult to consider the idea that language plays no role at all in shaping human cognition. If language provided no benefit or advantage, the mechanisms to produce and comprehend it would likely not have been preserved in the evolution of the species, nor would they continue to be utilized by human cultures. Wolff and Holmes (2011) suggest that thought occurs both with and after language. Thought *with* language occurs when thought and language work simultaneously, or online. Whereas, thought *after* language occurs when language directs attention (e.g., priming) to relevant aspects of the environment or influences the type of processing utilized during tasks, even if the tasks are nonverbal in nature (Wolff & Holmes, 2011).

As depicted in Figure 1, when thought is occurring after language, there are two proposed roles that language could play: language as a *spotlight* and language as an
inducer (Wolff & Holmes, 2011). In a perceptual world as complex as the one in which humans exist, language may function to highlight certain relevant features in order to help reduce the amount of information that is necessary to process at one time. In this role, language may act as a spotlight to aid in focusing attention to aspects of the environment made more salient by the exposure to and use of a language. Supporting evidence for this role of language has been demonstrated in research regarding how language affects spatial frames of reference and relations (Wolff & Holmes, 2011). For instance, English speakers emphasize the difference between prepositions indicating support (e.g., The lamp was placed on the table) and those indicating containment (e.g., The lamp was placed in the box). In contrast, Korean speakers emphasize the distinction between tight and loose fit in their placement verbs while the distinction between containment and support is irrelevant. Interestingly, like phoneme sensitivity early in infancy, very young infants in both cultures are sensitive to all distinctions but become more specialized as they are exposed to their native languages, suggesting language acting as a spotlight to draw attention to the relevant spatial distinctions for their language (Choi, 2006).

In addition, varying linguistic descriptions of an object’s position relative to another object has been shown to lead to differences in non-linguistic representations (e.g., gestures) of these spatial relationships from culture to culture (Gallistel, 2002; Majid et al., 2004). For instance, speakers of a language who would describe the position of a building as to the right of a statue differ in the way that they would non-linguistically demonstrate (e.g., by gesturing) where the building was in relation to the statue, compared to speakers of a language who predominantly would use a frame of reference
stating that the building was north of the statue (depending upon cardinal direction) (Majid et al., 2004). However, that is not to say that the way in which one’s language refers to spatial relationships makes thinking in any other frame of reference impossible. Language is in this case acting as a spotlight, making certain ways to view the spatial world easier than others (Gallistel, 2002).

Language is also hypothesized to act as an *inducer*, making one type of processing preferred over another when confronted with a task. Wolff and Holmes (2011) suggest that “language may prime a particular mode of processing that continues to be engaged even after language is no longer in use” (p. 260). In other words, language may act at an unconscious level that shapes how speakers perceive their environment (Thierry et al., 2009). Though most often research on color perception is spoken of in regard to language acting *with* thought in an online sense, recent findings suggest that the language one speaks functions to induce early, low-level perception of colors. Thierry and colleagues (2009) found that, for native Greek speakers, the cortical response (visual mismatch negativity) that is an indicator of preattentive (unconscious) change detection was greater for discriminating between light and dark blue. The authors suggest that this effect is due to the existence of two color terms in the Greek language that refer to that discrimination. In contrast, native English speakers did not show this cortical response, indicating that the existence of the two color terms in the Greek language acted as an *inducer* for detecting the differences between the colors for native Greek speakers, even when those terms were not being consciously utilized.

Additional evidence for language as an inducer comes from research on how time is conceptualized by speakers of differing languages. When speakers of Mandarin
Chinese were asked to confirm if a target month came before a comparison month (e.g., March before April), they were quicker to do so if they had seen an array of objects aligned vertically, which matches how they typically conceptualize time, versus if the array of objects was aligned horizontally, which is how English speakers typically conceptualize time. The opposite is true for English speakers, suggesting that the way in which someone typically speaks can influence how someone thinks about abstract concepts like time (Boroditsky, 2001). These results, however, have been heavily criticized due to the fact that they have failed to replicate in Mandarin/Chinese and English speakers using the same methods (January & Kako, 2007) or similar (Tse & Altarriba, 2008). Similar results have been shown in nonverbal number processing in young children (German versus English speakers), suggesting that the processing of place values in non-verbal, digital representations of numbers is nonetheless affected by the way in which the number words system is structured (Pixner et al., 2011). Like the findings regarding spatial relationships, the suggestion that nonverbal numerical processing is shaped by language has also been challenged. Brysbaert, Fias, and Noel (1998) found that when modality of response is controlled (verbal versus typed), the differences between languages disappear.

Though some of the evidence for the language after thought hypothesis is controversial, there are additional ways in which language has been suggested to shape thought when the two are working in tandem – thought with language. For example, Wolff and Holmes (2011) suggest that language may work with thought in two ways (refer to Figure 1): language as a meddler and language as an augmenter. In these two hypothesized roles, language can both help (augment) and/or hinder ( meddling with)
cognition. When language acts as a meddler, linguistic codes interfere in some way with non-linguistic codes, affecting the way in which one perceives the environment (e.g., color-perception). From a Whorfian perspective, even aspects of perception that one would assume to be relatively universal and biological in nature, such as color-perception, are affected by one’s language at each stage in the process. Therefore, without a word for a specific color or shade of a color, it is possible that the observer does not in fact perceive the color in the same manner that a person with a specific label for that hue does. These results have been demonstrated by several researchers (Davidoff, 2001; Davies, Sowden, Jerrett, Jerrett, & Corbett, 1998; Masharov & Fischer, 2006; Winawer et al., 2007), indicating that the number of available color terms in one’s language has an effect on the color discrimination of the speakers of the languages.

The above results suggest that the linguistic codes present in one’s language meddle with the non-linguistic perception of colors (Wolff & Holmes, 2011). However, these findings may not fully reflect the breadth of the issue. The effects of language could have more of an impact only later in life, after significant exposure to one’s native language, and have less of an effect earlier in life (Franklin et al., 2005). Whereas language appears to indeed shape the way in which individuals perceive color, there also exist universal properties of colors (e.g., light and dark) that allow for overlap among speakers of differing languages, demonstrated by a similar number of basic color terms across many languages (Claudiere, Jraissati, & Chevallier, 2008; Kay & Reiger, 2006).

Lastly, the augmenter hypothesis implies that language in this role supplements and/or aides thought by providing additional conceptual frameworks by which mental operations can occur. In essence, language becomes a tool for thought. This role of
language is of most importance to this proposal due to the function of language in the formation of concepts in humans (Wolff & Holmes, 2011). Language has been implicated as the game changer for categorical perception in that it highlights commonalities between members of a category that can be both observable (e.g., perceptual similarities) and/or unobservable (e.g., internal structures or emotional states) and facilitates concept formation by providing the organizational, anchoring structure (words) upon which a concept can be built (Gelman & Markman, 1987; Plunkett et al., 2008; Zhang & Schmitt, 1998). For instance, speakers of languages that utilize nominal classifier systems (classifies nouns into over 100 semantic categories), such as Chinese, categorize objects differently than speakers of languages that do not use this system (e.g., utilize shared perceptual features). Chinese speakers grouped objects based on the structure of the classifier system (grouping objects together that shared a common classifier), whereas English speakers did not, suggesting that language facilitated the categorization of the objects for the Chinese speakers (Zhang & Schmitt, 1998). Labels have even been deemed capable of overriding perceptually based concepts in early language learning humans, which provides evidence for the augmenting, and potentially meddling, role language can play in concept formation (Plunkett et al., 2008).

Beyond perceptual categorization, however, language is proposed to play a pivotal role in the formation and understanding of social concepts, such as theory of mind and emotional understanding (e.g., Astington & Jenkins, 1999; de Rosnay, Pons, Harris, & Morrell, 2004; Lindquist et al., 2006; Russell & Bullock, 1985; Russell & Widen, 2002; Watson, Painter, & Bornstein, 2000) due to the inherent internal nature of mental state attribution. Whereas forming a concept for a subordinate level natural category,
such as tigers, may be relatively straightforward due to the fact that members of that category share common observable perceptual features (e.g., stripes), forming a concept for mental states presents an obstacle because the characteristics that discriminate one from another are not always reliably displayed externally.

Theory of mind is the understanding that others possess knowledge, intentions, opinions, and feelings that can differ from those of the self. The development of this ability has been linked to linguistic ability in young children, with those who are more advanced linguistically early in development possessing more advanced theory of mind capabilities later in childhood compared to others in their age groups (Astington & Jenkins, 1999; Watson et al., 2000). This relationship is especially true for the understanding of false beliefs, perhaps due to the inherently embedded structure of a false belief statement (e.g., I know X is really true, but she thinks Y). The understanding of such statements could be facilitated by knowledge and understanding of the grammatical structure (syntax) of one’s language (Wolff & Holmes, 2011).

Of marked importance to the current project is the potential effect of language on the development of emotion understanding and recognition, specifically. Emotions are internal, psychological states, which create a challenge in terms of studying how emotion concepts are formed and how emotions are recognized by early language learners. For humans, one way in which this challenge may be overcome is by utilizing facial expressions to determine emotional states. Facial expressions are interpreted by perceivers as outward, externalized expressions of internal emotional states. Both a cross-cultural, innate, universality of emotion recognition hypothesis (e.g., Ekman, 1993; Izard, 1994; Waller, Cray, & Burrows, 2008) and a LRH explanation of emotion recognition
(e.g., Lindquist et al., 2006; Russell & Widen, 2002) have been explored with support for both a universal and relativistic approach to emotion recognition. The suggested role of language as an augmenter in this case, however, is hypothesized as providing a label for unobservable or difficult to discriminate emotional states (Russell & Bullock, 1985; Russell & Widen, 2002).

If language and thought are as deeply connected as the aforementioned findings suggest, then the question still remains as to what it is about language that causes language to exert influence on cognitive abilities. The affected abilities could include emotion recognition and natural concept formation, especially in early language learners. Human language is a complex system of communication that is comprised of significantly more than merely producing and understanding individual words in isolation. This fact alludes to not only the potential role of both expressive and receptive language, but also to the role of other aspects of language (e.g. grammatical competency and practical use/comprehension of language) in affecting the way in which one perceives and thinks about the world. Additionally, is language necessary for concept formation or does it simply help anchor concepts when it is present and is therefore only a sufficient condition for concept formation? Exploring such questions first necessitates the discussion of the theoretical and developmental bases of both natural and emotion concept formation.

Natural Concept Formation

Concepts are defined as mental representations of information utilized to reduce the amount of information that needs to be processed, stored, and later recalled. These concepts are formed during the process of categorization. Categories can either be well-
defined or ill-defined in terms of their structures. Well-defined categories, such as experimentally derived categories, are characterized by possessing a “set of separately necessary and jointly sufficient features” that distinguish one category from another (Bhatt, Wasserman, Reynolds, & Knauss, 1988, p. 219). Needless to say, these types of clearly organized categories are rarely found in nature. Natural categories, unlike well-defined categories, have what are termed as fuzzy boundaries, meaning that there is considerable overlap between and among categories, therefore, making natural categories ill-defined (Bhatt et al., 1988). The fact that natural categories (e.g., animals) do not have clear-cut boundaries creates unique challenges for the process of forming concepts for these types of categories. The following sections will describe the theories of conceptual structure, the order in which the different levels of concepts emerge, the information very young children utilize as a basis upon which to form concepts, and finally, a discussion on the hypothesized role that language plays in the formation and organization of natural concepts.

Concept Theory

Concepts are utilized to reduce the amount of information regarding category membership that needs to be processed, stored, and retrieved. The way in which organisms structure these concepts has been a topic of interest for decades due to the fact that natural categories, such as animals or plants, are ill-defined (Gelman & Markman, 1987; Markman & Wisniewskie, 1997; Quinn & Tanaka, 2007; Rosch, 1975; Rosch et al., 1976). So, how do we structure concepts for natural categories? One of the most popular views is that concepts are formed in a hierarchical manner based on what have been termed levels of abstraction (Rosch et al., 1976).
Rosch’s levels of abstraction. Rosch and colleagues (1976) proposed that natural categories are organized around three levels of abstraction, from least to most inclusive: subordinate, basic, and superordinate. The three levels are differentiated by level of between and within category inclusiveness, or similarity. It is of importance to note that a natural object can be represented at all three levels of abstraction at once; for example, a Golden Retriever is simultaneously represented at the superordinate level of animal, the basic level of dog, and the subordinate level of its own breed. This ability to flexibly categorize an object at multiple levels of abstraction has been suggested as a hallmark of human conceptual abilities (Lazareva, Frieburger, & Wasserman, 2004). Subordinate level categories, being the most exclusive level, have a high degree of both within and between category similarities (Markman & Wisniewski, 1997; Rosch et al., 1976). For example, a single breed of dog (e.g., Golden retriever) would be considered to be a subordinate level category. Two breeds of dogs, for example a Golden retriever and Border collie (two subordinate level categories), share many attributes both within and between the subordinate categories.

In contrast, superordinate level categories are considered the most inclusive categories. Superordinate categories, such as animals, share few common attributes both within and between categories. For example, both a grasshopper and a Golden retriever belong to the same superordinate category of animal, but share very few observable features in common. In addition, between superordinate categories, such as animals and plants, there are even fewer shared attributes. This level of abstraction has been suggested to be the level at which true conceptual knowledge regarding category membership is of utmost importance to the formation of the concept, relative to subordinate categories.
formed on the basis of shared perceptual features (Vonk & MacDonald, 2002, 2004), although others have argued that categories can be discriminated on a perceptual basis due to the between category dissimilarity (Mandler, 1992; Quinn, 2002; Quinn & Eimas, 1996). More details regarding this argument will be provided in a later section.

Basic level categories balance low between category similarity and an intermediate level of similarity within categories (Markman & Wisniewskie, 1997; Rosch et al., 1976). As an example, exemplars within the basic level category of dogs share many common features within the category, such as head shape, body structure, etc. If compared to another basic level category of cats, for example, there are fewer attributes in common than within the two categories, therefore making the two categories highly differentiated despite being members of the same parent superordinate category of animals.

Basic level categories have also been suggested to be the most economical in terms of cognitive resources due to the fact that they possess the most information needed to differentiate between objects without containing extra, unnecessary information (Rosch et al., 1976). In explanation, when one moves from a basic to a subordinate level category, there is little information gained from that differentiation, as determined by the fewer number of novel facts that can be named for a subordinate level category (e.g., Golden retriever) compared to its parent basic level category (e.g., dog). The little information that is gained (e.g., hair color and length or body size), however, is important for distinguishing among members of a basic level category.

Along the same vein, when one moves from a basic to a superordinate level category, the increase in information is not as useful for determining category
membership in comparison to the information used to describe the basic level categories. While there is a significant amount of overlap among the characteristics that can be used to describe animals, dogs, and specific instances of dogs (e.g., they all eat, breathe, reproduce, etc.), more novel, specific information can be used to describe the basic level category (dogs) than the subordinate (Golden retriever) or superordinate (animals) level categories. These assertions regarding the practicality of basic level categories have led to the proposition that these categories are cognitively privileged. Following Rosch and colleagues’ (1976) differentiation view, the other levels of abstraction are derived from basic level categories - subordinate levels are formed by breaking down basic level categories and superordinate levels are created by grouping together basic level categories. Basic level categories have been suggested to emerge first in development, and the labels for members have been shown to be learned and used first by early language learners (Rosch et al., 1976).

**Alignable differences view.** As popular as the differentiation view has been since its first proposal, there are some who assert that this view is underspecified. Critics assert that Rosch and colleagues (1976) emphasized the commonalities between and among category members too much and neglected what Markman and Wisniewskie (1997) propose as alignable differences. Alignable differences arise from shared features of category members. For a simple example using vehicles, Markman and Wisniewskie (1997) stated that the fact that most vehicles, with exceptions, have wheels as a commonality, but the fact that cars have four wheels and motorcycles have two is an alignable difference. They suggest that these alignable differences play a major role in
distinguishing between members of categories, especially at the basic and subordinate level of abstraction.

In contrast to the differentiation view, when contrasting two basic level categories (e.g., dogs and cats) that originate from the same superordinate level parent (e.g., animals), the two categories will share many commonalities (e.g., four legs, heads, tails, fur, sharp teeth, claws), but differ by having many alignable differences (such as retractable claws versus stationary claws, differing head shape, etc.). Similarly, two subordinate level categories (e.g., Golden retrievers and Border collies) that originate from the same basic level parent (e.g., dogs) will also share many commonalities (e.g., similar head structure, dentition, body shape, fur), but differ based on many alignable differences (e.g., fur color/length/texture, muzzle shape, ear shape). In addition, subordinate level categories from the same superordinate level parent, but different basic level parents also share representational structure with each other. Therefore, in contrast to the differentiation view, when two lower level categories share the same higher level of abstraction parent, using only the commonalities shared between and within them is insufficient to determine category membership; one must use both the commonalities and the alignable differences to help determine category membership at the lower levels of abstraction (Markman & Wisniewskie, 1997). Both views, however, are of importance when considering the developmental trajectory of the levels of abstraction in concept formation.

Order of Emergence – The Developmental Trajectory of Concept Formation

Basic level first hypothesis. As mentioned previously, it has been suggested that basic level categories are somehow cognitively privileged categories due to the fact that
they are the level at which “natural groupings of organisms possess bundles of correlated features and which are obviously different from other organisms” (Rosch et al., 1976, p. 386). In other words, basic level categories balance being highly differentiated from each other and highly related within each other. This balance and hypothesized cognitive bias has led to the suggestion that basic level categories are the first level of abstraction at which infants and children form concepts and continue to be the first accessed concepts throughout development (Rosch et al., 1976; Tanaka & Taylor, 1991).

For supporters of this view, the basic level emerges first. Superordinate levels are then formed by grouping together related basic level categories and subordinate levels by differentiating within the basic level categories (Quinn, 2002, 2004a). Rosch and colleagues (1976) found that basic level categories remained stable and privileged across development, from childhood through adulthood. This finding suggests that once formed, basic level categories will not change in their structure/organization, and a bias toward accessing category membership at this level remains across development. However, for both superordinate and subordinate levels, changes occur across the lifespan. Rosch and colleagues (1976) found that there were developmental changes only for superordinate level categories. Later research has shown the impact of expertise on the formation of subordinate level categories, which suggests that one must gather experience with the more broad members of a basic level category before forming a separate, more specific subordinate level category (Quinn, 2002, 2004a; Tanaka & Taylor, 1991).

Superordinate level first hypothesis. In contrast, more recent research has questioned the accuracy of Rosch and colleagues’ (1976) developmental trajectory of concept formation Whereas basic level concepts may be relatively privileged once
formed, many researchers have found evidence that it is the more global, superordinate level concepts that are formed first in development (Lazareva, Soto, & Wasserman, 2010; Mareschal & Quinn, 2001; Quinn, 2002, 2004a; Quinn & Tanaka, 2007; Rakison & Butterworth, 1998). Though superordinate categories share fewer within category similarities, they share many highly discriminable between category differences. For instance, the most typical exemplars of the superordinate level category of animals can generally be described, with exceptions of course, as all having legs of some form while most members of the category of vehicles can be described as having wheels, not legs, of some form. Whereas, when comparing two basic level categories (e.g., dogs versus cats), one must rely upon closer inspection of “specific values of similar features” (i.e., head and general body shape) to discriminate among members of the different categories (Quinn, 2002, p. 68).

The fact that superordinate level categories possess attributes that are easily discriminable from one another and are more frequently encountered than basic level attributes has led to the assertion that this level is first to emerge in development. Children would be able to make quick category judgments based on the presence or absence of highly salient attributes for superordinate groupings in comparison to more precise, detail-based judgments for basic level categories. The developmental trajectory for subscribers to the global/superordinate level first hypothesis would be that basic level categories are abstracted from superordinate level categories, and subordinate level categories would be formed by further subdivisions of the basic level categories (Mareschal & Quinn, 2001; Quinn, 2002, 2004a; Quinn & Tanaka, 2007). From birth to two and a half years old, the predominant level of abstraction utilized when making
category distinctions is the superordinate level (for review see Mareschal & Quinn, 2001). However, what the two aforementioned hypotheses fail to explain is what information is utilized by the infants/children to form these concepts, regardless of when they emerge in development.

**How Do Very Young Children Form Concepts?**

The previous sections have focused on theories regarding what types of concepts are formed and when the different levels emerge. However, a source of further debate focuses on *how* these concepts are formed by very young children (e.g., Cimpian & Erickson, 2012; Quinn, 2002, 2004a, 2004b; Quinn & Eimas, 1996). Is the ability to form and utilize concepts innate or learned? In addition, what types of information do very young children utilize when forming early concepts?

**Bottom-up concept formation – Perceptual basis of concepts.** Some argue that the ability to form and utilize concepts is an innate ability, emerging as soon as the human infant is capable of perceiving the structure of their environment (Cimpian & Erickson, 2012; Mandler, 1992). Such a view suggests that infants and very young children (i.e., early language learners) are forming these concepts *online*, or while they are actively perceiving the environment. Phrased differently, very young children are forming concepts from the *bottom-up*, detecting the inherent structure in the world and using that structure to gather the necessary information to form concepts (Cimpian & Erickson, 2012; Zhang & Schmitt, 1998). The information utilized by this bottom-up formation must be readily available to the infants and children.

Mandler (1992) suggests that the mechanism by which these early concepts are formed is *perceptual analysis*. Perceptual analysis is a process in which stimuli in the
environment that can be readily perceived by the senses (e.g., vision) is analyzed in order to extract necessary information from the stimuli. That information is then recoded into mental representations of the meaning of the information, which is then used as the basis to form accessible concepts. The key to this process of perceptual analysis is that infants and very young children are using the perceptual features of the stimulus to form the concepts *online*, as they perceive their environment. That is, infants and very young children, who are predisposed to think in terms of concepts, are utilizing the perceptual information readily available, such as head shape or face structure, to form complex, abstract mental representations about information in their environments.

But, for subscribers to this line of reasoning, what types of perceptual information are necessary and/or sufficient in order to form these concepts? If it is information that is readily perceivable, then the features being utilized must be surface features, such as coloration or body shape (Quinn, 2002). However, it has been found that for concepts of animals, information from the head region alone is not only sufficient, but seems to be necessary in order to form concepts (Quinn & Eimas, 1996). Specific information, such as the aforementioned, could then be “anchored by multiple static and dynamic attributes” of the objects (Quinn, 2002, p. 68). Perceptual information can be gathered after a single exposure to the stimulus, thereby, making perceptual analysis cognitively economical in terms of preserving cognitive resources for other tasks (Rakison & Butterworth, 1998).

The assertion that infants and very young children use readily available perceptual features to form concepts from the bottom-up helps to explain the evidence demonstrating that they may be predisposed to form more global, superordinate
categories. Initially, at least, the presence or absence of obvious perceptual features helps to discriminate between more broad, superordinate categories, such as animals from nonanimals. For instance, the possession of eyes and self-propelled movement can distinguish an animal from a non-animal, such as a tree. These very readily apparent attributes are less likely to help discriminate between basic and subordinate level category members (Quinn, 2004a; Rakison & Butterworth, 1998). As mentioned previously, information of this type can be extracted after a single instance, and therefore, does not necessitate repeated exposures to form concepts, which reserves cognitive resources for other tasks (Rakison & Butterworth, 1998).

*Top-down concept formation – Role of prior experience.* In contrast to the hypothesis that the formation and utilization of concepts is an innate ability, some suggest that experience with the world is needed in order to form concepts. Those who support this view suggest that conceptual ability is a late-emerging ability. Thus, infants and very young children possess not *concepts*, but *percepts*, with percepts being perceptually-driven representations that contain no true conceptual basis. Piaget (1952), for instance, believed that until the infant is capable of producing mental representations, an ability he believed did not occur until after the first year and a half of life (late sensorimotor-early preoperational stage), they were incapable of forming concepts; therefore, any “conceptual-like” behaviors were merely percepts with the single function of allowing for identification of stimuli in order to react appropriately in its presence (Mandler, 1992). The necessity to utilize prior experience and theories created from information previously gathered from the environment suggests that *concepts*, in contrast to *percepts*, are formed
from the top-down. If present and available, even infants are capable of using prior knowledge and experience to guide concept formation (Mareschal & Quinn, 2001).

Some evidence for the use of top-down processing in concept formation is the relatively late emergence of subordinate level categories. It has been suggested that only after an infant gains exposure to a basic level category can they then abstract more specific, subordinate level categories (Quinn & Tanaka, 2007; Tanaka & Taylor, 1991). These findings help explain the effects of expertise on the basic level bias. Tanaka and Taylor (1991) found that experts on specific basic level categories (birds and dogs), compared to novices, showed a subordinate level bias by naming more novel attributes for specific species (subordinate level categories) of birds or dogs than for the basic level categories as a whole. This pattern is in contrast to the results shown by novices in this experiment where more novel attributes were named for basic level categories. Rosch and colleagues’ (1976) pioneering experiment also found that more novel attributes were named for basic level categories than for subordinate level categories. Only after experience with the specific category members within a basic or superordinate level category do subordinate level categories emerge, demonstrating the use of top-down processing to form these concepts (Quinn & Tanaka, 2007). Perceptual features alone are not always sufficient to form concepts, suggesting the role of prior experience as one of importance, even in early concept formation.

In addition, the more abstract categories could also rely heavily upon experience for their formation. As categories become more abstract, some suggest that the characteristics that define these categories become less readily apparent by perceptual analysis, thereby necessitating possession of a more conceptual understanding of
category membership. The information utilized to generate this conceptual understanding may originate from perceptual analysis, but is not directly derived from perceptual features (Vonk & MacDonald, 2002, 2004). The only way to gain this type of conceptual understanding is through experience with the environment and learning about the more non-obvious attributes that contribute to category formation (Quinn, 2004b).

Reconciling top-down versus bottom-up processing. From the existing evidence, it seems prudent to suggest that infants and very young children use both perceptual features and prior experience to form concepts. What may begin as a primarily perceptually driven process may develop into conceptual understanding as an individual gains more and more experience with the environment. More readily perceivable attributes may be supplemented by information regarding more non-obvious attributes (e.g., internal structures) through experience and learning. If prior experience is available to be drawn upon, infants will utilize it, but in its absence, perceptual features could become more heavily weighted (Mareschal & Quinn, 2001). Existing research suggests that perceptual and conceptual categorization follow a parallel developmental trajectory and involve comparable, yet separate, cognitive processing mechanisms (Quinn, 2004a).

What role then does language - one of the most salient human experiences – play in the development of concepts? If concepts, particularly more abstract concepts, are formed based on more than perception alone, does experience with one’s native language impact how concepts are formed in early language learners? In addition, it is possible that the shift from early, perceptually based percepts to more abstract, theory driven concepts is facilitated or mediated by the acquisition of language (Gelman & Coley, 1990). The next section will delve into the impact of language on natural concept formation.
**Language’s Impact on Natural Concepts**

As reviewed, there is a vast amount of literature regarding the impact of language on the perception of the environment. Given the unlikelihood that language has no impact on cognitive abilities in humans, the question is to what extent does language impact cognition, particularly natural concept formation? There are those who argue for a strong version of the LRH (i.e., Linguistic Determinism), suggesting that the structure of one’s native language can override perceptual information when forming concepts (Gelman & Markman, 1987; Plunkett et al., 2008). However, evidence from work with very young infants, children with autism, deaf children, and nonhumans suggests the possibility that concept formation is an innate capacity, based in the abstraction of perceptual features, that does not explicitly depend on language and could have emerged earlier in our phylogenetic history than previously thought (Bhatt et al., 1988; Cimpian & Erickson, 2012; Fabre-Thorpe, Richard, & Thorpe, 1998; Gasteb, Strauss, & Minshew, 2006; Lazareva et al., 2004; Lazareva et al., 2010; Roberts & Mazmanian, 1988; Vonk, Jett, & Mosteller, 2012; Vonk, Jett, Mosteller, & Galvan, 2013; Vonk & MacDonald, 2002, 2004). The following sections will investigate the various hypothesized roles that language plays in concept formation.

**LRH and natural concepts.** Does the language one hears and speaks affect the types of concepts one forms? The simple answer for supporters of the LRH would be “yes”. Labels are proposed to aid in concept formation by providing information about the underlying/internal structure and more abstract, implicit characteristics of objects/entities that one would not know by perceptual features alone (Gelman & Markman, 1987; Hermann, Medin, & Waxman, 2012; Plunkett et al., 2008). In this role,
language is acting not as a meddler, but as an augmenter to perception, reducing some of
the inherent “fuzziness” in natural categories (Bhatt et al., 1988; Wolff & Holmes, 2011).
For instance, a very young child may confuse a zebra as a horse because of the perceptual
similarities between the two animals. Providing distinctive labels for the two animals can
aid the child in categorizing the animals properly and, thereafter, forming an anchored
contact for zebras that is independent of their concept of horses (Johnson, Mervis, &
Boster, 1992). Along the same line of reasoning, providing the same label for
perceptually dissimilar objects, such as calling both a whale and a dog a mammal, point
out the similarities between the two perceptually distinct species (Plunkett et al., 2008).

Clearly then, language is implicated in concept formation even before the infant
can produce or has fully acquired language. What this suggests is that it is not only the
language one speaks that can affect conceptual understanding, but the language one hears
as well. Specifically, the language utilized by the primary caregiver(s) should have a
major impact on the child’s conceptual abilities. There have been discussions of the role
that caregivers’ language may play in concept formation, but as of yet, there has been
very little empirical research to directly test this relationship (Plunkett et al., 2008;
Tanaka & Taylor, 1991). One exception is the cultural consensus model discussed by
Johnson and colleagues (1992). The model predicts that some pieces of information are
more widely distributed throughout a culture and become representative of a cultural
truth for that society. Truth, in this model, is defined not by factual integrity, but on the
basis that the majority of the members within that culture believe it to be accurate
(Johnson et al., 1992).
This model implies that the role of language is in spreading the truth about category membership. For instance, taxonomically speaking, humans are categorized as members of the ape family, along with chimpanzees, gorillas, orangutans, bonobos, and gibbons. However, in some cultures, it might be considered inaccurate to categorize humans as animals, let alone as apes. Thereby, for that group, the cultural consensus model would suggest that humans are in a separate category from other apes and/or animals. This cultural knowledge is passed on through language by older members of the society, such as parents and/or primary caregivers. Differences arise between the concepts of very young children and adults due to young children’s lack of experience and exposure to cultural truths. Also, this model explains differences in conceptual understanding between cultures with differing languages (Johnson et al., 1992).

The findings just reviewed lend support to the LRH in that language works as an augmenter to perception and helps to explain discrepancies between cultures when they arise. What remains unanswered, however, is what factors that make up human language aide in the process of categorization and concept formation for early language learners? Is it semantic knowledge regarding the meanings of words, grammatical competency, or more practical aspects of linguistic competence that create this relationship between language and concept formation? To date, there have been no studies directly investigating the role that language in a more complex, broader sense plays in concept formation, but there have been allusions to the role that semantic knowledge might play in concept formation (Gelman & Coley, 1990).

Gelman and Coley (1990) propose that for members of a category that do not possess an overabundance of perceptual commonalities with other category members
(i.e., atypical members), semantic knowledge of category names supplement the lack of perceptual information in order to accurately form concepts of categories that include these atypical members. If given labels for the categories, very young children were better able to categorize atypical members due to the fact that the semantic knowledge of the meaning of the category label provided the supplemental information necessary for accurate categorization and subsequent concept formation (Gelman & Coley, 1990). These results provide evidence suggesting that semantic knowledge could be important for natural concept formation, but other linguistic components could play a role as well, therefore, necessitating direct testing of this question, using a broader definition of language before conclusions can be drawn.

Concept formation “without” language? Though language may play a significant role in concept formation for typically developing humans, there is evidence that language is not a necessary condition for concept formation. It may very well augment concept formation, especially when perceptual features fail, but there is evidence to suggest that it is not explicitly needed in order to form concepts, even at more abstract levels (e.g., Bhatt et al., 1988; Cimpian & Erickson, 2012; Goldin-Meadow, Gelman, & Mylander, 2005; Roberts & Mazmanian, 1988). Some of this evidence originates from work with children with autism spectrum disorders (ASD) (Gasteb et al., 2006; Soulieres, Mottron, Giguere, & Larochelle, 2011), deaf children (Goldin-Meadow et al., 2005; Ozcaliskan, Goldin-Meadow, Gentner, & Mylander, 2009), and nonhuman animals (Bhatt et al., 1988; Lazareva et al., 2004; Lazareva et al., 2010; Roberts & Mazmanian, 1988; Vonk et al., 2012; Vonk et al., 2013; Vonk & MacDonald, 2002, 2004).
Cimpian and Erickson (2012) suggest that the capacity to think in categories is an innate ability for humans. From birth, human infants are predisposed to think in “kinds” – things in the world “go together” due to some inherent structure in nature. These authors suggest that this ability to group things into categories is *not* explicitly dependent upon linguistic input. In addition, the augmenting role of language can exist only if the child is already working under the assumption that objects/entities can be banded together to form categories. By this assertion, the authors are suggesting that it is not language that augments concept formation, but concepts that aide in the understanding of language (Cimpian & Erickson, 2012).

Even those who support the idea that language augments perception and concept formation concede that without specific linguistic input, perceptual features play a major role in concept formation in infants and very young children (Gelman & Coley, 1990; Johnson et al., 1992; Plunkett et al., 2008). For instance, Johnson and colleagues (1992) discuss the *ethnobiological*, or *cross-cultural universal*, model as the contrasting model to the cultural consensus model. The *cross-cultural universal model* predicts that the ways in which various people perceive the regularities in the natural world is similar across cultures and language barriers, resulting in universal trends in categorizing natural entities. These universals emerge due to the fact that humans exist in the same world and share many of the same perceptual experiences, despite being a part of differing cultures and speaking different languages.

The cross-cultural universal model bases its prediction regarding universals on the fact that we categorize entities based on morphological, highly salient, perceptual features, not specifics based on the structures of various languages. While Johnson and
colleagues (1992) found support for the cultural consensus model in their experiments, they admit the undeniable importance of perceptual features in concept formation when linguistic cues are not present (Johnson et al., 1992). Similarly, Gelman and Coley (1990) state that children can and do use perceptual information to determine category membership in the absence of language, even when the perceptual features are misleading or confusing, therefore, leaving open the possibility of concept formation without language.

*Children with Autism Spectrum Disorders.* However, for typically developing human children, it is nearly impossible to extricate the potential impact of language on concept formation because they are immersed in it from birth. There are human populations, though, that lend themselves to studying concept formation without language. One such population is lower functioning children with ASD, due largely to the fact that ASD is characterized by social, behavioral, and linguistic deficits/abnormalities as compared to typically developing children (subsequently referred to as typicals). Relevant to their abilities to form concepts is the suggestion that children with ASD may show significant differences in cognitive processing and executive functioning as compared to typicals. For instance, they may show general problems with data reduction from infancy, but a heightened sensitivity to detail and feature detection, which, when coupled together, makes grouping things together into categories, and hence forming concepts, more difficult (Gasteb et al., 2006; Soulieres et al., 2011). In addition, lower functioning children’s more severe language deficits could prevent them from using labels as cues to supplement perceptual features (Gasteb et al., 2006).
Despite the differences found between typicals and children with ASD regarding executive functioning and language, children with ASD do form concepts for natural objects in their environments. Even with linguistic deficits, children with ASD group objects together into categories and form mental representations for those categories. Are those concepts the same as those formed by typicals? The answer to that question, at this point, is “maybe.” Gasteb and colleagues (2006) have demonstrated that children with ASD do, indeed, form concepts despite their language deficits, though at a slower pace than typicals (Gasteb et al., 2006). In explanation of Gasteb and colleagues’ (2006) findings, Soulieres and colleagues (2011) suggest that this slower categorization seen in children with ASD may be due - not to deficits in categorization ability- but to differences in the strategies they use to form concepts. They found that children with ASD tended to need longer exposure to the exemplars before their categorization began to resemble that of typicals. Typicals began to extract rules for categorizing the exemplars quickly; for example, all entities with oval head shapes, spotted back patterns, and yellow coloration go together, despite having different tails and body shapes.

Children with ASD, however, required significantly more exposure to the exemplars before any strategy seemed to emerge that resembled the rule-based strategies of the typicals. The authors suggest that for children with ASD, using this experience-based, rule-based, top-down strategy may take time and initially play a lesser role to simply guessing. Again, however, the children with ASD were forming concepts, despite their linguistic deficits, albeit more slowly and using different strategies than typicals (Soulieres et al., 2011). These findings allude to the possibility that language may play a lesser role in concept formation relative to other cognitive skills, such as executive
functioning and relational skills. While language may act as an augmenter to concept formation when present and intact, it is not a necessary tool in that process.

*Children born deaf with no linguistic input.* Children born deaf can also shed light on the role of language in concept formation. Whereas many deaf children grow up in environments where linguistic input is present in the form of American Sign Language (or the prevailing gestural system of their culture) from very early on in their lives, there are others who are not exposed to language in any meaningful form throughout their development. This population is perhaps the best analog for studying concept formation without language outside of utilizing nonhumans. Deaf children create gestures to communicate information about generic, global kinds, such as *birds fly*, which emphasize stable, enduring characteristics of category members that are readily perceived by the senses. Even without linguistic input, these children are able to form concepts for entities/objects in their environments in order to create a way in which to communicate this information, emphasizing the role of perceptual features for concept formation (Goldin-Meadow et al., 2005; Ozcaliskan et al., 2009). This finding also lends support to the notion that concepts actually help structure language instead of the reverse (Cimpian & Erickson, 2012).

*Nonhuman animals.* In order to study the effects of no linguistic input on the ability to form concepts, nonhuman animals are frequently utilized as models. Comparative work has been done to determine what types of concepts animals are able to form in the absence of human-like language. Premack (1983) asserted that only language-trained apes and humans were capable of using more than perceptual similarity to form concepts of more abstract categories that do not rely on concrete, image-based
representations. This proposition suggests that non-language trained animals should have relatively little difficulty forming concrete, subordinate level concepts (e.g., members of the same species), but more difficulty as the concepts increase in abstraction to basic and superordinate level concepts. However, research has shown that animals of varying species can form concepts at more than the concrete level, some at multiple levels at once, suggesting that this ability to utilize more abstract concepts is not specifically dependent upon language (Bhatt et al., 1988; Fabre-Thorpe et al., 1998; Lazareva et al., 2004; Roberts & Mazmanian, 1988; Vonk et al., 2012; 2013; Vonk & MacDonald, 2002, 2004).

Some of the seminal work on concept formation at varying levels of abstraction in animals was done with pigeons. Bhatt and colleagues (1988) found that despite the fuzzy boundaries of natural categories, pigeons were capable of forming basic level concepts (specifically - cats, people, flowers, cars, and chairs). These categories, however, were perceptually dissimilar between categories and similar within categories, thereby, possibly making the formation of the concepts easier. Lazareva and colleagues (2004, 2010) extracted two global, abstract level categories from the basic level categories used by Bhatt et al. (1988) to test pigeons’ abilities to form more abstract concepts. The two superordinate level categories they formed were natural (flowers plus people) and artificial (cars plus chairs). They found that pigeons could not only form basic level concepts, but they were also capable of forming more superordinate level concepts that rely less on perceptual similarity and more on deeper, conceptual knowledge about the members. These findings also demonstrate that pigeons, like humans, can simultaneously and flexibly categorize the same stimuli at multiple levels of abstraction, though it is
possible that they simply learned to treat the two categories (e.g., flowers and people) similarly while lacking an overarching category that encapsulates them (Lazareva et al., 2004; Lazareva et al., 2010). Taken together, the work with pigeons indicates that concept formation is not exclusively dependent upon language and emerged farther back in evolutionary history than previously believed.

Nonhuman primates have also been widely researched due to their close genetic relationship to humans and the benefit to understanding the phylogenetic roots of concept formation. Roberts and Mazmanian (1988) tested whether or not squirrel monkeys, humans, and pigeons could form concepts at varying levels of abstraction. At the most concrete level, which corresponds to the subordinate level of abstraction, the animals were tested for their ability to form concepts for one species of bird (kingfishers) that excluded other species of birds. If the animals were able to form concepts at only this level, Premack’s (1983) hypothesis would be supported in that they are not capable of abstract conceptual understanding. The intermediate level, which corresponds to the basic level, discrimination required the animals to form a concept of birds that excluded other animals. At the most abstract level, which corresponds to the superordinate level, the animals were tested for their ability to form a concept for animals that excluded nonanimals (Roberts & Mazmanian, 1988).

Pigeons were found to learn concepts at the concrete level discrimination more rapidly as compared to the other levels, which supported Premack’s (1983) hypothesis. However, the monkeys were able to form concepts at both the concrete and abstract level of abstraction, with the slowest acquisition to the intermediate level in both nonhuman animal species (Roberts & Mazmanian, 1988). Similar results have been found in non-
language trained rhesus macaques (Fabre-Thorpe et al., 1998) and a juvenile gorilla (Vonk & MacDonald, 2002). More recent work with orangutans (Vonk & MacDonald, 2004) and chimpanzees (Vonk et al., 2013) have also shown similar patterns of results, demonstrating that the basic level is salient in their conceptual understanding. Outside of the primate order, recent work by Vonk and colleagues (2012) has demonstrated that American black bears are capable of forming concepts at varying levels of abstraction. While these animals’ concept formation capabilities may differ in the way in which they are formed or the amount of exposure needed to form concepts, they, like non-typically developing children, form concepts at multiple levels of abstraction. The aforementioned results from children with ASD, children who were born deaf and were not exposed to ASL, pigeons, nonhuman primates, and black bears demonstrate that these populations are capable of abstract thought and concept formation, despite their linguistic deficits and/or lack of linguistic input.

Summary of Natural Concepts

Forming concepts for naturally occurring stimuli is a daunting task due to the inherently ill-defined structure of natural categories (Bhatt et al., 1988) where features overlap between categories, some members are atypical members of the category that do not share many features with other members, etc. This task has been suggested to be impacted by the language one speaks and hears. Language may act as an augmenter, highlighting commonalities and regularities in the environment that might not be readily perceivable by the senses (e.g., Plunkett et al., 2008). Findings showing conceptual abilities in populations that lack linguistic input (e.g., children with ASD, deaf children, and nonhuman animals) demonstrate, however, that language is not a necessary
component to concept formation (e.g., Gasteb et al., 2006; Goldin-Meadow et al., 2005; Roberts & Mazmanian, 1988).

When present, though, language does appear to play a role in shaping concepts. Being that language is more than simply knowing the labels for objects and entities in the environment, is there more to the relationship between language and concept formation than what traditional measures of language ability provide? Another relevant question is what role does language play in forming concepts that are based on psychological, in contrast to biological, categories? Particularly, what role does language play in the formation of concepts for human emotions?

*Emotion Recognition*

Humans are by nature social animals; social living brings about challenges that are unique to living in groups. Some of those challenges include interacting with conspecifics, forming and maintaining social bonds, maintaining social order, escaping danger, confronting threats, and dealing with losses (Abe & Izard, 1999). Overcoming those challenges is done partially through the ability to interpret the emotions of conspecifics and reacting accordingly. But, how does one “read” the internal state of another? Some suggest that we have developed an outward, emotion signaling system using facial expressions that allows for quick interpretation of the emotion of a conspecific without the influence of language (Abe & Izard, 1999; Ekman, 1969, 1970; Ekman & Friesen, 1971; Izard, 1994). Whereas, others suggest that the language we speak determines/shapes the way in which we interpret facial expressions, essentially stating that language creates the emotional reality in which we live (Lindquist et al., 2006; Russell & Bullock, 1985).
Emotion Recognition “Without” Language – Role of Facial Expressions

When a layperson is approached regarding how they know how someone is feeling (i.e., interpreting the internal, emotional state of a conspecific), perhaps the most popular response is that they use facial expressions to determine which emotion the person is feeling from moment to moment. This commonly held belief that facial expressions are a reliable means by which to judge the internal state of another human was not widely accepted in the scientific community prior to the 1960s. Researchers, at the time, believed that the face was actually a meager source of relevant information for emotion recognition, and what information was provided was inaccurate and specific to the culture in which one lived. These beliefs directly contradicted long-held folk beliefs and evidence of the salience of faces to humans even in early infancy (Carroll & Russell, 1996; Ekman, 1993).

Following the hypotheses originally proposed by Darwin, two researchers, Paul Ekman and Carroll Izard, separately pioneered the empirical study of the cultural universality and innateness of facial expressions by comparing facial expressions and the interpretation thereof between and among cultures around the world. What these researchers and their colleagues found was that there was tremendous overlap in the types of facial expressions produced and the interpretations of these expressions among the cultures studied (e.g., Ekman, 1969, 1970; Ekman & Friesen, 1971; Izard, 1994). Their findings led to the proposal of an emotion signaling system and the innateness-universality hypothesis (IUH), both of which are underpinned by the assertion that facial expressions provide rich information that one can utilize in social situations to interpret
the emotional state of a conspecific and react accordingly (Ekman, 1993; Izard, 1994; Widen & Russell, 2010).

*Emotion signaling system.* The theory of an *emotion signaling system* predicts that certain patterns of facial movements, or facial expressions, have been selected for in our species’ evolution as outward, visible signals for specific emotions. This association between facial expressions and emotions is not arbitrary, but selected for through natural selection (Ekman, 1999; Widen & Russell, 2010). Having unique facial expressions as signals for emotions suggests that there are discrete psychological states occurring in an individual and that both the individual experiencing the emotion and those observing the individual possess a set of mental categories/concepts by which they can readily interpret each of those discrete states using the signals provided (Abe & Izard, 1999). The emotion signaling system is hypothesized to be in place and fully functioning before one year of age (innate) and biologically-based, suggesting that there is a unique evolutionary advantage for survival in group settings for producing easily interpretable, distinctive facial expressions for specific emotions (Izard, 1994; Widen & Russell, 2010).

According to this view, expressions serve as “a functional communication system that preceded language in evolution and precedes language in ontogeny” (Izard, 1994, p. 290). It is inherently adaptive and necessary to life in a social group to have differential, universally recognized emotion signals. These signals should be representative of specific emotions and not just based on valence (i.e., positive or negative). For instance, consider an adult playing outdoors with a toddler. In one situation, the adult comes across a dead animal in the grass by their feet and reacts with an expression of sadness or disgust. In another situation, the adult comes across a poisonous snake in the grass near his foot and
reacts with an expression of fear. If the emotion signaling system was not innate and was based only on valence, the toddler would not gain much information from the expressions. Conversely, if toddlers had an innate capacity to interpret each expression as representing a distinct emotion, they could gain much more information that is vital to their survival (Izard, 1994). An inability to recognize and discriminate between signals provided by conspecifics is a significant disadvantage to survival in social groups (Widen & Russell, 2010).

The innateness-universality hypothesis (IUH). The IUH arose out of the evidence for the emotion signaling system. As is stated in its name, the IUH predicts that emotion recognition based on facial expressions is both innate and universal. There are six “basic” emotions that have been identified: anger, fear, sadness, happiness, surprise, and disgust. These “basic” emotions have gained the most support for being innate and universally expressed by specific facial configurations (Ekman, 1993; Waller et al., 2008). From birth, human infants show a particular interest in and preferentially attend to the face. Throughout development, faces have been shown to provide substantial information that helps to organize and bring coherence to perceptual information (Quinn & Eimas, 1996). Infants as young as three months old have been shown to be able to discriminate positive from negative facial expressions, and by four to six months, have demonstrated the ability to distinguish between at least some of the basic emotions (fear, anger, and surprise).

By six to seven months, infants have been shown to be able to discriminate among all the negative (fear, sadness, anger, and disgust) emotions based on facial expressions (Izard, 1994). By the end of the first year of life, infants are able to use their
experience with facial expressions to direct their behaviors when interacting with a social partner through the use of social referencing (Widen & Russell, 2010). Early and relatively sophisticated understanding of the basic emotions is proposed to be solely based on biological cues, the most impactful of which are facial expressions (Wellman, Harris, Banerjee, & Sinclair, 1995), creating what is known as the Face Superiority Effect - more accurate categorization of emotions depicted when facial expressions are available (Russell & Widen, 2002). This evidence provides support for the innateness of the use and interpretation of facial expressions in emotion recognition. In addition, this early ability to utilize and interpret emotion information facilitates infant-caregiver attachment, social referencing, and the development of empathy and theory of mind (Russell & Widen, 2002).

As for the universality component of the IUH, evidence of the presence and utility of expressions for the basic emotions has been demonstrated in both literate and pre-literate cultures around the world. This evidence suggests that these expressions are culturally universal in nature, regardless of the language spoken in the cultures (e.g., Ekman, 1969, 1970, 1999). Across twenty-one literate cultures, there was strong agreement about the emotions portrayed by specific posed facial expressions. Members of pre-literate cultures chose the same facial expression to match an emotion-eliciting story that was chosen by members of literate cultures. Also, when judging and producing spontaneous facial expressions, there were no major differences between the cultures studied (Ekman, 1999).

However, some minor differences between and among cultures were found. According to the differential emotions theory, each distinct basic emotion varies along
dimensions of intensity, from understated to extremely intense, causing slight variations in facial expressions, but still containing similar underlying morphological features (e.g., smiles for happiness and frowns for sadness) (Abe & Izard, 1999; Izard, 1994). Differences in the expression of certain emotions in some cultures arise from variations in what have been termed as “display rules.” Display rules are culturally-specific rules regarding who and to whom one can show certain emotions and when it is proper/appropriate to display certain emotions. The differences between cultures that have been found emanate from these display rules and not from differences in the ability to produce the facial expressions or interpret the messages given by these signals across cultures (Ekman, 1993, 1999).

Taken together, the aforementioned information provides a solid argument for the existence of an emotion signaling system and support for the IUH. These findings suggest that emotion recognition is not dependent upon language and is possible in the total absence of language. This argument is supported by evidence demonstrating similar facial configurations between humans and other primate species, including apes and Old and New World monkeys (Ekman, 1999). However, there are those who assert that without language as a guide, wading through something as murky as emotion recognition in humans is nearly impossible (e.g., Lindquist et al., 2006). The controversy regarding the amount of information that can be gained from using nonverbal signaling systems to judge emotional states in others is partially due to the fact that some primates, including humans, have evolved the capacity to voluntarily control the facial expressions they produce in any given situation. This voluntary control allows for the extraction of
misleading information from the facial expressions or outright deception on the part of the expresser (Izard, 1994).

Russell (as cited in Izard, 1994) stated that there were two main issues raised by this capability that caused issues for the existence of the emotion signaling system, and therefore, the IUH, and its tenants regarding the use of facial information to judge emotions in others: 1) is there enough regularity in the link between a facial expression and its underlying emotional state to categorize the expression as representing that underlying state and 2) can the link between feelings and expressions be modified by the voluntary control of facial expression to the extent to which the link becomes nonexistent? Izard’s (1994) response to these questions is related to the fact that it would be maladaptive to possess such a large communication system of very obvious, self-revealing signals without the capacity to voluntarily control them when necessary. For example, when confronted with an enemy who both outnumbers and has more weaponry than you, it would be maladaptive to respond with an expression of fear. It would be more adaptive to be able to mislead or deceive one’s enemy by displaying confidence or enjoyment, despite your true internal state. This ability to self-regulate facial expressions may be a recent adaptation in the phylogeny of the species, not evidence against the system or the IUH, and might be a result of the highly complex social lives of humans and some other modern primates (Izard, 1994).

Despite the evidence provided above, however, there are still many critics who challenge the IUH and the reliance upon facial expressions (and other nonverbal signals) to classify emotions. The IUH suggests that by emotion recognition being an innate capacity, acquisition of the underlying emotion concepts is fast and not drastically altered
by the development of other cognitive skills, such as language, due to the fact that the basic concepts are already in place at birth. In fact, the absence of a label for an emotion does not inherently indicate that a child or culture does not express/feel that emotion. Because each basic emotion varies in intensity there are a vast amount of possible terms that could be used to describe each variation, so the lack of a term for a specific intensity of an emotion does not mean that it is not felt or expressed by a facial expression, just that there is no word for it in that culture (Ekman, 1999; Izard, 1994). As a note, there is even some evidence of early, relatively sophisticated emotion term comprehension and use by very young children that lends credence to the innateness of emotion recognition. Ridgeway, Waters, and Kuczaj II (1985) found that infants/toddlers were reliably using many of the basic emotion terms before the age of two years. This finding has been supported by evidence suggesting that by the age of two, children are referring to a wide range of emotions that are expressed by both others and themselves (Dunn, Bretherton, & Munn, 1987).

However, there are those who argue that the conceptual system that is in place at birth, if it exists, is inherently not the same as the conceptual system possessed by adults (Widen & Russell, 2008). This gradual emergence of emotion concepts argument has gained popularity among supporters of the LRH (e.g., Lindquist et al., 2006) and suggests that experience with the emotion labels in one’s language shapes, and possibly, effectively determines the ways in which we, particularly infants and early language learners, view the affective world (Lindquist et al., 2006; Widen & Russell, 2003, 2008, 2010).
Emotion Recognition “With” Language – LRH and the Circumplex Model

Advocates of the LRH suggest that the influence of language extends beyond concepts for observable, perceptual categories to help in the formation of concepts for unobservable phenomena (e.g., emotional states) (Astington & Jenkins, 1999; Lindquist et al., 2006; Wolff & Holmes, 2011). Because emotions are internal, psychological states, language allows for clarification when misinterpretations of outward cues occur and for reflection on past and/or future events in order to behave appropriately in the present (Dunn et al., 1987). As was its role in natural concept formation, language may act as an augmenter, providing the extra conceptual tools necessary to form concepts for internal, unobservable states (Wolff & Holmes, 2011).

Language has been suggested to play a role in differentiating between the varying emotions above and beyond what facial expressions are capable of alone. According to Carroll and Russell (1996), facial expressions show “limited situational dominance,” indicating that expressions are merely “quasi-physical” information that “indicate its simplest literal meaning,” (like a smile, cry, or yawn) which by themselves do not provide adequate information to judge the underlying psychological state (p. 206). It is then up to the language spoken by the culture to determine what emotional state(s) those facial expressions represent; in essence language creates the affective reality in which one exists (Lindquist et al., 2006). Therefore, it would follow that very young children and preverbal infants may not possess the same conceptual representations for emotions, as adults who have had more exposure to their native language. The LRH supports a more gradual emergence and development of emotion concepts than does the IUH. This assertion that emotion concepts are developed in incremental steps and continue to
differentiate longer into development than previously believed spurred Russell and colleagues to develop a model for how emotion concepts change through development and eventually become like those seen in adults. This model is termed the *Circumplex Model of Emotions* (Russell & Bullock, 1985).

*Circumplex model of emotions.* The fundamental premise of the Circumplex model is that emotion categories based on different facial expressions fall into two bipolar dimensions based on valence (pleasure-displeasure) and vary in degree of arousal. Figure 1 shows the graphical representation of the Circumplex model from Russell and Bullock (1985, p. 1291). The model gets its name based on the circular pattern that emerges when each expression is positioned in the model based on where it falls along the dimensions of valence and arousal.

*Figure 1.* Circumplex model of emotions: Multidimensional scaling representation of 28 emotion-related words (see Russell, 1980).

The main prediction that is derived from the Circumplex model is that the emotion concepts possessed by infants and very young children are fundamentally different from those of adults. The model predicts that emotion concepts emerge
gradually and continue to be shaped as the child develops. Research on the model has demonstrated that the emotion categories used by very young children are broader than those of adults. Concepts for emotions are initially based on the dimensions of pleasure and displeasure (positive-negative) and are differentiated gradually through learning the various labels for each specific emotion (Carroll & Russell, 1996; Russell & Bullock, 1985; Russell & Widen, 2002; Widen & Russell, 2003, 2008, 2010). It is of importance to note that this research has focused on the six basic emotions with happiness and surprise making up the positive facial expressions/emotions and anger, sadness, fear, and disgust constituting the negative facial expressions/emotions. Children do not actually possess the conceptual underpinnings to differentiate between the emotions until they have acquired the label for the specific emotion (Widen & Russell, 2010).

These results suggest that language is an integral part of differentiating the various emotions. In fact, Russell and Widen (2002) demonstrated a Label Superiority Effect (in contrast to the Face Superiority Effect discussed previously) in very young children when categorizing basic emotions. When given the labels for specific emotions, the children were significantly more accurate in categorizing facial expressions than when given only facial expressions by which to match the images. In the condition where facial expressions only were provided to help categorize emotions, children’s categorization of the facial expressions fell in line with the dimensions of pleasure-displeasure. In this experiment, the labels are working in a similar manner as labels for natural objects by differentiating between entities that are in the same category and, therefore, share more perceptual similarity (Russell & Widen, 2002). For example, Figure 2 (from Russell & Widen, 2002, p. 38) graphically depicts the pattern of differentiation
with age in the children’s concept for the negative emotions (anger, fear, sadness, and disgust).

*Figure 2.* Proportion of each type of facial expression categorized as angry by age in years from Russell and Widen (2002, Figure 3, p. 38).

As shown, at two-years-old, the negative emotions (anger, fear, sadness, and disgust) are not yet differentiated from each other, with the majority of children categorizing all negative facial expressions as anger. By four, sadness begins to become differentiated from fear, but full differentiation of the concepts does not occur until later in childhood (around seven) and continues even during that time, especially for fear and disgust (Russell & Widen, 2002). Russell and his colleagues found that these concepts narrow in a very similar manner that follows the acquisition and production of specific emotion labels. As the child learns the emotion labels of their native language, the concepts they form for specific emotions (based on facial expressions) become narrower until they begin to resemble the concepts of adults. They referred to this as a differentiation model of emotions based on the Circumplex model (Russell & Widen, 2002; Widen & Russell, 2008, 2010).
**Circumplex model as a differentiation model.** Children’s concepts for emotions begin in two very broad categories (positive and negative), encompassing all emotions in those two categories and not differentiating between the specific emotions as adults do. For instance, all negative facial expressions (anger, sadness, fear, and disgust) are categorized together; therefore, these categorization “errors” made by very young children simply reflect that the concepts they possess are not yet differentiated as are those of adults. Differentiation within the broad categories occurs as labels for emotions are learned (Widen & Russell, 2010). Tests of the Circumplex model have shown that the number of different emotion labels used to label facial expressions increases with age and that some expressions are labeled earlier than others (Russell & Widen, 2002; Widen & Russell, 2003, 2008).

Russell and Widen (2002) and Widen and Russell (2003) demonstrated that the labels for each emotion emerge in a systematic manner. If the child produces one emotion label, it is happy. If the child produces two emotion labels, they tend to be happy and angry (and in some cases, happy and sad). If the child utilizes three labels, they are usually happy, sad, and angry. The fourth and fifth labels used are typically either scared (fear) or surprise. The final of the basic emotion labels to emerge is disgust. Figure 3 shows the pattern of emergence of emotion labels by age that has been supported by Russell and colleagues (e.g., Russell, & Widen, 2002; Widen & Russell, 2003).
The main crux of these findings is that when children perceive facial expressions, they interpret them in a different manner than do adults based on the differing conceptual structures they possess for emotion concepts. Their “errors’ in categorization are rooted in the dimensions of pleasure and displeasure upon which their concepts are based. As it is for natural concepts, it is much harder to differentiate between facial expressions depicting expressions from the same broad category (e.g., anger and fear). Until the child has ample experience with the labels for each emotion and the contexts during which they occur, the concepts they form will remain broad and undifferentiated (Russell & Widen, 2002; Widen & Russell, 2003, 2008, 2010).

**Language complexity and emotion recognition.** The question still remains whether the effects of language on emotion concept formation are as simple as learning specific labels for specific emotions. Does possession of this extra conceptual tool aid in the ability to form specific concepts for each discrete emotion based on the outward cues provided by facial expressions? *Or,* is there is more to language’s role in guiding emotion recognition based on facial expressions? There is a significant amount of literature that
deals with the relationship between language and the development of social concepts such as emotional understanding and theory of mind (Astington & Jenkins, 1999; Cheung, 2010; de Rosnay et al., 2004; Watson et al., 2000). A consistent positive relationship between the child’s linguistic ability and performance on tasks relating to these abilities suggests that the LRH proponents are correct in their belief that language is related to how people perceive and interact with the world around them.

But what aspects of language are related to these effects? Is it knowledge of the meanings of words (semantics) and sheer size of the child’s vocabulary that lead to the results shown, or is it grammatical competency and the types of words used/how words are used that aides in the formation of social/emotion concepts? There is some evidence that both syntactic ability (knowledge of the grammatical rules of language) and semantics play a role in false belief understanding (Cheung, 2010). However, there is no evidence at this point looking at the complexity of language and how it relates to emotion recognition based on facial expressions. The research of Russell and colleagues seems to indirectly indicate that semantic knowledge of word meanings is of importance in developing emotion concepts for facial expressions (Russell & Widen, 2002; Widen & Russell, 2003, 2008, 2010). More research is needed to help fill in the gaps in our understanding of language’s role in emotion recognition based on facial expressions and to help elucidate the relationship between innate capacity and experience with language.

The Current Project

Specific Goals

The specific goal of the current project was to elucidate the relationship between language complexity and natural and emotion concept formation in early language...
learners (two-, three-, four-, and five-year-olds). Language complexity provides a broader, more encompassing means of assessing language competency by measuring more than the child’s semantic (word meanings) competency, which is the major focus of most of the traditional language measures. Specifically, the test utilized (a selection of assessments taken from the Brigance Diagnostic Inventory of Early Childhood Development II henceforth referred to as the IED-II – Brigance, 2004) measured not only receptive and expressive vocabulary, but also quantitative term comprehension, select aspects of grammatical competency, and more practical/applied linguistic competency. The inclusion of these components allows for a better understanding of the role of language in concept formation.

The IED-II was designed as a broad-spectrum developmental inventory for children from birth to age six years. It is highly utilized in educational settings as it is criterion-referenced, does not require specialized training to administer, and allows for a comprehensive understanding of whether or not the child is developing in a manner that is typical for his or her age (Brigance, 2004). The 2004 edition was also norm-referenced and validated to be used as a standardized measure (Glascoe, 2004). The IED-II contains eleven sections: a) perambulatory motor skills and behaviors, b) gross-motor skills and behaviors, c) fine-motor skills and behaviors, d) self-help skills, e) speech and language skills, f) general knowledge and comprehension, g) social and emotional development, h) readiness, i) basic reading skills, j) manuscript writing, and k) basic math (Brigance, 2004). The basic productive and receptive vocabulary tasks for this study were taken from the Speech and Language Skills, and all other tasks were taken from the General Knowledge and Comprehension section.
For the purpose of this study, the language complexity was comprised of the child’s composite productive and receptive vocabulary scores in addition to their comprehension of quantitative terms. In addition, measures of grammatical competency were included and were the child’s knowledge and use of plurals (-s and –ing), prepositions, and irregular plural nouns. In order to measure the child’s more practical/applied linguistic competency, their knowledge of class inclusions (e.g., foods, things you can read, toys), what to do in a given situation, and practical uses of objects were assessed (Brigance, 2004).

The categories utilized in the natural concept discrimination tasks were based on the levels of abstraction described by Rosch and colleagues (1976; subordinate, basic, and superordinate). These tasks have been utilized in comparative work with chimpanzees and bears by Vonk and colleagues (2012, 2013) and were adapted from the tasks utilized by Roberts and Mazmanian (1988) in pigeon, squirrel monkeys, and adult humans. They consisted of two-alternative-forced choice (2AFC) tasks, with two images representing two different concepts at the same level of abstraction (e.g., basic) presented simultaneously on a computer touch-screen. The participant was required to choose one of the two images that represent the category member that was correct for that session.

These natural concept tasks used images from the following categories, which increased in inclusiveness as the levels increase: tigers versus lions (subordinate), cats versus dogs (basic), and animals versus nonanimals (superordinate). These particular categories were chosen for two reasons. First, early language learners are likely to have more experience with, and greater interest in animals; therefore, these stimuli are likely to be salient for even the youngest of participants. Secondly, I chose to maintain a concept
structure as described by Markman and Wisniewskie (1997), where all lower level categories originate from the same parent superordinate level category, which increased the between category similarity, but allowed for enough variability to allow for choosing categories that have very salient perceptual differences (e.g., tigers have stripes and lions do not) at the lower levels.

The manipulation of levels of abstraction helped clarify the effects of language at the varying levels. At the subordinate level in the current tasks, linguistic cues may not be as necessary even for the youngest of participants due to the salient perceptual differences. In contrast, there may be a more pronounced need for language at the superordinate level in order to highlight the commonalities among the wider ranges of members within the categories. In addition, it is of importance to note that each of the higher levels incorporated images of members seen in the lower levels. For instance, the “cat” category contained both lion and tiger images, therefore, requiring the child to make the conceptual connection between the animals that they could have previously had to discriminate between in order to perform the lower level task.

The task for discriminating emotion concepts was the same as that used for the natural concepts. However, instead of images of animals, images of facial expressions were used. Five emotion/non-emotions, which included four of the six basic emotions discussed previously (anger, sadness, happiness, and positive surprise plus neutral faces), were used. In order to make the tasks as analogous as possible, the emotion concepts were presented within three levels of abstraction as well. These levels were primarily based on Russell and Bullock’s (1985) Circumplex model. As before, the lower levels
originated from the same parent superordinate level category and increase in inclusiveness as the levels increase.

The three levels of abstraction were as follows: anger versus sadness (subordinate), positive versus negative (basic), and emotion versus non-emotion (superordinate). The basic level categories were chosen based on the findings that very young children initially partition emotion concepts based on facial expressions into these two broad, more inclusive categories until they are later differentiated as the child learns specific labels for each discrete emotion/facial expression (Carroll & Russell, 1996; Russell & Widen, 2002; Widen & Russell, 2010). The positive category included facial expressions for happiness and positive surprise, while the negative category included facial expressions for anger and sadness. These emotions are considered basic emotions that have distinct facial expressions (for review, see Ekman, 1994; Keltner & Ekman, 2000).

The superordinate level of the emotion categories, emotion versus non-emotion, was the most inclusive of the categories. Both positive and negative emotions were combined to create the emotion category, while neutral faces comprised the non-emotion category. This study is the first to permit analysis of emotion concepts at varying levels of abstraction. The structure of these categories allowed for more direct testing of the Circumplex model by testing its central premise of the initial breadth of emotion categories in early language learners (Russell & Bullock, 1985).

It is of importance to mention that the images were not put through rigorous testing to ensure the expressions match precisely to the morphological configurations that have been found for each of the different emotion expressions. I relied on the judgments
of laypeople (college undergraduates) to determine if the images of facial expressions I chose to depict the emotions reliably signaled the emotions intended. This aspect is important because the majority of previous studies utilized images that were tested to ensure that the facial configurations were precise, prototypical, posed depictions of the intended emotions (e.g., Russell & Bullock, 1985; Widen & Russell, 2008). This study, however, could have increased external validity due to the fact that the facial expressions we encounter in daily life are not prototypical. They are not posed or produced by a computer program, but are often spontaneous, and can be both valid signaling cues, indicating the true emotions of the expresser, and deliberately misleading cues. As mentioned by Izard (1994), emotions vary significantly in the intensity in which they are felt and expressed. It is important to attempt to utilize images of facial expressions that represent the range of the realistic expression of emotions that occurs in everyday encounters, instead of relying heavily on averaged depictions.

Hypotheses

The overarching prediction was that language complexity would predict performance at all levels of abstraction in the natural and emotion concept discriminations, but could have the greatest impact at the most abstract levels, which depend more heavily on language and less on perceptual features. Specifically, it was hypothesized that as language complexity increased, so too would performance on the concept discrimination tasks, with this increase in performance being most pronounced for more abstract level categories. This hypothesis is in line with the Linguistic Relativity Hypothesis, which states that language impacts the way in which the speaker thinks and, in turn, how concepts are formed (i.e., Lindquist et al., 2006; Plunkett et al., 2008; Wolff
& Holmes, 2011; Zhang & Schmitt, 1998). While I predicted no differences between ages or genders, the variables were included in the model as they could influence the impact of language on concept ability. Language should be the primary predictor of concept ability and mediate effects of age and gender.

*Test of the “language as an augmenter” hypothesis.* Language can highlight commonalities between category members that are not obvious by perception alone (e.g., warm-blooded) (Wolff & Holmes, 2011). Along this vein, it could be predicted that language could play an influential role in the discrimination of concepts that are more abstract, in other words, that share fewer perceptual commonalities within and between categories (e.g., animals versus nonanimals). Whereas, it could play a less important role in the discrimination of more concrete concepts that contain more perceptual similarities within and between categories, and are easily differentiated by salient perceptual cues, such as coloration (e.g., lions versus tigers).

It is, in turn, predicted that the language complexity will have a greater impact on the superordinate level natural and emotion concept discriminations than they will on the subordinate level discriminations. It is the within category dissimilarity, rather than the distinction between categories, that could necessitate language as an augmenter to help highlight the commonalities between members that might not obviously be connected by perception alone. For instance, determining the categorical relationship between an insect and a mammal may be less obvious than determining the relationship between a lion and a domesticated housecat. Given that the basic level categories (cats versus dogs) originate from the same parent superordinate category, they share perceptual similarities between categories. In addition, there is a greater degree of perceptual overlap between exemplars
within basic level categories. Therefore, performance in this task could be less affected by language use.

*Emotion concept discrimination predictions – Tests of the Circumplex model.* If the predictions of the Circumplex model (Russell & Bullock, 1985) hold true for this sample, the children in all age groups should show similar patterns of responses and errors when performing the tasks. Based on this model, it was expected that the best performance should be on the basic level of abstraction, regardless of age – positive versus negative facial expressions – due to the fact that young children parse different emotions based on the dimensions of pleasure and displeasure, creating two broad, inclusive concepts for positive emotions (happy and surprise) and negative emotions (anger and sadness). It was also predicted that the most errors would be seen on the subordinate level discriminations. Despite the fact that anger is one of the first emotions to emerge as a distinct emotion, if fear has yet to be differentiated from other negative emotions, confusions will still occur at this level of abstraction (Widen & Russell, 2008). Performance on the superordinate level discrimination is predicted to be in between the basic level and the subordinate level performance or indistinguishable from the basic level due to the high degree of inclusiveness captured in this discrimination.

However, if emotion recognition is biologically based, innate, and an evolutionary adaptation for survival as predicted by the IUH (Ekman, 1993, 1999; Izard, 1994), then from early in development, faces are predicted to provide cues to the internal emotional state of an individual. These basic emotions, including happiness, sadness, anger, and surprise, are predicted to be differentiable from each other even in the youngest of participants (Ekman, 1993, 1999; Izard, 1994). Therefore, children’s performance on the
subordinate level (anger v. sadness) was predicted to be significantly above the level expected by chance alone, regardless of age, due to the fact that the emotion concepts are clearly distinguished from birth.
CHAPTER II
METHODS
Participants

There were 74 total participants ranging in age from 2:0 to 5:6 years old. Five two-year-olds (three males and two females ranging in age from 2:0 to 2:11), 39 three-year-olds (16 males and 23 females from 3:0 to 3:11), 23 four-year-olds (11 males and 12 females from 4:0 to 4:11), and seven five-year-olds (two males and five females from 5:0 to 5:6) were recruited from daycares and private schools in Mobile, Alabama, Ocean Springs, Mississippi, and the surrounding areas. Only children whose primary language is English participated in the study. In addition, children with a diagnosis of any language or cognitive impairments that could impact performance were not included in the study. There were no other constraints or restrictions on participation. Conformity to these selection criteria was determined through a short demographic survey given to the parents with the consent package containing the informed consent information and permission form.

Undergraduate Sample for Norming the Emotion Concept Images

One hundred and fifteen undergraduates with approximately 75% females and 25% males were recruited from the undergraduate psychology subject pool at The University of Southern Mississippi. There were no specific selection requirements for the undergraduates to participate beyond being over the age of eighteen. They received two experimental credit points towards their course grade for their participation in the norming of the emotion concept discrimination images.
Apparatus, Materials, and Stimuli

Norming of Emotion Concept Discrimination Images

Prior to choosing the images for the emotion concept discriminations, it was necessary to ensure the facial expressions in the images were rated by adults as portraying the intended emotion. These images were uploaded to an online survey site, Qualtrics.com. The participants were directed to the site from the SONA system. Prior to beginning the task, they were required to electronically provide a signature on the informed consent document. They were then directed to view each image, presented individually, and determine which of seven emotions were being depicted by the images.

For each of the seven facial expressions (happy, sad, angry, fear, surprise, amusement, and neutral), the participants were shown 152 total, 400 X 600 mp images that were downloaded from Google Image search and cropped using Microsoft Office Picture Manager to include only faces or faces and upper torso only. This number included the number of images for each expression that were needed in the computer tasks plus five extra images to account for any ambiguous (unknown) ratings. They were asked to classify the images as portraying a happy, sad, fearful, surprised, amused, angry, neutral, or unknown face. The ratings for each face were downloaded to an Excel spreadsheet and analyzed to determine if the images portrayed the intended emotions (70% of participants agreed upon emotion expressed). Experimental credit points to help fulfill course experimental opportunity points were awarded for participation.

Concept Discrimination Tasks

The computer tasks were presented on a Panasonic Toughbook CF 18 Laptop Computer. Experiments were programmed using RealBasic 2006 for Windows. Stimuli
for the natural concept formation discriminations consisted of two-dimensional photographs that were similar to those used by Vonk and colleagues (2012, 2013) while the stimuli for the emotion concept discriminations had not been used previously. For the three natural concept discriminations, the images depicted the animals from a variety of perspectives and orientations including close-ups, whole body, side views, head only, and so on, to help control for the possibility that a single perceptual feature (such as tails) could be utilized to distinguish between the stimuli. For the subordinate level discrimination, there were twenty images of lions and twenty images of tigers. The basic level discrimination consisted of twenty images of felines/cats that included novel images of both lions and tigers in addition to a variety of other members of the Felidae family versus twenty images of canines/dogs that could include wolves, foxes, domestic dogs and other members of the Canidae family. The superordinate level discrimination included twenty images of animals including felines and canines plus other taxonomic groups such as primates, reptiles, birds, insects, etc., versus twenty images of nonanimals that could include foods, dwellings, plants, statues, clothing, etc.

For the emotion concept discriminations, the images for the most subordinate level discrimination consisted of twenty images of facial expressions of anger versus sadness. For the basic level discrimination, the images were faces (some close-up faces and some upper body shots including the face and the upper torso) depicting two positive facial expressions (ten happy and ten positive surprise) versus twenty images depicting two negative facial expressions (ten angry and ten sad). The superordinate level discrimination included twenty images containing all four facial expressions from the previous level of abstraction (five of each - happy, positive surprise, anger, and sadness)
versus twenty images depicting neutral facial expressions (non-emotion). Although the images depicted the same categories as used in other discriminations, novel images were used for each discrimination. The images for both the basic and superordinate level discriminations were cropped to show only the head region or the head and part of the upper torso. The images were from slightly varying angles with some being the head facing straight ahead and some with the head slightly turned, but both eyes still visible and some being more close-up than others. All images, however, had to have the entire face visible to be included. The categories increased in level of abstraction and degree of inclusiveness from subordinate to superordinate with the subordinate having the lowest level of both abstraction and inclusiveness and superordinate containing the highest level of both abstraction and inclusiveness.

If the child made an incorrect choice, the computer produced an unpleasant buzzing sound, and the experimenter told the child to try again. If the child made a correct response, the computer produced a pleasant tone, and the experimenter told the child that he or she did a good job. Additionally, after a correct choice a short amusing video clip was played immediately after the pleasant tone. For the first five correct choices, a video clip of a cat jumping out of a box was played. The next six correct choices were reinforced with a clip of a kitten being tickled. And the next nine correct responses were reinforced with video of a hamster doing back flips. Stickers were also used as reinforcement for correct responses. Snack-size plastic zipper bags were used to contain the child’s stickers during testing.
Language Complexity

Selections from the IED-II (Brigance, 2004) were utilized to measure language complexity (described in a previous section). The materials were kept in a two-inch binder. The materials were simply the images printed on cardstock provided by the authors of the measure, but some tasks required utilizing outside materials. In order to assess the child’s knowledge of body parts, the child was asked to point to the part of their body named by the experimenter or name parts of the experimenter’s body when indicated. A PowerPoint presentation on the Panasonic ToughBook was utilized to present images from the quantitative concepts section. These images included such images as a full versus an empty glass/box, a small versus a large animal, a tall versus a short building, a box with more versus less kittens, etc. Additionally, seven paper clips and two pencils (one short and one long) were utilized in the quantitative concepts section. Children received stickers as reinforcement sporadically throughout the task to maintain motivation. The children received the stickers regardless of their performance on the measures.

Procedure

In order for a child to participate, their parents must have returned the consent form, which was distributed by the facility prior to beginning testing, to the experimenter. The consent packet also included a short demographic survey containing the child’s name, birthday, primary language spoken in the home, questions regarding any diagnosed language or cognitive impairments, socioeconomic status of the family, and parents’ level of education.
After receiving the signed consent forms, the testing occurred at the child’s school or daycare facility during regular school hours with testing occurring over an average of two days with one to two testing sessions per week (depending upon the facility), per child and with each testing session taking approximately thirty to forty-five minutes to conduct. The child was removed from his or her regular classroom activities for testing and taken to a room where the testing materials were set up. Before beginning any testing the child was asked to give their assent to participate and had the purpose of the study and the informed consent information explained to them in terms he or she could understand. It was emphasized that they did not have to answer any questions if they did not want to do so, could stop the testing at any point, and could take breaks if they needed or wanted to do so.

Procedure for the Norming of the Emotion Concept Images

The images were uploaded onto a secure online survey site, providing the participants the opportunity to participate from any location with Internet access. Before being able to proceed to the images, the participants were required to give their electronic consent to participate. They were given the opportunity to read and print the informed consent document, which emphasized that they could stop participating at any point. Each image was then presented one following the other on the page in the same serial order for all participants, and a scale was provided for the participants to classify the images as portraying a happy, sad, fearful, angry, surprised, amused, neutral, or unknown facial expression. All basic and one derived emotion were included initially. Upon completion of the experiment, the participants received experimental credit points to contribute to their course experimental participation requirement.
After the completion of testing, the responses were analyzed by the experimenter. Only images that were rated as portraying the intended emotion by 70% of the undergraduates were utilized in the emotion concept discriminations. Any images that did not meet this criterion were not utilized as images in the tasks for the children. It was found that fear was not distinguishable from other negative emotions, nor was amusement clearly distinguishable from other positive emotions. These emotions were then excluded from the categories for the children’s tasks; therefore, the facial expressions utilized for the concept discrimination tasks were anger, sadness, happiness, positive surprise, and neutral.

Experimental Design

The order in which the child received the concept tasks was randomized and counterbalanced between subjects and within age groups to control for order effects. The IED-II (Brigance, 2004) was administered on a separate testing day approximately one week after completion of the concept tasks due to the late inclusion of this task to the project. Each of the two-alternative, forced choice tasks contained twenty trials. The tasks contained forty images total for each of the three discriminations: twenty correct stimuli (S+) and twenty incorrect stimuli (S–). The order in which the participants received each of the three levels of abstraction was counterbalanced across participants to control for and investigate any possible order effects. There were six possible orders in which the children could have received the discriminations (subordinate, basic, superordinate).

Within the subordinate level natural concept discrimination, approximately half of the participants were assigned lions as the S+ with tigers as the S–, and half were assigned tigers as the S+ with lions as the S–. For the basic level discrimination, all the participants
were reinforced for choosing felines/cats with canines/dogs as the S- as this category is inclusive of the subordinate level categories (lions versus tigers). At the superordinate level all the children were reinforced for choosing animals with nonanimals as the S- again due to the fact that this category is the parent category of both the lower level categories. The side location (left or right) of the S+ was counterbalanced within the tasks. Images were randomly paired and presented on each trial with no images repeated within or between tasks.

For the subordinate level emotion concept discrimination, approximately half were reinforced for choosing facial expressions depicting anger with expressions depicting sadness as the S-, and half were reinforced for choosing facial expressions depicting sadness with expressions depicting anger as the S-. The basic level followed the same pattern with all reinforced for choosing negative facial expressions with positive facial expressions as the S- due to the fact that the subordinate level categories (anger and sadness) are included within the negative emotions category. At the superordinate level, all participants in each age group were reinforced for choosing facial expressions clearly depicting different emotion states with faces that do not clearly depict an emotion (non-emotions) as the S-. The emotion category was also based on the structure of the two lower level categories being derived from this parent category of emotions. The side position of the correct matches (S+) were counterbalanced within each session of each task, and images were randomly paired and presented on each trial with no images repeated within or between tasks.
Procedure for Natural and Emotion Concept Discriminations

The procedure was the same for both the natural and emotion concept discrimination tasks. The child was removed from his or her regular classroom for the duration of the testing session and brought to the testing room. Each child was tested individually in a quiet room in order to eliminate as much distraction as possible. The child was asked if he or she wanted to “play my games with me,” and if the answer was affirmative, a brief discussion ensued regarding how to play the “games.” The child was seated at a desk beside (or cattycorner to) the experimenter and in front of the computer. All responses by the child were made by using a stylus on the touchscreen monitor. The experimenter set up the session by choosing the appropriate S+ and S- as determined by the trial configuration for that child’s participant number. This was done with the computer screen facing away from the child as to not accidentally prime the child if he or she could read.

Before starting the session, the experimenter explained the “game” by saying, “We are going to play a picture game today.” Then the experimenter set up a demonstration task, using categories that the child was not tested on (primates versus non-primates). The experimenter then introduced “magic pencil” (the stylus) and told them that they were supposed to use it to touch the screen and make their choices. Then, she stated, as the demonstration images appeared, “You are going to see two pictures on the computer screen. Your job is to pick the picture that makes the computer beep.” She then chose the correct image and stated, “If you make the computer beep, a silly video will play and you will get a sticker in your sticker bag.” She then stated, as she chose an incorrect image, “But, if you make the computer buzz, you won’t get a sticker, but you
can keep trying and try to get stickers next time.” Then the experimenter allowed the child to try. She handed the child the stylus and asked them, “Which one do you think will make the computer beep so we can see a silly video?” The child was allowed to choose until they got one correct, and guidance was provided if necessary. The experimenter then asked the child if he or she understood how to play and if so, began the session. If not, the child was allowed to ask questions to clarify the instructions.

The child was then required to make an orienting response by touching a black screen with the stylus to initiate the first trial. After they touched the screen, two images appeared, and the child was to choose one of them using the stylus. If the child did not immediately make a choice, the experimenter prompted he or she to pick the picture they thought would make the computer beep with the “magic pencil.” The experimenter gave the child no cues as to what was correct or incorrect. If the child asked the experimenter any questions regarding which one was correct, the experimenter simply said, “Which one do you think is right?” There was no time limit set in the computer program for them to make a response. If after thirty seconds the child had made no attempt to respond, the experimenter asked the child if he or she still wanted to play the game to make sure they still wanted to participate.

If the image chosen by the child represented an image from the S+ category, the computer emitted a pleasant tone, the amusing video clip played, and the experimenter put a sticker in the child’s sticker bag and told them “Good job!” If the child made an incorrect choice, the computer produced an unpleasant buzzing sound, the screen became black and displayed the trial number and the word incorrect, and the experimenter said to the child “Oops! That’s okay! Try again!” There was no correction procedures if the trial
was incorrect; therefore, the next trial proceeded as usual until all twenty trials were complete for that session. The next discriminations were then administered as determined by random test orderings. The child was reminded of the task instructions prior to each new discrimination task if deemed necessary from their performance and attention level.

The procedure for all discriminations was the same. The only prompt the experimenter gave was reminding them to pick the picture that they think would make the computer beep if they did not make a choice after approximately ten seconds between trials. The experimenter responded to any questions regarding which picture was correct with, “Which one do you think is right?” After completion of a set of three tasks (emotion or natural discriminations), the child was asked if he or she needed to take a break. If so, a three to five minute break began where the child was allowed to go to the restroom, stand up and stretch, etc. If not, the experimenter began the next three discrimination tasks. If the child was fatigued or did not want to keep participating, the session was discontinued for the day and restarted on the next day of testing.

*Procedure for the IED-II*

After the child was finished with all six concept discrimination tasks, the measure of language complexity was administered. There was a possible total composite score of 224 for the measure. The child was brought into the same room as was used in the computer tasks and was seated either beside or cattycorner to the experimenter. The child was given a new sticker bag to hold his or her stickers and was told that we were going to play a word game. The first task that was administered was a receptive vocabulary test (twenty-seven possible points) where the child was shown a page of nine images and asked to point at the image that depicted the word produced by the experimenter. There
were twenty-seven images total on three pages. The words for each page were presented in a pseudo-random order for each participant, meaning that the experimenter asked the child to point to the images in whatever order she determined, but not the same order each time. The child received stickers after completion of this task, regardless of performance.

The same twenty-seven images were used for the productive vocabulary measure, but instead of pointing to the image as the experimenter labeled them, the child was asked to name the images as the experimenter pointed at them. Again the images were pointed to in a pseudo-random order. After completion of the initial task, the children were asked twelve questions regarding the images on each page (six for page one and three for pages two and three) to test for deeper comprehension of the meaning and utility of the words/items. For example, the child was asked to point to all the pets shown on the first page of images and asked which animals had two feet and two wings on the third page. For both tasks, if the child was incorrect on three consecutive items, the testing was discontinued. The questions were asked after the productive vocabulary task and were added into that component score (thirty-nine possible points towards composite score). The child received stickers after completion of this task, regardless of performance.

The child’s knowledge of plurals (-s) and present participles (-ing), prepositions (up, down, in[side], and out[side]), and irregular plural nouns (feet and mice) were measured by asking the child questions about images (eight possible points). For the plural –s, the experimenter pointed to an image of two kittens and asked the child, “What are these?” If the child responded with cats, kittens, kitty-cats, or kitties, the response was counted as accurate. If the child responded with another animal, but with the correct
plural suffix (-s), the experimenter asked them, “What are those again?” with a quizzical look on her face to see if that would elicit the correct label, but the response was counted as accurate and they moved on to the present participle –ing image. If the child did not use the correct suffix, they were given the option to re-try with a second image depicting two keys. The same process was followed with that image. Also, the same procedure was followed for the images for the –ing suffix, except the question was phrased as what is the person in the image doing. The first image was of a little boy splashing in a puddle, and the child was asked, “What is this little boy doing?” Any response using the suffix –ing was accepted as accurate. If the child did not use the proper suffix, the experimenter asked a similar question about the second image of a little girl walking and holding a doll. These images could add two possible points towards the composite score.

To assess preposition use, an image depicting a boy going upstairs and a girl going downstairs was shown. The experimenter pointed to the boy in the picture and asked the child, “What is this little boy doing?” Then the child was asked, as the experimenter pointed to the girl, “What is this little girl doing?” The accurate response was supposed to contain up and down. Each question was considered a separate response contributing to the composite score. Next the experimenter directed the child’s attention to a picture depicting one kitten inside a box and one kitten outside a box. This image assessed the child’s use of the prepositions in(side) and out(side) by pointing to the kitten in the box and asking the child, “Where is this kitten?” then pointing to the kitten outside of the box and asking, “Where is THIS kitten?” If the child used the proper preposition, it was counted as accurate and contributed two points towards the child’s composite score.
The final part of this section examined the child’s use of irregular plural nouns. The child was first shown an image of two sets of feet. The experimenter pointed to the feet and asked the child, “What are these?” One point towards the composite score was added if the child responded with the word “feet,” not foots, feets, or foot. The second image depicted three mice, and the experimenter circled all three with her finger while asking, “What are these?” If the child called them mice, not mouses or mouse, then a point was added to their composite score. If the child called the animals rats, the experimenter pointed at one of the mice and said, “This is a mouse, so what are these called?” If the child persisted in calling the animals rats, the response was counted as inaccurate. The child received stickers after completion of this task, regardless of performance.

As a part of the child’s receptive and productive vocabulary score, the next task assessed the child’s knowledge of parts of the body. For the receptive task, the experimenter told the child that we are going to play a silly game where they pointed to things or showed me things. The child was then asked to point to or show the experimenter individual parts of their body. There were twenty-nine possible points available for this section. The parts of the body used were as follows: eyes, nose, mouth, hair, feet, ears, tongue, head, legs, arms, fingers, teeth, thumbs, toes, neck, stomach, chest, back, knees, chin, fingernails, heels, ankles, jaw, shoulders, elbows, hips, wrists, and waist. If the child missed three items consecutively, testing for this section was discontinued. For the productive section of the parts of the body, the experimenter would point to the part of the body she wanted the child to label and ask, “What is this?” All of the same parts of the body were used as in the receptive section except tongue and teeth;
therefore, this section contributed twenty-seven possible points towards the child’s composite score. The same discontinue rule was used in the productive section. The child received stickers after completion of this task, regardless of performance.

Also as a part of productive and receptive vocabulary, the next task measured quantitative concepts. This measure included questions regarding the following quantitative contrasts: big/little, one/one more, full/empty, heavy/light, tall/short, fat/thin, fast/slow, all/none, long/short, large/small, deep/shallow, thick/thin, wide/narrow, more/less, many/few, huge/tiny, and most/least. To assess the child’s comprehension of the contrast between big and little, an image of two big cats and two little cats was shown to the child. The experimenter asked, “Show me the big cat. Which cats are big?” If the child pointed to the big cats, the response was counted as accurate. Then the experimenter asked, “Show me the little cat. Which cats are little?” If the child pointed to the little cats, the response was counted as accurate. This image was the only one provided by the author.

The remaining contrasts were assessed using either a PowerPoint presentation depicting images that fit the criterion provided by the author or by using real stimuli. For instance, to assess one and one more, the experimenter placed four-six paper clips in front of the child then asked the child, “Would you please hand me one of these?” If the child handed the experimenter only one of the paper clips, the response was counted as accurate. Then the experimenter asked the child, “Would you please hand me one more?” If the child handed the experimenter only one more of the paper clips, the response was counted as accurate.
Some items were asked in order to measure receptive vocabulary while others were asked in a way to assess the child’s ability to produce quantitative words. As an example, to assess the child’s concepts of all versus none, the experimenter would ask the child, “How many cars on the road have wheels?” If the child responded with an answer containing the word “all,” the response was counted as correct. Then the experimenter would ask them, emphasizing the silliness of the question, “How many cars on the road have legs?” If the child’s answer contained the word “none” or words ”not any,” it was counted as correct. An answer of “no” was not counted as correct as it is not a quantitative term. If the child made two consecutive incorrect responses, testing was discontinued for this section. In total, these items could contribute thirty-four possible points towards the child’s composite score. The child received stickers after completion of this task, regardless of performance.

In order to assess some of the more applied or practical aspects of language, the classifying task examined the child’s understanding of the following sixteen semantic categories: animals, toys, means of travel, clothes, foods, dishes, people, pets, numbers, things to read, fruits, vegetables, tools, furniture, shapes, and musical instruments. Each page contained twelve images, three of each semantic category. The experimenter would then ask the child to point to all the category members on each page. In order for the child’s response to be considered correct, he or she must have chosen either all three of the category members or two of three of the category members. If the child chose none of the three possible members or only one of the three members for two consecutive categories, testing was discontinued for this section. The child could earn a possible
sixteen points towards his or her composite score in this section. The child received stickers after completion of this task, regardless of performance.

The next section also assessed the child’s practical language comprehension and production. In this section, the child was asked what he or she should do given a specific circumstance. There were fourteen questions including questions such as, “What do you do when you are sleepy?” and “What should you do if you cut/get a boo boo on your finger?” The experimenter counted the child’s response as correct if they were appropriate given the situation (e.g., “go take a nap” and “get a Band-Aid”). If the child was inaccurate on two consecutive questions, testing was discontinued for this section. The child received stickers after completion of this task, regardless of performance.

The final section was an additional measure of the child’s practical understanding and utilization of language by assessing the child’s knowledge of the use of common objects. There were two pages of images, one with eight images (chairs, cars, beds, houses, pencils, dishes, coats, and stoves) and the second with seven images (book, phone, scissors, key, refrigerator, airplane, and clock). To assess the child’s expressive understanding, the experimenter would point to each image and ask the child, “Why do we have _______?” The child was to respond with some function of the item depicted in order for their response to be counted as accurate. If the child responded inaccurately to three consecutive questions, testing was discontinued for the receptive component of the task. After completion of the expressive component of this task, the child’s receptive ability to indicate the item that matched the description of the use of each of the items was measured. The experimenter would ask the child, “Show me what we (e.g., sleep on).” This request was made for each of the items on the page in a pseudo-random order.
The same discontinue rule was used for the receptive component. The child could earn thirty possible points total towards their composite score during this task. The child received stickers after completion of this task, regardless of performance.

Data Analysis

Variables in the Model

The dependent variable was performance, in the form of percent correct on each of the three natural concept discrimination tasks and the three emotion concept discrimination tasks. The within-subjects independent variables were type of stimulus (natural, emotion) and level of abstraction (subordinate, basic, superordinate). Age, gender, and composite language complexity score were the between subjects independent variables.

Analyses for the Hypotheses

To test the main hypotheses a mixed model factorial ANOVA was conducted with the specific predictor variables of interest for each hypothesis, and the dependent variable entered in the model. As language complexity is a continuous variable, it was entered in the model first as a covariate then a specific model was built which allowed for the interactions between it and the other independent variables to be investigated. This technique is highly utilized in social psychology research and forces SPSS to treat the continuous variables as a discrete variable in the model (Wuensch & Everhart, 2006).
CHAPTER III

RESULTS

Tests of the Language as an Augmenter Hypothesis

A mixed model factorial ANOVA of performance on the concept tasks with language complexity, age, and sex as between subjects factors, and type of concept (natural, emotion) and level of abstraction (subordinate, basic, and subordinate) as within subjects factors indicated that, contrary to the language as an augmenter hypothesis, there was no main effect of language complexity, $F(2, 130) = 2.051, p = 0.137$. There were also no significant main effects of age, $F(3, 65) = 0.681, p = 0.567$, or sex, $F(1, 65) = 0.628, p = 0.431$. Refer to Appendix A for a full table of descriptive statistics for the model. Table 1 provides the descriptive statistics for language complexity as a function of sex. Based on these statistics, it is unlikely that the lack of effect of language complexity is due to a lack of variability in the language complexity variable.

Table 1

*Language complexity by sex.*

<table>
<thead>
<tr>
<th>Sex</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>162.844</td>
<td>34.915</td>
</tr>
<tr>
<td>Females</td>
<td>167.191</td>
<td>40.164</td>
</tr>
<tr>
<td>Total</td>
<td>165.311</td>
<td>37.795</td>
</tr>
</tbody>
</table>

Figure 4 shows performance as a function of type of concept, level of abstraction, and sex of the child.
Interestingly, there was an interaction between concept type and sex of the participant, $F(1, 65) = 6.481, p = 0.013$. Follow up ANOVAs for each concept type including sex, language complexity, and levels of abstraction as variables, indicated that there was no effect of sex on performance for the natural concept discriminations, $F(1, 65) = 0.603, p = 0.44$, whereas there was a main effect of sex on performance for the emotion concepts, $F(1, 65) = 4.133, p = 0.046$, with females performing significantly better ($M = 10.635, \text{SEM} = 0.42$) than males ($M = 9.384, \text{SEM} = 0.463$) at discriminating emotions. Figure 5 graphically illustrates this relationship.
Tests of the Circumplex Model of Emotions

Tests of the Circumplex Model for the Emotion Category Discrimination would predict the best performance on the basic level concept discrimination (positive versus negative). A repeated measures ANOVA of performance on the Emotion Concept Task contrasting the three levels of abstraction (subordinate, basic, and superordinate—including subjects factors) and including age and sex as between subjects factors indicated a lack of support for the model, $F(2, 146)=3.381, p=0.037$, in that the best performance was actually with the subordinate level discrimination (angry versus sad, $M = 10.811, SD = 3.510$), and lowest on the basic level discrimination ($M = 9.446, SD = 2.445$).

Post-hoc analyses, using Tukey’s least significant difference (LSD) tests, indicated that performance at the superordinate level of abstraction differed significantly from performance at the basic level of abstraction ($LSD = 1.169, p = 0.027$) with
performance at the superordinate level of abstraction better than performance at the basic level. Performance at the subordinate level also differed significantly from performance at the basic level (LSD = -1.141, p = 0.022) with performance at the subordinate level better than performance at the basic level. Taken together, the results provide some support for the Innateness Universality Hypothesis. Of note, however, the only scores that significantly differed from chance level performance (ten correct out of twenty trials) using one-sample t-tests were three-year-olds’ superordinate level performance, \( t(41) = 2.423, p = 0.02 \), and four-year-olds’ subordinate level of performance, \( t(22) = 3.166, p = 0.004 \) when categorizing on the basis of emotions. Both were significantly higher than chance level performance. Figure 6 graphically illustrates the relationship between performance as a function of levels of abstraction in the emotion concept discriminations.

* Figure 6. Number correct by level of abstraction for the emotion concept discrimination tasks, where the horizontal black line indicates chance level performance of ten correct out of twenty total trials. The error bars represent the standard error.
Natural Concept Discrimination Performance

One sample t-tests performed on the natural concept level discrimination performances by age of the participants showed that only four-year-olds’ superordinate level performance was significantly above chance, $t (22) = 2.426, p = 0.024$. 
CHAPTER IV

DISCUSSION

The language as an augmenter hypothesis suggests that language, when present and intact, acts as a supplement to thought. Words provide anchors for concepts, providing the organizational structure upon which a concept can be built (Gelman & Markman, 1987; Plunkett et al., 2008; Wolff & Holmes, 2011; Zhang & Schmitt, 1998). In keeping with this hypothesis, the current study predicted that a higher language complexity score would predict higher performance on the concept discrimination tasks regardless of age, sex, type of concept (natural or emotion), and level of abstraction (subordinate, basic, and superordinate). However, the results provided no support for this hypothesis, with no significant main effect of language on concept discrimination performance for either the natural or emotion concept tasks.

Based on the current methodology where no words were provided for the categories, supporters of the LRH could argue that the reason for the lack of an observed relationship between language complexity and categorization could be due to the fact that children need a label upon which to construct the concept (Lindquist et al., 2006; Johnson et al., 1992; Russell & Bullock, 1985; Wolff & Holmes, 2011). Perhaps, language cannot be as readily used as an augmenter unless it is explicitly present during the task itself. Even if the child has the word in their verbal repertoire, it could be argued that in order to properly assess the effect of language on concept formation, the word anchoring the concept should be provided to the child before the task, allowing for a more direct test of the hypothesis. The effect of providing a verbal label could easily be assessed if, in addition to the IED-II language measures, one group of children is provided with the
corresponding verbal label for the categories prior to beginning each concept discrimination task. A control group would not be provided with verbal labels, as was the case for the current participants. If language was used as an augmenter, aiding in the discrimination and formation of concepts, the performance of the group given the labels for the categories should be greater than performance of the group not provided with the labels.

Alternatively, children could be asked to generate labels themselves during the task in an experimental group, and performance could be compared based on the facility and/or accuracy with which they performed the labeling task. One could also compare the performance of children with and without the capacity to generate labels, but it would be difficult to do so without the confound of age or other developmental delays. By the language as an augmenter hypothesis, being able to generate labels for the images could help facilitate the concept discrimination as the labels could provide an anchoring structure upon which to build the concept (Wolff & Holmes, 2011). Future work should investigate these possibilities.

It is also possible that language could play far less of a role than would be suggested by the LRH and the language as an augmenter hypothesis. The evidence from nonhuman animals, children with ASDs, and children born deaf without exposure to sign language suggests that natural concept formation is possible without linguistic influence (e.g., Gasteb et al., 2006; Goldin-Meadow et al., 2005; Roberts & Mazmanian, 1988). Premack (1983) suggested that the capacity for a symbolic system endows humans, and perhaps symbol-trained animals, with the unique ability to think in abstract terms, indicating that nonhuman animals should not be able to form abstract, superordinate level
categories. Research has indicated, however, that several species of nonhuman animals can, indeed form superordinate level categories (Fabre-Thorpe et al., 1998; Roberts & Mazmanian, 1988; Vonk & MacDonald, 2002; Vonk et al., 2012), suggesting that language may not be as necessary as Premack (1983) and supporters of the LRH implicate. In addition, supporters of the IUH and the emotion recognition system assert that emotion discrimination is present and intact from birth, downplaying the impact of linguistic input on the ability to judge emotion based on facial expression alone (Ekman, 1993; Izard, 1994). The fact that no relationship was found between language complexity and concept formation lends some support to the idea that concept formation, for both natural and emotion categories, could be an innate capacity impacted by experience with the environment and less reliant on language than is suggested by supporters of the LRH and the language as an augmenter hypothesis (Cimpian & Erickson, 2012; Mandler, 1992).

One interesting interaction between concept type and sex emerged from the data whereby females scored significantly higher on the emotion concept discriminations than males. These results are supported by findings suggesting an early difference in the processing of facial expressions, where females are better able to decode and process emotions based on facial expressions and at an earlier age than males (Boyatzis, Chazan, & Ting, 1993; McClure, 2000; Schmidt & Cohn, 2001). These early differences in facial expression processing could be explained from a socialization perspective, suggesting that parents and society, at least in western societies, place greater emphasis on emotional sensitivity and responsiveness for females in comparison to males. Males experience a less emotionally enriched environment from birth onwards in comparison to females.
(McClure, 2000; Schmidt & Cohn, 2001). From an evolutionary perspective, as females tend to be the primary caretakers of infants, they should have evolved specialized skills to aid in the survival of these infants. A very important skill for survival as social primates is the use, recognition, and interpretation of facial expressions as they serve as important nonverbal communicative cues from birth onwards (Babchuk, Hames, & Thompson, 1985; Hamson, van Anders, & Mullin, 2006). Therefore, the current results, framed in a social and evolutionary perspective, appear to support previous findings, suggesting a female superiority for emotion recognition based on facial expressions.

Exploring performance on the emotion concepts further, the tenets of the Circumplex model of emotions were tested. The Circumplex model of emotions (Russell & Bullock, 1985) suggests that emotion categories based on different facial expressions fall into two bipolar dimensions based on valence (pleasure-displeasure) and vary in degree of arousal early in life. This model is an LRH model in that it is argued that exposure to language (learning the words for the different emotions) then differentiates the categories, creating the fully discriminated emotions we have as adults (Carroll & Russell, 1996; Russell & Bullock, 1985; Russell & Widen, 2002; Widen & Russell, 2003, 2008, 2010). In contrast to this model, the IUH suggests that emotion recognition based on facial expressions is an innate capacity based on the possession of an emotion recognition system that is present and intact from birth (Ekman, 1999; Izard, 1994).

The current project tested the premise of the Circumplex model that emotion categories begin in undifferentiated, valence-based categories of pleasure and displeasure by establishing the basic level category of positive (happiness and surprise) and negative (anger and sadness) emotions. If the Circumplex model is an accurate
decoration of early emotion concepts, the results should have shown the best performance for the basic level discrimination. In contrast, the results showed that the best performance was obtained with the subordinate level discrimination of anger versus sadness. Importantly, post-hoc analyses indicated that the basic level category differed significantly from both the subordinate and superordinate level categories. These results indicate that, even at very young ages (two to five years), emotion concepts, specifically the negative emotions of anger and sadness, appear to be differentiated, providing some support for the IUH and the emotion recognition system. More work should be done to examine discriminations between all basic emotions. Evolutionarily speaking, having a quick, efficient method for interpreting emotional states from birth would be adaptive in a social species. Through facial expressions, humans have an efficient means for conveying information about affect without the necessity of language (Ekman, 1999; Izard, 1994). The current study provided a direct test of the Circumplex model utilizing a nonverbal task, methodology that is unique in the current literature.

In using a nonverbal task, the current study allows for assessing concept discrimination ability independently of language ability. Many other concept discrimination tasks, both for natural and emotion concepts (e.g., Carroll & Russell, 1996; Gelman & Markman, 1987; Rosch et al., 1976; Russell & Bullock, 1985; Russell & Widen, 2002; Widen & Russell, 2003, 2008, 2010) relied heavily on both receptive and expressive language abilities. The children were given fairly complex verbal instructions prior to the tasks and many tasks required the children to respond verbally. The current study differentiates itself by using limited verbal instructions and requiring nonverbal responses from the child. These aspects of the task support its utilization with very young
children, and children with limited verbal abilities. An additional benefit to a nonverbal task is that it allows for more direct comparisons of abilities between humans and nonhuman animals. This basic task has been successfully utilized with nonhuman animals (Vonk et al., 2012; 2013; Vonk & MacDonald, 2002, 2004). In the nonhuman animal studies, the animals were tested continuously until they reached a set criterion at which point they were provided with a transfer task. Here, the children participated in only a single session to test for spontaneous rather than learned abilities. The methodology could easily be adapted to allow for direct comparisons to be made. Truly comparative methodologies are rare, but are necessary for understanding the phylogeny of cognition.

Although the inclusion of a nonverbal concept task is a benefit of the current study, it also has a downside. The children’s scores were on average close to chance level performance (ten out of twenty trials correct). One-way t-tests showed that the only performances that were significantly above chance level performance were: three-year-olds’ performance on the emotion superordinate level discrimination (emotion versus neutral) and four-year-olds’ performance on the natural superordinate level discrimination (animals versus nonanimals) and the emotion concrete level discrimination (anger versus sadness). These scores indicate that the children did not successfully discriminate the concepts. It could be that the tasks, without explicit instructions, were too difficult for the age range tested. It could also be that if the children were given more sessions of the task, they could eventually discriminate the concepts at levels significantly above chance, but it is important to note that I was specifically interested in their spontaneous ability to discriminate the concepts. Allowing them to learn to discriminate the concepts would not be relevant to the main goal of the current
study. Furthermore, as mentioned previously, providing children with explicit
instructions prior to completing the tasks (i.e., labeling the categories) could be extremely
interesting and may more directly test the question asked by the current study, but doing
so would also impact how the child responds, moving away from innate ability and
looking more at a derived skill. The current methodology allows for the investigation of
children’s innate ability to discriminate concepts as it relates to their language abilities.

An additional strength of the current study is the utilization of language
complexity as the measure of language ability instead of focusing on the child’s receptive
and expressive language ability only. Human language is, arguably, the most complex
system of communication in the animal kingdom; it is far more than simply
understanding and producing labels for objects. By utilizing a more inclusive language
measure, the variable becomes more representative of the child’s actual language ability,
increasing the external validity of the measure. In utilizing language complexity instead
of more traditional measures, more complex analyses of the role of language in cognitive
processes could be made.

Also increasing the external validity of the study is the use of facial expressions
that were not overly standardized or computer-generated prototypical examples.
Although examining processing of artificial and prototypical facial expressions has its
place in the study of facial expression processing, the facial expressions that humans
encounter on a daily basis are not prototypical or perfect examples of the facial
configurations for each emotion. They are spontaneous expressions of emotion that can
be both true depictions of the emotional state of the individual or misleading expressions
meant to deceive the receiver of the information (Izard, 1994). The images used in this
study were naturalistic photographs gathered from internet search sites (e.g., Google Image) and judged as representing the intended emotion by laypeople (college undergraduates). These facial expressions could be more accurate representations of what children experience in their everyday lives relative to prototypical and/or artificial facial expressions, potentially providing a better measure of their abilities to judge emotions based on facial expressions.

Although the current study failed to find a significant relationship between children’s language complexity and their concept discrimination abilities, it is possible that children’s language abilities have less of an impact than does the language that they hear in their environments, specifically from their parents/caregivers. Research has indicated that parental, specifically maternal, language use has an effect on the child’s theory of mind (Cheung, 2010; de Rosnay et al., 2004; Watson et al., 2000) and emotion understanding (de Rosnay et al., 2004; Martin & Green, 2005; Mcquaid et al., 2007). Less is known about the impact of parental language use on natural concept formation. Future research should investigate the role of parental language use on natural concept formation in children. There could be sex differences in the types of labels used more frequently by parents. It could be that parents use more natural category labels when interacting with male children whereas they might use more emotion labels when interacting with female children, which could also help to explain the sex differences found in the current study. This possibility has been supported by research conducted with emotion recognition showing that mothers tend to use more elaborate emotion language with female children in comparison to male children (Cervantes & Callanan,
Less is known about natural categories, necessitating further investigation.

The main finding of this study is that language complexity appears to have no significant relationship to concept discrimination in young children - results that contradict the language as an augmenter hypothesis set forth by supporters of the LRH. These results provide some support for the arguments that the ability to organize information into concepts is an innate skill, not dependent on language (Cimpain & Erikson, 2012). The results also support the bottom-up argument for the formation of concepts, suggesting that children actively build concepts from perceptual features as they are perceiving the world (Cimpian & Erickson, 2012; Mandler, 1992). Perceptual features might play a more dominant role in concept formation for very young children, in contrast to linguistic input.

Despite the lack of relationship between language and concept formation found in this study, I hesitate to state that there is no relationship between language and concept formation. Language is a powerful force in a child’s life; children are exposed to it from the time their brains can perceive auditory information in utero and throughout their lives. It is possible that while perceptual features dominate how children form concepts early in life, that exposure to language could shape these concepts as the child develops. For more abstract concepts that involve less easily observable perceptual differences, language could play a stronger role in helping to anchor those concepts than for concepts easily formed by perceptual similarity (Vonk & Povinelli, 2006). Also for relational concepts, concepts formed by sharing common relational structures instead of common properties (e.g., a bird and a nest), language appears to help point out those underlying common
structures for young children (Bandurski & Galkowski, 2004; Gentner, Anggoro, & Klibanoff, 2011; Gentner & Kurtz, 2005). These findings suggest that we have merely just begun to scratch the surface of language’s role in concept formation, paving the way for a wide range of future investigations.
# APPENDIX A

## DESCRIPTIVE STATISTICS FOR THE MODEL

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<th>Natural</th>
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<tbody>
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<td></td>
<td>Age</td>
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<td>Basic</td>
<td>Superordinate</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>5.667 (3.055)</td>
<td>14.0 (2.646)</td>
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<tr>
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<td>10.625 (2.217)</td>
<td>10.563 (3.54)</td>
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</tr>
<tr>
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<td>9.364 (2.618)</td>
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</tr>
<tr>
<td>5</td>
<td>11.5 (2.121)</td>
<td>10.5 (2.121)</td>
<td>10.0 (1.414)</td>
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<td></td>
<td></td>
</tr>
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<td><strong>Total</strong></td>
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<td>Age</td>
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<td>Basic</td>
<td>Superordinate</td>
</tr>
<tr>
<td><strong>Males</strong></td>
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<td></td>
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<tr>
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<tr>
<td><strong>Total</strong></td>
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<td></td>
</tr>
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<td>10.784 (2.65)</td>
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</table>

*Note: The statistics presented are in the following format: mean (standard deviation).*
Letter to Parents from Facilities

October 22, 2013

Dear Parents,

As you all know, we take our positions as caregivers/educators of your children very seriously and we love our work. We are continually updating and improving our practices and materials to provide the best for your children’s growth and development.

That said, Stephanie E. Jett is a Doctoral Student in the department of Psychology at the University of Southern Mississippi, who is conducting a dissertation in the area of cognitive development. She recently approached us with a research idea for our children. We would like to invite your child to participate in two 30-40 minute (on average), one-on-one session to learn about their understanding of natural and emotion concepts/categories and how these abilities interact with language. It is suspected that language affects how early language learners (two- to five-year-olds) group things into categories, but the particular aspects of language that contribute to this categorization remains unclear. If we can better understand this relationship between language and concepts, we will better understand how concepts for natural categories and emotions are formed and utilized. Please see the attached University of Southern Mississippi consent form with more of the research specifics and procedures.

Our center approves the participation of your child in these computer-testing sessions. The sessions will take place during the regular school time in an area adjacent to the classroom over the next several weeks. Your child will not miss any free or outside play time, or any critical testing material. Feel free to contact Stephanie or her supervisor, Dr. Heidi Lyn, with any questions about the project (email: stephanie.jett@eagles.usm.edu or cell: 251-490-3433; Dr. Lyn email: heidi.lyn@usm.edu or office: 228.214.3234).

If you would like your child to participate, please sign the attached consent form allowing your child to participate and return to us this week.

Thank you in advance for your assistance.
INFORMED CONSENT FORM

Title of Research Project: LNEC12

Project Contact: Stephanie E. Jett, M.S., Experimental Psychology Ph.D. Program, The University of Southern Mississippi. 251-490-3433 or stephanie.jett@eagles.usm.edu.

Purpose of the Project: The purpose of this work is to investigate the role of language complexity on natural and emotion concept formation in early language learners (two- to five-year-olds). Using six (three natural and three emotion) tasks presented on a touch screen computer, children will be asked to choose one of two images that are presented simultaneously that represent different concepts. Only one concept will be considered correct. Three of the tasks will present the children with pictures of different animals and three tasks will present them with pictures of human emotion expressions. We are interested in how language complexity might predict performance on these categorization tasks. To assess language complexity we your child will be given an abbreviated version of the Brigance Early Childhood Screen II. This test measures aspects of language such as receptive and productive vocabulary, irregular noun use, quantity terms, etc. and will allow for a more comprehensive understanding of language’s effects on concept formation.

Procedures: Your child will be asked to complete the six concept discrimination tasks described above on a touch screen computer. I will explain the tasks by stating that, “We are going to play a picture game on the computer. Your job is to choose the picture that makes the computer beep (correct choice).” All six tasks should take approximately 30-40 minutes to complete. Additionally, the Brigance will be administered in a separate session after completion of the computer tasks and will take approximately 20-30 minutes to complete. The child will be allowed to stop participating at any point and will not be penalized in any way. If the child does not complete all the tasks in one session, an additional session may be conducted to finish the remaining tasks if the child agrees to continue to participate. Performance on these tasks will not be used in any way to evaluate your child’s intelligence or academic performance. These two testing sessions will be conducted one-on-one with me in an office/classroom adjacent to the classroom area during regular school hours.

Potential Risks or Discomforts: The risks involved for your child participating in the project are negligible. It is expected that they will find the tasks fun to complete. There is a chance they become discouraged if they select the wrong choices. However, they will be allowed to stop at any time if participating in the tasks makes them uncomfortable or if they refuse to respond.

Potential Benefits: Your child should find the tasks fun to complete. Their responses are not graded by the teachers at ______________________, nor will they be used in any kind of assessment of their academic progress. However, your child’s participation will allow psychologists to better understand the particular way that language impacts the formation of these concepts.

Voluntary Participation: The participation of the children is entirely voluntary, and participants can withdraw from the project at any time. Children will be asked to print their name or form some kind of
identifying mark on an assent form to indicate their intent to participate. Children will be told the purpose of the project and will be given the opportunity to ask questions and take breaks at any point during the one-on-one session which will last, on average, 30-40 minutes. The session to administer the Brigance should take on average, 20-30 minutes. Additionally, you, as the parent, may refuse to respond to any questions on the demographic survey and/or withdraw your participation at any time without penalty for you or your child.

Protection of Confidentiality: All of the information that is collected will be kept strictly confidential. An ID number will be created for your child at the beginning of the study. All data is stored according to the ID #, not participant names. At the conclusion of data collection for this study, all identifying information will be deleted. Data gathered from the present study will be stored in a secure location for six years, at which time it will be destroyed. THE DATA MAY BE VIEWED BY THE PRINCIPLE INVESTIGATOR AND HER MENTOR. ONCE RESULTS HAVE BEEN LINKED FROM AGGREGATE FILES, IDENTIFYING INFORMATION WILL BE REMOVED, SUCH THAT NO ONE WILL VIEW NAMES ASSOCIATED WITH THE DATA. When information is used in research reports and journal articles, it is only done in a way that no one could know that the information is about any specific student.

PLEASE KEEP THIS PORTION FOR YOUR RECORDS

This project has been reviewed by the Human Subjects Protection Review Committee, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research subject should be directed to the chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive Box #5147, Hattiesburg, MS 39406, (601) 266-6820.

I HAVE BEEN FULLY INFORMED OF THE ABOVE-DESCRIBED PROCEDURES WITH THEIR POSSIBLE BENEFITS AND RISKS, AND I GIVE PERMISSION FOR THE PARTICIPATION OF MY CHILD.

Signature ______________________________________ Date ____________________

Printed Parent Name ______________________________

Name of Child ________________________________

PLEASE RETURN THIS PORTION TO THE FACILITY

Parent Child Questionnaire for LNEC12 Project

*NECESSARY INFORMATION:

*Child’s Name ________________________ *Date of Birth __________________

*Languages Spoken at Home:___________________________________________________________

*Does your child have any diagnosed language disorders (circle)?  Yes or No

If yes, please explain:_________________________________________________________________
*Does your child have any diagnosed intellectual disorders (circle)? Yes or No

If yes, please explain:_____________________________________________________

Optional Information:

Please indicate (by circling the appropriate response) your child’s birth order:

a) Only child
d) Third child
b) First child
e) Fourth child
c) Second child
f) Other: Explain

How many brothers and sisters (siblings) does your child have? Please list the ages of each:

a) Full siblings and their ages: _______________________________________
b) Half siblings and their ages: _______________________________________

Please indicate the living arrangements in your home:

a) Single mother home
c) Two parent home
b) Single father home
d) Shared custody between parents
e) Other: Explain ___________________________________________________

What is your annual household income?

a) Below $30,000
d) $70,100 - $90,000
b) $30,000 - $50,000
e) Above $90,000
c) $50,100 - $70,000

What is the ethnic background of your child?

a) Caucasian (white)
d) Asian
b) African American
e) Native American
c) Hispanic
f) Other: Explain_____________________________________________________

PLEASE RETURN THIS PORTION TO THE FACILITY
University of Southern Mississippi
Statement of Informed Assent

Participant’s Name ________________________________

The purpose of these activities is to help me learn more about you and how you think, so we can understand more about your brain. I am going to play some picture games with you on the computer that will show me how you put things into groups.

Some children may feel funny about doing some of these tasks. This is ok. You do not have to play the games if you do not want to. You can decide to stop working with me at any time, or to take a break whenever you want to. I will let you take a break between the different tasks. Also, the choices you make will not be shown to your teachers, parents, or friends. They will be completely private.

If you agree to help us with this study, please print your name on the line below.

_________________________________________  ______________________
Your Name                                      Date
APPENDIX D

INSTITUTIONAL REVIEW BOARD NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the “Adverse Effect Report Form”.
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 12102403
PROJECT TITLE: LNEC12
PROJECT TYPE: Dissertation
RESEARCHER/S: Stephanie E. Jett
COLLEGE/DIVISION: College of Education & Psychology
DEPARTMENT: Psychology
FUNDING AGENCY: N/A
IRB COMMITTEE ACTION: Expedited Review Approval
PERIOD OF PROJECT APPROVAL: 11/01/2012 to 10/31/2013

Lawrence A. Hosman, Ph.D.
Institutional Review Board Chair
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the “Adverse Effect Report Form”.
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: CH12102403
PROJECT TITLE: LNEC12
PROJECT TYPE: Change in a Previously Approved Project
RESEARCHER(S): Stephanie Jett
COLLEGE/DIVISION: College of Education & Psychology
DEPARTMENT: Psychology
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 10/29/2013 to 10/28/2014

Lawrence A. Hosman, Ph.D.
Institutional Review Board
APPENDIX E

PERMISSION TO REPRODUCE COPYRIGHTED ILLUSTRATIONS

On Mon, Oct 13, 2014 at 11:45 AM, Stephanie Jett <stephanie.e.jett@gmail.com> wrote:

Thank you, Dr. Russell! I very much appreciate it!

Stephanie

On Mon, Oct 13, 2014 at 11:42 AM, James Russell <james.russell@bc.edu> wrote:

I am delighted to have you use the figures.

James A. Russell  
Department of Psychology  
Boston College  
Chestnut Hill, MA  USA  
tel 617 552 4546  
fax 617 552 0523

On Mon, Oct 13, 2014 at 11:40 PM, Stephanie Jett <stephanie.e.jett@gmail.com> wrote:

Hello Dr. Russell,

My name is Stephanie Jett and I have just completed defending my dissertation at the University of Southern Mississippi under the direction of Dr. Jennifer Vonk (Oakland University, Michigan) and Dr. Heidi Lyn (University of Southern Mississippi). My dissertation is on the effects of language on natural and emotion concept formation and I based one of my hypotheses on the Circumplex Model of emotion recognition. I am emailing you first, to express my admiration of your work, and secondly to ask permission to use a figure from two of your manuscripts in my dissertation. I would like to use Figure 1 from Russell and Bullock (1985, p. 1291), Figure 3 from Russell and Widen (2002, p. 38), and Figure 2 from Widen and Russell (2008, p.294). Please let me know as soon as possible if I can utilize the figure. I sincerely appreciate your time and assistance! Take care!

Stephanie E. Jett, M.S.  
Comparative Cognition and Communication Lab  
University of Southern Mississippi Gulf Coast
REFERENCES


