Adjective Acquisition: Developmental Changes in the Use of the Shape Bias, Syntax, Shape Consistency, and Semantic Attributes.

Lenore Carol Frigo

Louisiana State University and Agricultural & Mechanical College

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ADJECTIVE ACQUISITION:
DEVELOPMENTAL CHANGES IN THE USE OF THE SHAPE BIAS, SYNTAX, SHAPE CONSISTENCY, AND SEMANTIC ATTRIBUTES

A Dissertation
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Lenore Carol Frigo
B.A., Marquette University, 1993
M.A., Louisiana State University, 1995
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# Table of Contents

Acknowledgments .................................................................................................................. ii

Abstract ................................................................................................................................... v

Chapter 1: Literature Review ............................................................................................. 1
  Lexical Principles Framework ...................................................................................2
  Learning Adjectives ............................................................................................... 10
  Summary ..................................................................................................................22

Chapter 2: Overview of Study and Predictions ................................................................. 23
  Overview ..................................................................................................................23
  Variables and Predictions .......................................................................................23

Chapter 3: Methods for Experiment 1 ................................................................................. 30
  Design ......................................................................................................................30
  Participants ..............................................................................................................30
  Stimuli ......................................................................................................................31
  Procedure ..................................................................................................................33

Chapter 4: Results and Discussion of Experiment 1 .......................................................... 34
  Results: Child Data .................................................................................................34
  Discussion: Child Data ...........................................................................................39
  Results: Adult Data .................................................................................................42
  Discussion: Adult Data ...........................................................................................47
  Comparing Children and Adults .............................................................................49

Chapter 5: Method for Experiment 2 ................................................................................... 58
  Participants ..............................................................................................................58
  Stimuli and Procedure .............................................................................................59

Chapter 6: Results and Discussion of Experiment 2 .......................................................... 60
  Results: Child Data .................................................................................................60
  Discussion: Child Data ...........................................................................................63
  Results: Adult Data .................................................................................................66
  Discussion: Adult Data ...........................................................................................72
  Comparing Children and Adults .............................................................................73

Chapter 7: Cross-Experiment Comparisons ....................................................................... 78
  Children ....................................................................................................................78
  Adults ........................................................................................................................82
  Summary ..................................................................................................................83
Abstract

When learning vocabulary, children must determine the meaning of each word that they hear. In hypothesizing about word meanings, children follow certain principles that simplify vocabulary acquisition. Among these principles are several that lead children to follow a shape bias. Under the shape bias, children assume that words extend to objects that share a common shape. This shape bias is useful for learning count nouns, which often include whole-object shape as an important aspect of meaning. However, the shape bias is not useful for the development of other word classes, such as adjectives.

In this study, several variables were examined in their relation to preschoolers’ and adults’ use of the shape bias in an experimental word learning setting. In response to syntactic frame, the shape bias was lower when novel words were presented as adjectives rather than as count nouns or when no words were presented, although this effect did not occur across all conditions tested. Responses varied when different attributes, namely colors, textures, emotions, or damages, were presented as the alternative to shape as the referent of novel words. Children found texture particularly salient, resulting in a low shape bias when texture was available. Adults found emotions to be most salient and color the least salient of the four domains. When novel words labeled two objects that contrasted in shape, use of the shape bias was lower than when words labeled two identical objects. When responses to unfamiliar and familiar objects were compared, adults showed a greater shape bias when unfamiliar objects were labeled, as predicted by several word learning principles. Children in contrast showed a greater shape bias for the familiar objects.
Word learning principles are discussed, particularly the lexical principles framework (Golinkoff, Mervis, Hirsh-Pasek, 1994) and its ability to account for acquisition of adjectives. The framework contains some principles that apply to adjectives, but other principles might be necessary to account for acquisition of adjectives, such as a newly proposed principle of property scope. According to property scope, adjectives should be extended on the basis of a single property of objects.
Chapter 1: Literature Review

In learning their language, children face a momentous and complex task. They must master several components including phonology, vocabulary, syntax, and pragmatics. Vocabulary acquisition alone is a large task and is more complex than it might appear at first glance. Learning vocabulary is not simply a matter of memorizing pairings between words and their corresponding referents. Even before children can begin to make word-referent associations, they must first determine what exactly is the referent of each word. Correctly determining a word's meaning may seem simple for children, because adults frequently point to and label objects for children (e.g. "Look at the cat"). Yet, even when an adult uses a word to label a particular object, it is not always clear what concept the word refers to. A word could refer to a whole object and other like objects, to that certain object only, or the object’s size, location, position, color, texture, and so on. For example, a child hearing cat for the first time might hypothesize that cat refers to one certain cat, all small animals, the color brown, furry things, and so forth, rather than correctly hypothesizing that cat refers to all cats and only cats.

Thus, for any new word that a child hears, the child could potentially hypothesize any of an infinite number of possible meanings for that word (Quine 1960). With this in mind, it seems astonishing that children learn any words at all. If children did not somehow limit the number of hypotheses to consider for each word's meaning, vocabulary learning would be an extremely slow and tedious task. Although vocabulary acquisition does begin at a slow rate, the rate of acquisition markedly increases as children approach their second year, and they master thousands of words during the
preschool years (Benedict, 1978, 1979; Dromi, 1987; Goldfield & Reznick, 1990; Gruendel, 1977; Nelson, 1973; Templin, 1957). Accordingly, it does not appear that children could be selecting hypotheses about word meanings on a random basis. Instead, they follow certain regularities or biases when hypothesizing about unfamiliar words. Several researchers have proposed principles that describe children's word learning strategies. Some of these word learning principles are reviewed below.

**Lexical Principles Framework**

Golinkoff, Mervis, and Hirsh-Pasek (1994) have provided a lexical principles framework—a set of six principles that account for children's word learning. Some of these principles were originally developed by other researchers but were incorporated into the framework, and others were formulated by Golinkoff et al. Overall, the set of six principles helps to account for children's lexical acquisition. Specifically, by following the principles children can reduce the amount of information that they consider when hypothesizing about a word's meaning. The principles are not necessarily innate or universal but develop through experience and the interaction between cognitive and linguistic processes. Within the framework, the principles are organized into two tiers. Each tier includes three principles that develop around the same time frame and are conceptually linked to one another. The first tier contains three principles known as reference, extendibility, and object scope; these provide children with some general information to guide their word learning. With the later developing second tier, the principles of categorical scope, novel name-nameless category, and conventionality allow children to become sophisticated word learners. All six principles are described in more detail below. It should be noted that these principles were
developed primarily from research on object labels (i.e., count nouns) in children’s vocabulary development. Currently, it is not fully understood how these principles might relate to the acquisition of other classes of words, such as verbs, adjectives, or prepositions. However, at least one study has provided evidence that some of the principles, with minor adjustments, do occur in relation to verb acquisition (Golinkoff, Jacquet, Hirsh-Pasek, & Nandakumar, 1996).

Reference

Even before children begin to determine the meanings of words, they require an understanding of the fundamental nature of language. Children must learn that speakers use language to refer to items in the world; this is the principle of reference. It is a basic principle but basic to understanding the purpose of language. Although the principle of reference is necessary for children to understand how language works, it is not sufficient for mastering the entire language. Children, after learning that things can be named, must learn what exactly each word refers to. That is, they must match words to their referents.

Extendibility

In learning what words refer to, children must learn that words refer to many objects not only the objects he or she sees paired with a word, but others as well (with the exception of proper nouns). For instance, the word cat does not refer to only the household pet but to all other cats as well. According to the principle of extendibility presented by Golinkoff et al. (1994), children find that a word is used not only for the object that they first hear a speaker refer to, but extends to other objects as well. Additionally, this extension is based on similarity to the original object or a common
thematic relationship (based on common participation in an event, such as a baby and a crib). If children do adhere to the principle of extendibility, then they should extend words to objects that they have never seen directly labeled by a speaker. Indeed, Golinkoff et al. (1994) noted that diary studies have provided evidence for the notion of extendibility (Barrett, 1978; Bloom, 1973; Dromi, 1987; Mervis, Mervis, Johnson, & Bertrand, 1992). Within these diary accounts, it was found that beyond children's very first words, children do not restrict words to a single object that a speaker had labeled; children extend words across similar objects. Although children produce extension or generalization on many bases such as shared movement, size, sound, texture and taste, the majority are based on a similar shape (Clark, 1977, 1983).

Object Scope

The principles of reference and extendibility provide children with some basic knowledge about how speakers use words. However, these two principles are very general; children need guidance that is more specific in order to determine what exact referents correctly map with each word in their language. Children follow a whole object assumption and assume that words refer to whole objects rather than parts or properties of an object (Markman 1990, 1994; Mervis, 1987). This assumption is incorporated in the principle of object scope (Golinkoff et al., 1994). Object scope provides children with the information that words label objects and additionally that words label whole objects, not properties or parts of objects.

Evidence that children do extend novel words to whole objects has been found in experimental studies. For instance, Taylor and Gelman (1988) explored children’s (2-year-olds) preferences for choosing the referent of novel words. Children heard a novel
noun (e.g., "This is a tiv") in reference to a stuffed animal (e.g., a green furry dog). When children were asked to choose objects as referents for that novel noun, they most often selected objects of like category even when these did not match the original in surface material (e.g., a plaid dog). Children did not tend to select objects sharing the same surface material but of a different kind (e.g., a green furry bird), providing evidence that young children use the principle of object scope when faced with novel words.

It should be noted that object scope is not an absolute principle; instead, it can be mediated by linguistic information. In particular, syntactic context may determine how children interpret novel words and whether they adhere to the principle of object scope. For instance, in Taylor and Gelman’s (1988) study children’s responses focused on surface material as well as category membership when novel words were presented as adjectives (e.g., "This is a tiv one") rather than as nouns. The effect of syntactic context on children’s interpretation of novel words will be discussed in more detail later in this chapter.

The three principles within the first tier of the lexical principles framework, namely reference, extendibility, and object scope, provide children with basic information to guide vocabulary learning. Children begin learning the first tier during their first year. Although the first tier of principles gives children some direction in word learning, acquisition during this phase is slow and deliberate; children do not produce many words that they hear and they master novel words only with multiple exposures. During their second year, children begin to develop the second tier of word learning principles. At this point children become more sophisticated and efficient word

**Categorical Scope, and Categorical Scope Compared with the Taxonomic Assumption**

The first second-tier principle of the lexical principles framework is categorical scope (Golinkoff et al., 1994). When following categorical scope, children will extend words on the ground of basic level categorization. Categorization can be organized into three levels, superordinate, basic, and subordinate (e.g., clothing, shoes, and sneakers or reading materials, books, and novels, respectively). At the basic level, objects share many features (both perceptual and functional) with each other but contrast with members of other categories (Rosch, Gray, Johnson, Boyes-Braem, 1976). It is at this basic level that children extend the words when they adhere to the principle of categorical scope. In contrast with the principle of object scope, which states that words refer to whole objects, categorical scope adds the constraint that the objects labeled by a word should be within the same basic level category, not superordinate or subordinate. As items within a basic level category commonly share a similar shape, a shape bias dominates most of children’s hypotheses about object labels (Smith, Jones, & Landau, 1992).

Other researchers have proposed a taxonomic assumption that is somewhat similar to categorical scope (Markman 1990, 1994; Markman & Hutchinson, 1984). According to the taxonomic assumption, children will extend words to objects that share category membership, based on shared functional or perceptual properties (e.g., animals, bicycles). Because members of taxonomic categories often share a common shape, the
taxonomic principle leads to a tendency for children to extend words based on shape, just as does the principle of categorical scope.

Although the categorical scope and taxonomic principles are somewhat comparable, they are not identical, as noted by Golinkoff et al. (1994). For one, the taxonomic principle encompasses the principle of extendibility as well, in that it proposes that words are extended on the basis of some shared property. Second, the taxonomic assumption does not differentiate between basic and superordinate levels of categorization. In contrast, according to categorical scope, children focus primarily on basic level categorization when extending new words. Although there are distinctions between the principle of categorical scope and the taxonomic assumption, both predict a shape bias in children's hypotheses about word meanings.

**N3C and N3C Compared with Contrast and Mutual Exclusivity**

Another second-tier principle is that of novel name-nameless category (N3C). According to N3C, as stated by Golinkoff et al. (1994), novel words refer to unnamed categories of objects. In following the N3C principle, children should assume that a novel word refers to a category of objects that they do not know a name for, and not a category of objects for which they already know a term. For instance, a child would more readily extend a novel word to an unfamiliar tool rather than an object for which the child knows a name, such as a hat or a car.

Similar but not identical to N3C are two principles proposed by other researchers. For one, Clark (1983) proposed the principle of contrast, according to which children assume that every two words contrast in meaning. The principle of contrast differs from the N3C principle in that the focus of contrast is on assigning contrasting meanings to
any pair of words. The N3C principle, on the other hand, focuses on the status of objects, specifically whether children already have a word for an object and if not, when a new word occurs it should be mapped to that category of objects.

Another related principle is mutual exclusivity (Markman, 1990, 1994; Markman & Wachtel, 1988). According to the principle of mutual exclusivity, children are biased to assume that an object can have only a single word and that children will reject redundant labels. Here children are motivated to avoid labeling a single object with two words rather than focusing on connecting novel names to nameless categories as indicated by the N3C principle. Mutual exclusivity was not proposed as an absolute constraint on children's word learning (Markman & Wachtel, 1988). Instead, children are initially biased to assume that words are mutually exclusive but will abandon this assumption when presented with contradictory information (e.g., synonymous terms). According to mutual exclusivity, children prefer to not allow meanings to overlap. The N3C principle allows for overlapping meanings, but when there is an unnamed category it receives priority for a novel word.

Although the principles of N3C, contrast, and mutual exclusivity vary in their specific formulations, they all share the prediction that children should be more likely to assume that a novel word refers to a novel (unnamed) object rather than to a familiar one if given a choice. Indeed, experimental evidence does support this hypothesis.

Golinkoff, Hirsh-Pasek, Bailey, and Wenger (1992) found that when 3-year old children heard a novel word (e.g., "Where's the zorch?") in the presence of four objects, three with familiar names (e.g., a brush, fork, and crayon) and one unfamiliar (e.g., a white broom handle tip), children most often chose the unfamiliar object as the referent of the
novel word. Markman and Wachtel (1988) also found evidence that children (ages 3-4 years) would select unfamiliar objects (e.g., a cherry pitter) more often than familiar named objects (e.g., banana) as referents of novel nouns. This preference for novel objects appears to be linked to the presence of novel words; in a control condition, in which no novel nouns were presented, children selected familiar and novel objects at equivalent levels.

**Conventionality**

Children often fill gaps in their vocabulary by using words in idiosyncratic ways (Clark, 1983), such as overextension (e.g., dog for cat or horse), creating new compound words (e.g., plantman for gardener), or using words in a nonstandard grammatical form (e.g., to broom for to sweep). Although such lexical innovations assist children in meeting their communicative needs, children eventually learn that to communicate most effectively, they must replace their idiosyncratic usages with standardized forms. When children learn that speakers expect certain words to be used for certain meanings, they are following the principle of *conventionality*. This principle of conventionality is the final principle within the lexical principles framework of Golinkoff et al. (1994).

**Summary**

The lexical principles framework (Golinkoff, et al., 1994) along with other principles have been proposed in an attempt to account for children’s ability to determine word meanings. These principles help children to narrow the range of hypotheses they consider for a given word. Without these useful constraints, children would not become efficient word learners and would acquire vocabulary in a slow and deliberate manner.
One restriction of these principles discussed is that they were principally
developed based on children's object label (count noun) acquisition. However,
principles that are more general may be required to account for children's vocabulary
development across all word classes. For instance, Bloom, Tinker and Margulis (1993)
have proposed the principle of relevance. The principle of relevance states that children
assume that words refer to what they actively hold in their focus of attention; words are
relevant to a child's current experience. Although the principle of relevance does not
provide specific information about the meaning of a word, it can assist children in
learning many types of words, rather than only nouns.

**Learning Adjectives**

As a class, adjectives have received relatively little attention in the word
acquisition literature. Much of the previous research on adjective acquisition has
typically focused on the order in which children acquire certain types of adjectives.
However, another way to explore adjective development would be to examine adjectives
in reference to the word learning principles. Although the principles outlined above
were developed primarily based on children's development of nouns, one might ask how
well these principles would apply to other classes of words, in this case adjectives.
Some principles, such as reference and conventionality, are quite general and may apply
equally well to adjectives and nouns.

Other principles, namely extendibility, object scope and categorical scope
(Golinkoff et al., 1994), as well as the taxonomic assumption (Markman & Hutchinson,
1984) predict a shape bias. Through extendibility, children extend words to multiple
referents on the basis of similarity. Children most frequently focus on similarity of
shape. According to object scope, children will use words to label whole objects, focusing on the whole object shape rather than parts, attributes, or functions or an object.

Categorical scope also leads to a shape bias as children extend words based on basic level categorization—many basic level category members are similar in shape.

Similarly, based on the taxonomic assumption, children extend words to objects of a single category, and shape is often similar among category members. Regardless of whether the shape bias derives from some or all of these principles, the resulting shape bias is a specific word learning strategy that is well suited for nouns but is not so appropriate for adjectives.

The Nature of the Shape Bias

Evidence for the shape bias in young children's hypotheses about novel words comes from both observational and experimental data. Based on speech production of children ages 12-30 months old, Clark (1977) provided evidence of the shape bias. For instance, one child used the word ball to refer to apples, grapes, a bell clapper, and in general anything round. This particular overextension of ball to round objects is one of the most common shape-based overextensions, but children demonstrate many others as well (Rescorla, 1980).

Children also have been shown to demonstrate the shape bias in experimental settings. When sorting, matching, or looking at objects that have been labeled with novel words, children attend to shape more often than other qualities such as size, color, or texture (Baldwin, 1986, 1989; Denney, 1972; Golinkoff, et al., 1992; Landau, Smith, & Jones, 1988). In such studies, children are typically exposed to an object or picture that is labeled by the experimenter with a novel word (e.g., “Look, this is a dax”).
Children then view test items, which vary from the labeled object in shape or on other dimensions such as color or texture, then are asked to find a match to the labeled item. Generally, children preferred test items that matched the original item in shape to items that contrasted in shape from the original. When objects are not labeled with words, but are simply shown to children, they lower their preference for shape. Thus, at least in part, the shape bias is the result of object labeling. Evidence suggests that the shape bias begins to develop as early as 18 months as children learn their first words and increases through the preschool years and from childhood to adulthood (Landau, et al., 1988; Markman, 1994; Smith 1995).

The developmental increase in children’s use of the shape bias might suggest that the shape bias is a learned strategy rather than an innate and universal constraint. In support of this hypothesis, cross-linguistic evidence has demonstrated that the language to which children are exposed mediates the shape bias. Gathercole and Min (1997) found that whereas Spanish and English children focused more on object shape in extending novel words, Korean children attended less to shape and gave more weight to objects’ substances and to functions related to their substance (e.g., that a magnet can pick up paper clips, or that a sticky substance adheres to the wall). Gathercole and Min suggested that the differences between the language groups reflected variations in the children’s native languages. In particular, Spanish and English include a singular-plural distinction on nouns. For instance, in English, one must indicate whether any count noun refers to one (e.g., the cat) or multiple referents (e.g., the cats). This clear distinction between single and multiple objects may highlight the countability of objects, leading children to focus on whole objects resulting in the shape bias. In contrast to
Spanish and English, regular nouns in Korean are similar to English mass nouns, which are words that refer to substances or masses of undifferentiated items (e.g., milk, rice, wood, fur) that have no typical shape as a whole. Thus, Korean-speaking children might learn to focus on substances or objects as part of a mass whole to a greater degree than English and Spanish-speaking children who instead learn to focus on individual items with distinct and stable shapes.

The shape bias is useful for children in learning count nouns, in that many count nouns are extended on the basis of common shape between members of a category. For instance, objects that fall under labels such as chair, table, pencil, and book tend to share a common shape among category members. Thus, a shape-based strategy can guide children toward the meaning of many count nouns.

In contrast, different results would occur if children applied the shape bias to other words, such as verbs, substance terms, prepositions or adjectives. The shape bias would hamper acquisition of these words because they are usually not correctly extended by common shape. At first glance, it might seem that the shape bias does slow the acquisition of words other than count nouns. Count nouns appear to become the largest category in early vocabulary suggesting that the shape bias might dominate the early vocabulary of English-speaking children (Bates et al., 1994; Benedict, 1978 & 1979; Fenson et al., 1994). For instance, based on a longitudinal study of English-speaking children (ages 8-30 months), Bates et al. showed that nouns comprised the largest category of words in early vocabulary (approximately 40% of all words) whereas other words classes such as predicates (i.e., verbs and adjectives) and closed-class words (e.g., pronouns) accounted for a smaller percentage of early vocabulary (approximately
25% and 15%, respectively). Additionally, nouns showed the fastest initial rate of acquisition. However, Tardif (1996) has demonstrated that unlike children acquiring English as their native language, children learning Mandarin-Chinese produce more verbs than nouns, reflecting characteristics of Mandarin, such as a higher frequency of verbs in child-directed speech and a more salient positioning of verbs within sentences. Thus, the high proportion of nouns found in English-speaking children's vocabularies is not a universal phenomenon.

**Flexibility in Using the Shape Bias**

The shape bias is not a rigid constraint. Instead, children learn to use various types of information, both linguistic and nonlinguistic, to determine when it is appropriate to use the shape bias in interpreting new words. Syntactic and morphological information can help children to identify words as adjectives and indicate that the shape bias is not an appropriate strategy. Features of objects also provide semantic information that can also cause children to rely less heavily on the shape bias. Some of these factors, both linguistic and nonlinguistic, are described below.

**Syntactic frame.** The syntactic context of a word, or its specific place in a type of sentence, can indicate its grammatical class within the language. For instance, the sentence frames "He likes to X" and "She was X-ing" suggest a verb, whereas frames such as "This is a X" or "They like the X" suggest a noun. The sentence frame of a word provides information about its syntactic or grammatical class and corresponding semantic or conceptual nature. For instance, nouns are associated with things, verbs with actions and events, and adjectives with properties of things.
Using nonce words (e.g., sib), Brown (1957) tested whether preschool children would be sensitive to syntactic frame when hypothesizing about word meanings. Children viewed pictures, each including an action, a mass, and an object. For instance, one picture included hands cutting a mass of cloth with a strange tool. While viewing such a picture, children heard a novel word in one of three syntactic frames, either verb (e.g., sibbing), mass noun (e.g., some sib), or count noun (e.g., a sib). At test, children were asked to find another referent of the novel word, choosing from three pictures, each representing either the action, mass, or object from the labeled picture. The preschool children were able to choose the appropriate test pictures, that is for verbs they chose actions, for mass nouns substances, and for count nouns objects, demonstrating a sensitivity to syntactic context when interpreting novel words.

Since Brown's study (1957), several researchers have used similar methods to show that children consider syntactic context when hypothesizing about word meanings. For instance, Landau and Stecker (1990) tested whether adults and children (ages 3 and 5 years) were sensitive to the syntactic frame of novel words presented as count nouns (e.g., "This is a corp") or prepositions (e.g., "This is acorp my box"). Participants heard a novel word while viewing a novel object positioned in reference to a box (e.g., in the box). At test, participants were asked whether other objects were referents of the novel term. A series of test objects varied from the original in both shape and position in relation to the box. Within the noun condition, both children and adults focused on shape; that is they rejected exemplars that varied in shape from the original but accepted those similar in shape but differing in position. In contrast, for the preposition
condition, individuals accepted exemplars that varied from the original in shape but rejected those that varied in position.

Syntactic frame also plays a role when children hear novel adjectives. Particularly, the shape bias decreases for novel words presented in adjective frames relative to those presented as count nouns (Hall, Waxman, & Hurwitz, 1993; Landau, Smith, & Jones, 1992; Smith, Jones, & Landau, 1992; Taylor & Gelman, 1988). As previously mentioned, Taylor and Gelman presented children (age 2 years) with novel words in either a count noun (e.g., "This is a tiv") or an adjective frame (e.g., "This is a tiv one"). Using the novel word in either syntactic frame, the experimenter labeled a stuffed animal of a particular surface texture and shape (e.g., a furry green dog) and then determined whether children chose objects that matched in texture only (e.g., a furry green bird) or in shape only (e.g., a plaid dog). Within the count-noun condition, children most often chose items of the same shape, but within the adjective condition, children preferred the texture matched items instead, illustrating the impact of syntactic frame on the shape bias.

Hall et al. (1993) conducted a similar study. In this experiment, children again heard novel words as either count nouns or adjectives. For each trial, one novel word labeled an object (e.g., a leather glove) and children were asked to choose a second referent of the novel word from one similar in shape only (e.g., a wool glove) and the other similar in texture only (e.g., a leather belt). Children aged 4-years more often chose the shape-based items in the count-noun condition than in the adjective condition, however 2-year-olds did not show sensitivity to this variation in syntactic frame.
Landau et al. (1992) also established that children (ages 3-5 years) and adults varied their use of the shape bias according to whether novel words were presented as count nouns or adjectives. In their study, participants saw a novel object (e.g., a deformed circle made of wood) that was labeled with a novel word. Participants were then asked whether each of a series of test items were a referent of the novel word. The test items each varied from the original on one dimension, either shape, texture, or size. For novel count nouns, participants found shape to be an important factor, rejecting objects that varied in shape from the original but accepting changes in either texture or size. For the novel adjectives, participants began to focus on texture, rejecting items that varied from the original texture, but accepting changes in shape and size. (Interestingly, both children and adults did not view size as a viable meaning of novel words.) Three-year-old children showed less of a differentiation based on syntactic frame than did five-year-olds and adults.

Also demonstrating children's sensitivity to adjective versus count-noun syntactic frames, are studies that investigated how novel words affected children's grouping of objects. Children (ages 2-5 years) were found to categorize objects according to whether novel words were presented as count nouns or adjectives (Waxman, 1990; Waxman & Kosowski, 1990). Count nouns prompted children to select taxonomic or superordinate matches (e.g., pairing a flower with a tree and a houseplant) rather than thematic matches (e.g., pairing a flower with a bee and a vase). Adjectives in contrast did not promote superordinate classification. However, adjectives were shown to encourage subordinate classification (e.g., types/colors of grapes). Similarly, Gelman and Markman (1985) found that children were able to determine that novel adjectives
implied contrast within a category, in this case on the basis of surface patterning (e.g., distinguished a dotted hat from a plain hat). On the other hand, children interpreted novel count nouns as implying contrast between categories on the basis of shape (e.g., distinguishing hats and boxes). Thus, across various types of experiments, we see that children are able to distinguish novel adjective and count nouns based on syntactic context and children more often attend to shape with count nouns than with adjectives.

**Morphology.** Related to syntactic frame, children also can take advantage of morphological information contained within words that helps to indicate a word’s grammatical class. In regard to the English language, suffixes such as -y, -like, and -ish tend to indicate that a word is an adjective. In order to test children’s sensitivity to such morphology, Landau, et al. (1992) presented novel adjectives with or without the morpheme -y. Children (age 5 years) heard either "This is a daxy one" or "This is a dax one" in conjunction with a novel object. Children who heard the adjective with -y were more accurate in extending the word as an adjective (i.e., to surface texture rather than whole-object shape) than those who had heard the adjective without the suffix.

**Semantic information.** In addition to syntactic or morphological information, semantic information may also influence the magnitude of the shape bias. Namely, features or characteristics of an object may influence how a word is interpreted. Although there are many features potentially related to word meanings, only a limited number of semantic features have been studied in regard to children’s hypotheses about novel adjective meanings and the shape bias.

For one, Jones, Smith, and Landau (1991) and Smith (1995) reported that whether a labeled object was represented as animate or inanimate influenced children’s
interpretations of novel words. When geometric shapes were represented as animate creatures (by adding eyes or a pair of shoes to the shapes), children were less likely to use the shape bias and were more likely to base their interpretations of novel words on material covering (texture). Jones, et al. proposed that children found shape less important for animate items because shape is less consistent or reliable in animals due to locomotion, postural changes, and growth. However, children's perceptions of why shape varies influences how they treat shape. Children will match novel animals that vary in shape if the variation appears to be due to postural change. However, if the shape variation appears to designate different species of animals, children will not match animals across contrasting shapes (Becker & Ward, 1991; Ward et al., 1989; Ward, Becker, Hass, & Vela, 1991).

Also regarding the influence of semantic features on the shape bias, Ward et al. (1989) discovered that functional significance can influence how children categorize objects. In particular, children focused more on types of wheels (e.g., smooth versus bumpy) than on whole-object shape when making classification decisions about drawings of imaginary riding toys.

Finally, Smith, et al. (1992) investigated whether the relative salience of a non-shape attribute would influence the shape bias. Specifically, Smith et al. found that the shape bias for novel objects decreased as the salience of surface coloration was increased. In an experiment, children focused more on surface coloration when researchers provided an attractive surface coloration on the stimulus objects (i.e., shining glitter) and emphasized that surface coloration within the experimental setting (i.e., by presenting objects under special lighting conditions).
In summary, researchers have investigated several aspects of semantic features of referents and how they influence the shape bias in interpretations of novel words. Studies of semantic factors are rather limited in scope; other possibilities remain to be tested.

Object familiarity. In word learning experiments, children have often viewed unfamiliar objects paired with novel words (e.g., Becker & Ward, 1991; Brown, 1957; Landau, et al., 1992; Smith, et al., 1992). However, in natural language situations, children might hear a speaker apply a novel word to a familiar object, for which the child already knows a word. For instance, a child may be familiar with the word cat but could hear the cat also labeled as furry, brown, or sleepy. In experimental settings, researchers can parallel this occurrence by labeling familiar rather than novel objects. In fact, researchers have compared children's word learning hypotheses across conditions in which familiar versus novel objects were labeled with novel words (e.g., Hall, Waxman, & Hurwitz, 1993; Markman & Wachtel, 1988; Taylor & Gelman, 1988). Three related word learning principles, N3C (Golinkoff et al., 1994), contrast (Clark, 1983), and mutual exclusivity (Markman & Wachtel, 1988) make predictions relevant to such a situation. Although these principles vary in their exact specifications and theoretical underpinnings, they all predict that children should avoid redundant labels and therefore be less likely to follow the shape bias when they already know a count-noun label for a given object.

If a child is already familiar with a count noun for an object and she or he hears another word labeling the object, the child should hypothesize that the new word does not refer to the whole object but to some characteristic of the object. Experimental
studies have provided evidence suggesting that if children know a particular object label (count noun), they will extend new words presented with that object more often either as substance, color, or part of object than if the object were unfamiliar (Hall, et al., 1993; Markman & Wachtel, 1988; Taylor & Gelman, 1985).

Markman and Wachtel (1988) introduced children to novel words (e.g., "This is rattan") describing either familiar (e.g., a rattan hat) or unfamiliar objects (e.g., a rattan crescent-shaped container). When the labeled object was familiar, children (ages 3-4 years) were less likely to interpret the novel word as a label for the whole object than when the labeled object was unfamiliar. With familiar objects children extended the novel word on the bias of texture. Similar results also were found comparing words for familiar and unfamiliar whole objects (e.g., a fish or a pagoda) and their parts (e.g., a dorsal fin or a finial). Familiarity with a count noun moved children's attention away from shape and toward the parts as they interpreted novel words.

Hall, et al., (1993) found that children (age 4) when interpreting novel adjectives and count nouns were more likely to focus on an object's texture if the object was familiar rather than unnamed. Taylor and Gelman (1988) also found that children were more likely to attend to surface texture for familiar objects than for unfamiliar objects. This effect was limited to novel words presented as count nouns and did not extend to those presented as adjectives, which children generally extended on the basis of texture over familiar and novel items.

In particular regard to adjectives, the word learning principles (N,C, contrast, and mutual exclusivity) predict that adjectives should be easier for children to acquire when
applied to familiar (named) objects rather than novel (unnamed) objects as the tendency to use the whole-object shape bias should be reduced.

**Summary**

Children gain sophistication and efficiency in word learning as they develop principles to guide them in determining the meanings of words. Although these principles do well in explaining children's acquisition of count nouns, they do not fully account for the acquisition of other word classes, such as adjectives. It is possible that children use other principles to facilitate the acquisition of adjectives. Although researchers have put forth some general word learning principles that can apply beyond count nouns, no principles specific to adjectives have been proposed. In fact, Smith, et al. (1992) have suggested that there may be no consistent principles for adjective acquisition. Beyond the word learning principles, children also learn to use other types of information to guide them in lexical acquisition including syntactic, morphological, and semantic input.

Although children master words in all grammatical classes, much of the research on vocabulary development has concentrated on object labels (count nouns). However, for a full understanding of vocabulary development, all classes of words must be considered. The purpose of this study is to explore children's acquisition of adjectives, and to investigate what factors cause children to reduce their shape bias, a tendency that does not lead children to the correct meaning of most adjectives.
Chapter 2: Overview of Study and Predictions

Overview

In two experiments, this study explored children’s and adults’ hypotheses about novel words with a focus on how their use of the shape bias differed in response to variations in linguistic and nonlinguistic information. In these experiments, pairs of objects were labeled with novel words (e.g., two balloon-like shapes of sequined fabric were labeled "very nart"). Refer to Figure 1 for examples of all labeling and presentation conditions. After hearing a novel word, participants were shown two test items. One of these items matched the original in shape but differed on another dimension (e.g., balloon-like shape without sequins) and the other item differed in shape but matched the original on the other dimension (e.g. angular shape with sequins). Participants were asked to choose one of the test items as the referent of the novel word. The choice of the shape-matched item was taken to indicate that the individual had extended the novel word based on shape. When participants selected test items based on nonshape attributes (e.g., texture), this response was taken to imply that the participant had hypothesized that the novel word related to that attribute and did not use the shape bias. The dependent variable reported throughout this study is the mean percentage of shape-based selections. Within the study, several variables were examined and are described in detail below.

Variables and Predictions

Syntactic Frame

Participants heard novel words presented as adjectives (e.g., "very nart") or count nouns ("two narts") or heard no novel words at all ("look at these"). This no-word
<table>
<thead>
<tr>
<th>Presentation</th>
<th>Test</th>
</tr>
</thead>
</table>
| **Adjective** | "Where's another nart one?"
| "Look, here are two that are very nart. This is a nart one and this is a nart one. See how nart they are."
| **Noun** | "Where's another nart?"
| "Look, here are two narts. This is a nart and this is a nart. There are two narts."
| **No Word** | "Where's another one like these?"
| "Look at these on this page. See this one and this one. Look at both of these."

<table>
<thead>
<tr>
<th>Textures</th>
<th>Presentation: Consistent Shape</th>
<th>Presentation: Inconsistent Shape</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Image1" alt="Texture1" /> <img src="Image2" alt="Texture2" /></td>
<td><img src="Image3" alt="Texture3" /> <img src="Image4" alt="Texture4" /></td>
<td><img src="Image5" alt="Texture5" /> <img src="Image6" alt="Texture6" /></td>
<td><img src="Image7" alt="Texture7" /></td>
</tr>
</tbody>
</table>

<table>
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<th>Presentation: Inconsistent Shape</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Image8" alt="Damage1" /> <img src="Image9" alt="Damage2" /></td>
<td><img src="Image10" alt="Damage3" /> <img src="Image11" alt="Damage4" /></td>
<td><img src="Image12" alt="Damage5" /> <img src="Image13" alt="Damage6" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Color</th>
<th>Presentation: Consistent Shape</th>
<th>Presentation: Inconsistent Shape</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
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<td><img src="Image17" alt="Color3" /> <img src="Image18" alt="Color4" /></td>
<td><img src="Image19" alt="Color5" /> <img src="Image20" alt="Color6" /></td>
<td><img src="Image21" alt="Color7" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Emotions</th>
<th>Presentation: Consistent Shape</th>
<th>Presentation: Inconsistent Shape</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
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<td><img src="Image24" alt="Emotion3" /> <img src="Image25" alt="Emotion4" /></td>
<td><img src="Image26" alt="Emotion5" /> <img src="Image27" alt="Emotion6" /></td>
<td><img src="Image28" alt="Emotion7" /></td>
</tr>
</tbody>
</table>

**Figure 1**

Examples of labeling and stimuli for Experiment 1
condition was included to provide a baseline measure of how individuals would match items without the presence of novel words. The adjective and count noun conditions were included to measure word learning strategies. Although children’s use of syntactic frame to differentiate adjectives and count nouns has been demonstrated in several past studies (Gelman & Markman, 1985; Hall et al., 1993; Landau, et al., 1992; Smith et al., 1992; Taylor & Gelman, 1988; Waxman, 1990; Waxman & Kosowski, 1990), it is of interest to determine whether the effect will extend to the current methodology. The current study varied from past studies in several ways. For instance, in these experiments, children see two objects, rather than only one object labeled with a novel word.

**Predicted for syntactic frame:** Relative to the no-word baseline condition, the shape bias should be lower in the adjective condition and greater in the noun condition.

**Domain**

In previous studies of adjectives and the shape bias, the stimuli have been limited in the range of attributes available as an alternative to shape, focusing primarily on some aspect of coloration or texture. Moving beyond this domain, stimuli representing four domains of adjective traits were included in this study, namely color, damage, emotions, and texture. This factor of attribute domain or type was one of two semantic features manipulated within this study. From the results it will be determined whether findings regarding novel adjective interpretation and the shape bias are consistent across attribute domains or whether results vary with the attributes presented. Previous research provides suggestions as to how these varying domains of adjective traits might influence children’s shape bias and is reviewed below.
**Color.** In the case of color, these items may provide the weakest alternative to shape, resulting in a high shape bias. This hypothesis derives from the fact that children have difficulties making correct associations between colors and words and are slow to fully master color terms in relation to other adjectives (Au & Markman, 1987; Bornstein, 1985a & b).

**Damage.** In the course of vocabulary development, children do not acquire all types of adjectives at the same rate; children produce some types of adjectives earlier than others. For instance, transient terms (e.g., **cold**, **hot**, **wet**, **broken**, **dirty**) account for the majority of the earliest adjectives in a child’s lexicon (Dromi, 1987; Fenson et al., 1994; Gruendel, 1977; Nelson, 1973; 1976). Accordingly, it is possible that transient states are quite salient to children and may provide a more compelling alternative to shape than other attributes such as material or texture, resulting in a lowered shape bias. Representing transient states in the experimental stimuli were damaged items, but other types of transient qualities could be investigated in future studies.

**Emotions and animacy.** For the emotion items within this study, it was required to include faces on the stimuli. This addition of faces also added the trait of animacy to these items. As detailed in Chapter 1, children’s attention to texture or material kind increases with animate over inanimate objects, reducing the relative importance of shape in their extension of novel words (Jones, et al., 1991; Smith, 1995). It is possible that on the emotion items in this study, with their quality of animacy as well as the transient nature of emotions, the shape bias will be reduced and attention will shift to the emotions instead, resulting in a lowered shape bias.
Texture. Many experiments exploring adjectives and the shape bias have included texture or material kind as the nonshape attribute available within their stimuli (Hall, et al., 1993; Landau, et al., 1992; Taylor & Gelman, 1998; Smith, et al., 1992). The attribute of texture provides stimuli most similar to those included in previous studies, allowing for a comparison across studies. Because texture has been so widely used across studies, it will be of interest to determine the relative level of shape bias between texture and the other domains.

Summary and predictions. The factor of adjective attribute, or domain, was varied in order to test the hypothesis that children’s interpretations of novel words would vary across various domains. Predicted for domain: It was predicted that the damage and emotion items would provide a very strong alternative to shape leading to the lowest percentage of shape-based responses. Conversely, it was predicted that color would provide a weak alternative to the shape leading to the largest percentage of shape-based responses among the four domains. Finally, with no reason to hypothesize that texture would be either high or low in shape bias, it was predicted that the texture items would yield an intermediate level of shape preference.

Shape Consistency

Beyond looking at the non-shape attributes in relation to the shape bias, one might explore shape itself. For instance, one way to assist children in overcoming the shape bias would be for a speaker to purposefully violate the shape bias when using a word to label objects (Frigo, 1996). Specifically, if a speaker used a novel word to refer to multiple objects, each having a different shape, children should hypothesize that the novel word refers to some common attribute of the objects other than shape.
Presumably across language interactions, adults do not use adjectives to refer only to objects all of a similar shape. For instance, when the word yellow describes a school bus and a canary, the lack of common shape between the two should move children to interpret yellow not based on shape but on the shared feature of color.

Thus, a second semantic component included in this study is shape consistency. Participants heard novel words, and each word referred to two items rather than only one as in a typical word learning experiment. For each trial, the two items were either identical or contrasted in shape. (See Figure 1 for examples of stimuli).

**Predicted for shape consistency:** participants should show a greater shape bias when the labeled items share a common shape than when they contrast in shape.

**Age Differences**

Previous experimental work has shown that the shape bias appears to increase throughout the preschool years and between childhood and adulthood (Landau, et al., 1988). Additionally, with increasing age, children are able to use syntactic information in determining whether the shape bias is an appropriate word learning strategy (Hall et al., 1993; Taylor & Gelman, 1985). In order to investigate age effects within this study, children of two age groups (roughly 3 and 4 years of age) and adults were tested. Comparisons were made between the two groups of children and between the adults.

**Predicted for age among children:** (a) Older children should show a greater shape bias than younger children; (b) Older children should show more sensitivity to syntactic context. That is, the older children should demonstrate greater differences between the level of shape bias used within the three syntactic frame conditions.
Predicted for age between children and adults: (a) Adults should provide a greater shape bias than the children; (b) Adults should be more sensitive to the syntactic frame of novel terms. The differences between the syntactic conditions should be greater for adults than for children.

**Novel versus Familiar Objects**

Recall that three related word learning principles, namely N3C (Golinkoff, et al., 1994), contrast (Clark, 1983), and mutual exclusivity (Markman & Wachtel, 1988), suggest that children should be less inclined to use the shape bias in interpreting a novel word if objects with familiar names are labeled as compared to unfamiliar objects. This prediction has been supported by results from previous experiments (Hall et al., 1993; Markman & Wachtel, 1988; Taylor & Gelman, 1988).

To further test this effect of object familiarity, the familiarity of objects was varied within this study. In Experiment 1, the stimuli were based on novel objects, and in Experiment 2 the stimuli were based on familiar objects. A comparison between the two experiments can determine how the effect of object familiarity might extend to the materials and procedure used in this study. It should be noted that previous research concerning familiarity and the shape bias has typically compared children’s preference for shape versus texture or surface coloration but has not investigated other attributes such as emotions and damages, which were present in this study. Thus, it will be of interest to determine how object-label familiarity might function with the other types of attributes. **Predicted for novel versus familiar objects:** the shape bias will be higher when novel words label novel objects (Experiment 1) rather than familiar objects (Experiment 2). This hypothesis was tested by making cross-experiment comparisons.
Chapter 3: Methods for Experiment 1

**Design**

In this experiment, children and adults saw novel geometric shapes labeled with nonce words. Four variables were included with a resulting design of 3 (syntactic frame: between subjects) × 4 (domain: within subjects) × 2 (shape consistency: within subjects) × 2 (age: between subjects). For the analysis of child data alone, the variable of age indicates a comparison between older and younger preschool children. For the analysis of adult and child data combined, age refers to a comparison between adults and all children. For the analysis of adult data alone, the variable of age was not included.

**Participants**

**Children**

Thirty-six children, 18 girls and 18 boys, were tested individually. The children ranged from 31-59 months of age with a mean age of 44 months. The children were divided into two age groups, with the younger children ranging from 31 to 45 months of age ($M = 37$ months, $SD = 4.2$) and the older children ranging from 46-59 months ($M = 51$ months, $SD = 4.2$). The children were recruited from preschools in Baton Rouge, Louisiana. Parental consent was obtained for each child. The children were tested in quiet locations at their schools. Data from three children were replaced as one child failed to follow instructions and two did not wish to complete the task. From each age group, six children were assigned to each of the syntactic conditions.

**Adults**

Forty-eight undergraduate students at Louisiana State University participated in exchange for extra credit in psychology courses. They were tested in groups with up to
six participants per session rather than individually as the children were. Sixteen adults were assigned to each of the three syntactic frame conditions.

**Stimuli**

See Figure 1 (page 24) for representations of the stimuli. For each trial, two pictures were presented side by side on a single sheet of paper. The pictures were abstract shapes cut out of colored paper or other materials and glued on the page. For the color trials, shapes were cut from four shades of colored paper (peach, purple, black, and bright green). For the texture items, shapes were cut from four types of materials (fake fur, sponge, sequined cloth, and sandpaper). Colored-paper shapes that had been manipulated in four different ways (ripped, smeared with dirt, smeared with black grease, and wrinkled) represented the damaged states. Finally, to represent emotions, shapes cut from colored material were made into cartoon-like faces with eyes and mouths that showed various emotions (happy, sad, angry, and surprised/afraid). For each item, one page was made with both items identical (the consistent shape condition) and a second page was made with both items identical except in shape (the inconsistent shape condition). Each participant saw either the consistent or inconsistent shape page for each item. Within each of the four domains, each participant saw half of the items with consistent shape and half with inconsistent shape. Across subjects, all items were viewed equally often as consistent and inconsistent shapes. For the inconsistent shape pages, the placement of the "odd" shape was varied between left and right placement, counterbalanced across domains.

For testing, two pictures were presented on a page for each trial. For examples see Figure 1. One of these pictures matched the original in shape but not in the target
attribute (i.e., color, texture, damage, or emotion). The second matched the original on the targeted attribute but not shape. Within each domain, the shape matched item occurred equally often on the right and left sides of the page.

These stimuli were different from those used in past studies investigating the shape bias and the adjective syntactic frame, in that they involved unfamiliar forms cut from various materials rather than actual three-dimensional objects (e.g., Hall, et al., 1993; Landau et al., 1992; Smith, et al., 1992; Taylor & Gelman, 1988), pictures of actual objects (e.g., Gelman & Markman, 1985; Waxman, 1990; Waxman & Kosowski, 1990), or line drawings of novel objects (Gelman & Markman, 1985). Additionally, only in the current study were two rather than one object labeled with a single novel word.

Data from the adult participants were collected originally as one of a series of pilot experiments. One purpose of the pilot experiments was to identify appropriate stimuli for the conducting the experiment with children, which was the primary focus of this paper. Included in the pilot experiments were four additional stimuli items, consisting of two color items and two texture items that were not in the stimulus set presented to children. These items were not included because in the pilot experiments, adults least often attended to the targeted non-shape attributes on these items. Although adults did view these four extra items during the experiment, the items are not included in the following analyses so that a comparison can be made between adults’ and children’s responses.
Procedure

For children, but not adults, the experimenter used a puppet (a raccoon) to introduce the stimuli, indicating that the puppet wanted the child to look at some pictures and listen to what the puppet said. The experimenter labeled the objects with a word in either the adjective or noun frame or with no novel words and then asked the participants to find another. For the adjective condition, participants heard a novel word in the frame, "Look, here are two that are very X. This is a X one and this is a X one. See how X they are. Where's another X one?". In the noun condition, participants heard, "Look, here are two Xs. This is a X and this is a X. There are two Xs. Where's another X?". For the no-word condition, the experimenter stated, "Look at these on this page. See this one and this one. Look at both of these. Where's another one like these?". Upon asking the question, the experimenter displayed the test page. Both the presentation page and the test page were in view during the test phase of each trial. For each trial, a different novel word was used. For children, the experimenter recorded their responses on an answer sheet. Adults were asked to choose one test item per trial and mark their choice on an answer sheet.
Chapter 4: Results and Discussion of Experiment 1

The analysis of child data alone is presented first, including a comparison between older and younger children. Second, the analysis of adult data is presented. Finally, results from the analysis of combined child and adult data are described. (Appendix A lists statistical abbreviations used.)

Results: Child Data

Table 1 lists cell means for children, with percentages of shape-based choices listed. These data were analyzed in a four-way mixed design ANOVA with two between-subjects factors: syntactic frame (adjective, noun, and no-word) and age group (younger and older children) and two within-subjects factors: domain (color, texture, damage, and emotion) and shape consistency (consistent and inconsistent). For analysis by items, domain was a between-items factor; age, frame, and shape consistency were within-items factors.

Predictions

Briefly summarized from Chapter 2, the predictions were as follows: (a) Syntactic frame: Relative to the no-word baseline condition, the shape bias should be lower in the adjective condition and higher in the noun condition; (b) Domain: The shape bias should be highest on the color trials, intermediate on the texture trials, and lowest on the emotion and damage trials; (c) Shape consistency: The shape bias should be lower when labeled items were inconsistent rather than consistent with each other; (d) Age: The shape bias should be higher for older children than younger children. Older children should show a greater effect of syntactic frame than younger children.
Table 1

Responses of children in Experiment 1: Mean percentages of shape-based choices (and standard deviations)

<table>
<thead>
<tr>
<th></th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young Adjective</td>
<td>83.3</td>
<td>0.0</td>
<td>41.7</td>
<td>41.7</td>
</tr>
<tr>
<td></td>
<td>(20.4)</td>
<td>(0.0)</td>
<td>(49.2)</td>
<td>(20.4)</td>
</tr>
<tr>
<td>No Word</td>
<td>8.3</td>
<td>0.0</td>
<td>41.7</td>
<td>58.3</td>
</tr>
<tr>
<td></td>
<td>(20.4)</td>
<td>(0.0)</td>
<td>(37.6)</td>
<td>(37.6)</td>
</tr>
<tr>
<td>Noun</td>
<td>33.3</td>
<td>16.7</td>
<td>58.3</td>
<td>66.7</td>
</tr>
<tr>
<td></td>
<td>(40.8)</td>
<td>(25.8)</td>
<td>(49.2)</td>
<td>(51.6)</td>
</tr>
<tr>
<td>Old Adjective</td>
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<td>41.7</td>
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<tr>
<td></td>
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<tr>
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<td>(51.6)</td>
<td>(27.4)</td>
</tr>
</tbody>
</table>
**Syntactic Frame**

Surprisingly, the main effect of syntactic frame was not significant. Children's use of the shape bias did not differ according to the syntactic frame in which they heard novel words. Thus, the effect of syntactic frame differentiating adjectives and nouns as previously found (e.g., Hall, et al., 1993; Landau, et al., 1992; Smith, et al., 1992; Taylor & Gelman, 1988) did not extend to this methodology.

**Domain**

The main effect of domain was significant, $F(3, 90) = 24.24, p < .0001, \text{MSE} = 0.112; F(3, 12) = 24.52, p < .0001, \text{MSE} = 0.074$. Children selected shape items less often on texture trials ($M = 20.8\%, SD = 25.0$) as compared to trials of the three other domains, color ($M = 47.9\%, SD = 30.1$), damage ($M = 57.6\%, SD = 34.2$), and emotions ($M = 65.3\%, SD = 32.9$) according to a post hoc Tukey HSD test $Q(4, 140) = 5.24, 7.12, \text{and} 8.59, \text{respectively}, p < .05$. This pattern of results does not match the prediction of a high shape bias for color items and a low shape bias for emotions and damages.

**Shape Consistency**

The main effect of shape consistency was significant in the subjects analysis and approached significance across items, $F(1, 30) = 4.26, p < .05, \text{MSE} = 0.066; F(1, 12) = 3.31, p < .10, \text{MSE} = 0.057$. As predicted, the shape bias was stronger when presentation items were consistent in shape ($M = 51.0\%, SD = 26.1$) rather than inconsistent in shape ($M = 44.8\%, SD = 22.2$).
**Shape Consistency x Domain**

The effect of shape consistency was qualified by an interaction with domain, \( F(3, 90) = 5.71, p < .01, \text{MSE} = 0.094; F(3, 12) = 6.33, p < .01, \text{MSE} = 0.057 \). Means for this interaction are listed in Table 2. Specifically, the effect of shape consistency was only significant within the emotion items, according to a post hoc Tukey HSD test, \( Q(8, 280) = 4.45, p < .05 \). Only within the emotion items, did the consistent shape trials (\( M = 79.2\%, \text{SD} = 34.6 \)) yield a significantly greater shape bias than did the inconsistent shape trials (\( M = 51.4\%, \text{SD} = 42.2 \)). Although there was a trend of a higher shape bias for consistent shape trials within the texture items, this difference was not significant.

**Age Differences**

The main effect of age group was significant, \( F(1, 30) = 7.44, p < .05, \text{MSE} = 0.366; F(1, 12) = 50.58, p < .0001, \text{MSE} = 0.036 \). Older children (\( M = 57.6\%, \text{SD} = 19.8 \)) exhibited a higher shape bias than did the younger children (\( M = 38.2\%, \text{SD} = 21.0 \)). As predicted based on previous findings (Landau, et al., 1988), the shape bias became stronger with children's increasing age. However, there was no evidence that older children were more sensitive to syntactic context than were the younger children.

**Four-way Interaction**

All of the above effects were qualified by a four-way interaction, Shape Consistency x Domain x Syntactic Frame x Age Group, which was significant across subjects and approached significance over items \( F(6, 90) = 2.35, p < .05, \text{MSE} = 0.094; F(6, 24) = 2.33, p < .09, \text{MSE} = 0.063 \). Cell means associated with this interaction are listed in Table 1. This interaction can be interpreted to show that the main effect of age, with a higher shape bias in the older age group, occurred in all but four particular
Table 2

Responses of children in Experiment 1: Mean percentages of shape-based choices (and standard deviations) for shape consistency by domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent</td>
<td>26.4 (32.7)</td>
<td>51.4 (45.4)</td>
<td>47.2 (39.5)</td>
<td>79.2 (34.6)</td>
<td>51.0 (26.1)</td>
</tr>
<tr>
<td>Inconsistent</td>
<td>15.3 (26.2)</td>
<td>63.9 (37.1)</td>
<td>48.6 (38.7)</td>
<td>51.4 (42.2)</td>
<td>44.8 (22.2)</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>20.8 (25.0)</td>
<td>57.6 (34.2)</td>
<td>47.9 (30.1)</td>
<td>65.3 (32.9)</td>
<td>47.9 (22.4)</td>
</tr>
</tbody>
</table>
conditions. The older children did not demonstrate a higher shape bias under the following conditions, all within the consistent shape trials only: noun frame on texture items, adjective frame on damage items, and adjective and no-word frames on color items. The age effect may have been inconsistent as the two groups of children were relatively close in age rather than further apart as in previous work finding age-based differences in the shape bias (3 and 5 years of age; Landau, et al., 1992).

The interaction also demonstrated that the effect of shape consistency primarily occurred within the texture and emotion items, and at a greater magnitude for the emotion items. This effect of shape consistency was not uniform across all cells within the texture and emotion items. In particular, the effect of shape consistency did not occur for the younger children within the adjective condition for the emotion items and for the older children within the noun condition on the texture items.

**Discussion: Child Data**

**Syntactic Frame**

Varying from the performance of young children in similar past experiments (Hall, et al., 1993; Landau, et al., 1992; Smith, et al., 1992; Taylor & Gelman, 1988), children in this experiment did not show a sensitivity to variations in the syntactic frame of words presented as either adjectives or count nouns. Although the children chose shape-based items more often in the noun condition than in the adjective condition, this difference was negligible and did not approach significance. Children's sensitivity to syntactic frame in reference to adjectives and nouns has been established for children even as young as 2 years (Taylor & Gelman, 1988) and it is uncertain why children in this experiment did not vary their selections in response to syntactic frame. Differences
in methodology between this and past studies may account for the difference in results. For instance, in this study children saw two rather than one object labeled and the objects themselves were novel geometric forms rather than pictures of actual objects or three dimensional objects. Possibly, children needed to use more processing capacity to process the novel forms, leaving insufficient capacity to attend to syntactic information resulting in no clear effect of syntactic frame.

**Domain**

The purpose of including the stimuli representing four various domains—color, texture, damages, and emotions—was to determine whether varying the attributes available as an alternative to shape would influence learners’ tendencies to use shape when extending novel words. Indeed, children’s choices were not uniform across domains. Although the percentage of shape based choices varied across all domains, the only significant difference between domains was that texture items yielded a lower shape preference than did the three other domains. In other words, when the stimuli allowed children to match based on texture (e.g., furry), they were less likely to extend words based on shape than when a color (e.g., peach), a damage (e.g., ripped) or emotion (e.g., happy) was happy instead.

Based on previous research, it was originally predicted that the shape bias would be highest for color items, intermediate for texture items, and low for both damage and emotions (Bornstein, 1985a & b; Dromi, 1987; Fenson et al., 1994; Gruendel, 1977; Jones et al., 1991; Nelson, 1973, 1976; Smith, 1995). Instead, children gave a high shape bias for the emotion items and a low shape bias for the texture items. This ordering does not reflect the original predictions that were based on the order in which
children acquire various types of adjectives. Children varied their preference across attributes on some other basis, possibly based on perceptual salience. The issue of perceptual salience will be discussed in more detail later.

Shape Consistency

As predicted, children extended novel words more on the basis of shape when labeled items shared one common shape rather than varied in shape. For instance, children chose shape more often when two identical rounded figures were labeled with a word than when the word labeled a rounded figure and an angular figure. This effect of shape consistency was significant only within the emotion items, and the expected difference was present but not significant among the texture items. The limited scope of the effect suggests that shape consistency might be an important factor in children’s word learning but only under particular circumstances, such as when an initial preference (e.g., for shape on the emotion items) is strong.

Age Differences

As predicted, the shape bias increased with age, namely between children around 3 and 4 years of age, replicating previous findings (Landau, et al., 1988). However, this effect was not consistent across all cells. Older children did not show a greater sensitivity to syntactic frame, as predicted. Indeed, there was no evidence that children in either age group attended to the syntactic information in this experiment. Possibly, the effect of age on the shape bias was not robust as the two groups of children tested were relatively close in age.
Results: Adult Data

Data collected from adults were analyzed in a mixed-design three-way ANOVA over both subjects and items: 3 (syntactic frame; between-subjects, within-items) x 2 (shape consistency; within-subjects, within-items) x 4 (domain; within-subjects, between-items). Table 3 displays cell means. Predictions are identical to those for children.

Syntactic Frame

The main effect of syntactic frame was significant, $F(2,45) = 6.01, p < .01$, $\text{MSE} = 0.517$; $F(2, 24) = 57.00, p < .0001, \text{MSE} = 0.013$. Adults hearing novel words within an adjective syntactic frame ($M = 30.9\%, SD = 15.8$) were less likely to choose shape-matched test items than were adults who heard the novel words in a noun frame or no words at all ($M = 61.3\%, SD = 28.7$; $M = 51.7\%, SD = 29.4$, respectively), according to Tukey HSD post hoc tests, $Qs (3, 16) = 4.79$ and 3.28, respectively, $p < .05$.

Domain

The main effect of domain was significant $F(3, 135) = 19.28, p < .0001, \text{MSE} = 0.111$; $F(3, 12) = 12.64, p < .001, \text{MSE} = 0.041$. On color items ($M = 66.3\%, SD = 30.7$), participants gave significantly more shape responses than to items of the other three domains (damage: $M = 50.5\%, SD = 38.1$; texture: $M = 44.8\%, SD = 34.2$; emotions: $M = 30.2\%, SD = 36.5$). There were significantly fewer shape responses within the emotion items than for items representing the other three domains. These differences were significant according to a Newman-Keuls post hoc test (color items versus: damage $Q(2, 188) = 3.12$; texture $Q(3, 188) = 4.26$; emotion $Q(4, 188) = 7.15$; emotion items versus: damage $Q(3, 188) = 4.02$; texture $Q(2, 188) = 2.88$; all $p < .05$). The main
### Table 3

Responses of adults in Experiment 1: Mean percentages of shape-based choices (and standard deviations)

<table>
<thead>
<tr>
<th></th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjective</td>
<td>34.4</td>
<td>12.5</td>
<td>50.0</td>
<td>21.9</td>
</tr>
<tr>
<td></td>
<td>(39.7)</td>
<td>(22.4)</td>
<td>(44.7)</td>
<td>(31.5)</td>
</tr>
<tr>
<td>No Word</td>
<td>65.6</td>
<td>50.0</td>
<td>59.4</td>
<td>43.8</td>
</tr>
<tr>
<td></td>
<td>(43.7)</td>
<td>(40.8)</td>
<td>(49.1)</td>
<td>(44.3)</td>
</tr>
<tr>
<td>Noun</td>
<td>71.9</td>
<td>34.4</td>
<td>78.1</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>(36.4)</td>
<td>(43.7)</td>
<td>(40.7)</td>
<td>(44.7)</td>
</tr>
</tbody>
</table>
effect of domain was qualified by two interactions, one with syntactic frame and the second with shape consistency. Both are detailed below.

**Syntactic Frame x Domain**

There was a significant interaction between syntactic frame and domain: $F(6, 135) = 2.22$, $p < .05$, $MSE = 0.111$; $F(6, 24) = 5.55$, $p < .01$, $MSE = 0.013$. See Table 4 for means relevant to the interaction. According to this interaction, the effect of syntactic frame was significant only within the emotion items, by a Tukey HSD post hoc test, $Q(12, 180) = 5.94$, $p < .05$. Although the means show a pattern of a lower shape preference within the adjective condition across all domains, this difference did not reach significance among the damage, color, and texture items. The interaction also indicated that the effect of domain was significant only within the adjective frame. Although the trend for domain generally holds true within the noun and no-word conditions, these differences were not statistically significant.

**Shape Consistency**

The main effect of shape consistency was also significant, $F(1,45) = 36.70$, $p < .0001$, $MSE = 0.167$; $F(1, 12) = 50.09$, $p < .0001$, $MSE = 0.032$ with fewer shape responses for the trials with inconsistent shapes ($M = 35.3\%, SD = 33.3$) than those with consistent shapes ($M = 60.6\%, SD = 29.7$).

**Shape Consistency x Domain**

The interaction between shape consistency and domain was significant, $F(3, 135) = 7.41$, $p < .0001$, $MSE = 0.068$; $F(3, 12) = 4.46$, $p < .05$, $MSE = 0.032$. See Table 5 for means illustrating this interaction. According to this interaction, the effect of shape consistency was significant within the color, damage, and texture items, but not within
Table 4

Responses of adults in Experiment 1: Mean percentages of shape-based choices (standard deviations) for syntactic frame by domain

<table>
<thead>
<tr>
<th>Description</th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjective</td>
<td>23.4 (25.0)</td>
<td>35.9 (28.8)</td>
<td>59.4 (27.9)</td>
<td>4.7 (10.1)</td>
<td>30.9 (15.8)</td>
</tr>
<tr>
<td>No Words</td>
<td>57.8 (35.0)</td>
<td>51.6 (44.2)</td>
<td>64.6 (33.8)</td>
<td>32.8 (36.2)</td>
<td>51.7 (29.4)</td>
</tr>
<tr>
<td>Noun</td>
<td>53.1 (32.8)</td>
<td>64.1 (36.5)</td>
<td>75.0 (29.8)</td>
<td>53.1 (38.6)</td>
<td>61.3 (28.7)</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>44.8 (34.2)</td>
<td>50.5 (38.1)</td>
<td>66.3 (30.6)</td>
<td>30.2 (36.5)</td>
<td>48.0 (28.0)</td>
</tr>
</tbody>
</table>

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Table 5

Responses of adults in Experiment 1: Mean percentages of shape-based responses (and standard deviations) for shape consistency by domain.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent</td>
<td>57.3 (42.5)</td>
<td>62.5 (45.6)</td>
<td>88.2 (27.9)</td>
<td>34.4 (41.5)</td>
<td>60.6 (29.7)</td>
</tr>
<tr>
<td>Inconsistent</td>
<td>32.3 (39.3)</td>
<td>38.5 (41.6)</td>
<td>44.4 (45.3)</td>
<td>26.0 (42.5)</td>
<td>35.3 (33.3)</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>44.8 (34.2)</td>
<td>50.5 (38.1)</td>
<td>66.3 (30.6)</td>
<td>30.2 (36.5)</td>
<td>48.0 (28.0)</td>
</tr>
</tbody>
</table>
the emotion items, $Q(4, 376) = 7.38$, $Q(4, 376) = 4.04$, $Q(5, 376) = 4.22$, respectively for color, damages, and emotions, $ps < .05$, from a post hoc Newman-Keuls test. The shape bias was relatively high on consistent shape trials on the texture, damage, and color trials, allowing for inconsistency in shape to reduce the shape bias. However, on the emotions trials, the shape bias was quite low even with consistent shapes, so that shape inconsistency had little effect (i.e., a floor effect).

In addition, the interaction indicates that the effect of domain was significant only on the consistent shape trials. On color trials, the shape bias was significantly higher than for the other domains, and on emotion trials, the shape bias was significantly lower than on the other domains (Newman-Keuls tests for color versus: damage $Q(2, 376) = 4.33$; texture $Q(3, 376) = 5.21$; emotions $Q(6, 376) = 9.07$; affect versus: damage $Q(5, 376) = 4.74$; texture $Q(4, 376) = 3.86$; all $ps < .05$). The pattern of results holds true among the inconsistent shape trials as well although the differences are not statistically significant.

**Discussion: Adult Data**

**Syntactic Frame**

As predicted, adults were sensitive to syntactic context, using less of a shape bias for novel words presented as adjectives as compared to nouns. In the no-word control condition, the shape bias was intermediate to that in the adjective and noun conditions, although not significantly less than in the noun-frame condition. Thus, in comparison to the no-word control condition, the adjective frame caused adults to have a significantly lower shape bias. But for the noun condition, relative to the no-word condition, the shape bias did not increase to a statistically significant degree.
Although the mean level of shape-based responses was lower in the adjective condition than in the noun and no-word conditions across all four domains (color, texture, damage, and emotions), this difference between syntactic frames was markedly larger within the emotion items. For these items, in which emotions were offered as an alternative to shape as the referent of a novel word, the shape bias was extremely low within the adjective frame condition ($M = 4.7\%$). Thus, on one hand, this work replicates previous effects of syntactic frame on adults’ hypotheses about the meanings of novel words (e.g., Landau, Smith, & Jones, 1992). But additionally, these results demonstrate that the effect of syntactic frame can vary with the nature of the stimuli; namely that it was most pronounced when on emotion items, in which both the emotional states and the quality of animacy were present.

**Domain**

Adults showed a higher shape bias for items in which color was the alternative to shape and a lowered shape bias when emotions were offered as an alternative to shape. From these results it appears that the type of attribute offered as an alternative to shape affects how often individuals interpret words on the basis of shape. It is important to note that the effect of domain was qualified by two interactions. Namely, the differences across domains were more prominent within the adjective-frame condition and on consistent shape trials.

**Shape Consistency**

Also as predicted, adults were less likely to use shape in extending novel words when the words were used to label two items of different shapes rather than two identical shapes. This effect of shape consistency was qualified by an interaction with
domain. In comparison with the color, damage, and texture items, the difference between consistent and inconsistent shape trials was not statistically significant among the emotion items due to a floor effect. Within the emotion items, the shape bias was relatively low even when shape was consistent between the two labeled objects.

**Comparing Children and Adults**

A comparison between the adults’ and children’s responses suggest that they did not perform identically in their word learning strategies within this experiment. To investigate differences between children and adults, data were combined for a single analysis. A mixed model ANOVA used the following design: 3 (syntactic frame) x 4 (domain) x 2 (shape consistency) x 2 (age). For this analysis, children’s data were collapsed across the two age groups to simplify the comparison against adults. The results of this analysis are described below. Note that statistics are reported only for the main effect and interactions involving age. For effects that duplicate those reported in the previous analyses statistics are not listed.

**Overall Shape Bias**

It was predicted that adults would show a greater shape bias than children. However, in contrast to previous findings (Landau, et al., 1988), there was not a difference between the level of shape bias exhibited by preschoolers and adults. Instead, the overall level of shape based choices was quite similar between children (M = 47.9%, SD = 22.4) and adults (M = 48.0%, SD = 28.0).

**Syntactic Frame x Age**

In the original analysis of the child data, children did not exhibit an effect of syntactic frame, but adults did lower their preference for shape when novel words were
presented as adjectives rather than as nouns or when no words were presented. Thus, adults but not children used syntactic information toward interpreting novel words within this experiment. The relevant interaction between age and syntactic frame was significant in the items analysis only, $E(2, 78) = 1.86, p = .16, \text{MSE} = 0.475; E(2, 24) = 8.94, p < .01, \text{MSE} = 0.027$.

**Domain x Age**

An interaction between domain and age indicated that children and adults responded differently to the various domains, $E(3, 234) = 26.73, p < .0001, \text{MSE} = 0.113; E(3, 12) = 22.48, p < .0001, \text{MSE} = 0.039$. For adults, the highest shape bias occurred on color trials, and the lowest shape preference occurred on the trials involving emotions. Children, on the other hand, showed a different pattern of results. Opposite to the adult responses, children did not find the emotions to be a compelling alternative to shape. In contrast, children showed their highest shape bias for the emotion items (although not significantly greater than damage and color items) and their lowest shape bias for texture items. Thus, we see that although the overall level of shape bias was identical between preschool children and adults, the shape bias occurred at different levels across domains between the children and adults.

One possible explanation for this result is that some of the domains, or at least the stimuli representing them, were simply more or less salient to adults than to children. To test the hypothesis that the salience of the domains differed between adults and children and that this variation related to the difference in their interpretations of the novel words, an informal post hoc test was conducted. Twenty-four adults and nine children (ages 31-45 months, mean age 36 months) were shown only the presentation
pictures for each trial and asked to briefly describe what they saw. These individuals had not participated in the original study. Adults wrote their responses on an answer sheet. The experimenter recorded children’s responses. All responses were coded into four categories: (a) shape based (e.g., jellybean); (b) target attribute based (e.g., furry); (c) both target and shape (e.g., dog ears); (d) ambiguous, including no response, unintelligible, and vague responses (e.g., "pretty", "this", "mommy and daddy’s", "foreign").

In Figures 2-5, the original data from Experiment 1 are plotted against corresponding data from the post hoc follow-up tests. Figure 2 includes shape-based responses by adults on both the experimental and post hoc measures. Note that there is a clear parallel between the two types of responses. Thus, for adults their varying preferences for shape within the word learning experiment may have been driven by their initial focus on shape. In contrast, as depicted in Figure 3, this correlation between experimental and post hoc responses does not hold up for the children. This discrepancy may have been due to the fact that half (52.8%) of the children’s free responses were not codeable as related to either shape or the targeted non-shape attribute.

When examining the same data set in regard to the non-shape targeted attribute responses (i.e., those related to color, texture, emotion, and damages) for both children and adults there is a parallel between the original forced-choice responses and the free responses gathered post hoc (see Figures 4 and 5). Thus, it appears that the initial salience or attractiveness of the stimuli representing the four domains is reflected in the results of the word learning experiment. Further, it seems that for children this is driven primarily by their level of attraction to the non-shape attributes and might not relate to
Figure 2

Adult shape-based responses from Experiment 1 and post hoc follow-up
Figure 3

Child shape-based responses from Experiment 1 and post hoc follow-up
Figure 4

Adult non-shape responses from Experiment 1 and post hoc follow-up
Figure 5

Child non-shape responses from Experiment 1 and post hoc follow-up
the salience of shape itself. Although these results should be taken cautiously as data were gathered post hoc and have been interpreted informally, they provide some evidence to explain why children and adults gave more and less attention to shape across the various domains. Based on these exploratory findings, future research might address the question of why the attributes varied in salience for children and adults. For instance, perhaps children are less sensitive to emotions represented graphically; or are more strongly attracted to tactile stimuli than are adults.

Regardless of the distinction between children and adults in regard to the domains of attributes, it remains clear that the attributes do not function identically. For future studies, researchers should consider broadening the range of stimuli beyond the few typically studied (i.e., size, shape, surface coloration, and material kind) so that results might better generalize to all types of adjectives, for instance emotions, damaged states, or evaluative terms (e.g., good, bad, yucky), or adjectives that describe tastes and smells. Additionally, for any future research comparing the domains, it would be informative to determine whether word learning strategies would vary across the domains if the initial level of salience were controlled before novel words were applied.

Shape Consistency x Age

Finally, both children and adults showed less of a shape bias when novel words were used to label two objects of different shapes rather than two objects of identical shapes although at a greater magnitude for adults, as indicated by an interaction between age and shape consistency, $F(1, 78) = 11.96, p < .001$, $MSE = 0.124; F(1, 12) = 13.61, p < .01, MSE = 0.034$. The effect of shape consistency demonstrates that word learners,
both children and adults, are able to use semantic information to become more flexible in their interpretation of novel words.

Additionally, children and adults used the information about shape consistency differently across the domains presented, as indicated by an interaction between domain, shape consistency, and age, $F(3, 234) = 10.40, p < .0001, \text{MSE} = 0.082; F(3, 12) = 7.74, p < .01, \text{MSE} = 0.034$. For children, the effect of shape consistency occurred primarily on emotion items, which had the highest shape bias initially on the consistent shape trials. Showing an opposite trend, adults used shape consistency across all domains but not significantly so for the emotion items, which were the lowest to begin with. Although these trends suggest that children and adults used shape consistency in different manners, there is actually a parallel between children’s and adults’ use of shape consistency. That is, when the shape bias was low on the consistent shape trials (i.e., within emotion items for adults and for children texture, color, and damage items), the level of shape bias did not become greatly lower when shapes became inconsistent.
Chapter 5: Method for Experiment 2

Experiment 2 parallels Experiment 1, the only distinction being the nature of the stimuli. Whereas in Experiment 1 the stimuli were based on novel geometric shapes, in Experiment 2 the stimuli were based on well-known objects. It was predicted that with these familiar items the shape bias would be lowered. Additionally, Experiment 2 further tests the predictions for the other variables (syntactic frame, domain, shape consistency, and age).

Participants

Children

Thirty-six children, who had not taken part in Experiment 1, participated in this experiment. There were 18 girls and 18 boys. Ages ranged from 30-59 months with a mean age of 45 months. The children were divided into two age groups, with the younger children ranging from 30 to 42 months of age \( (M = 38 \text{ months, } SD = 3.2) \) and the older children ranging from 46-59 months \( (M = 51 \text{ months, } SD = 3.3) \). The children were tested in quiet locations at their preschools in Baton Rouge, Louisiana. Written parental consent was obtained for each child. Six children from each age group were assigned to each of the three syntactic frame conditions.

Adults

Thirty-six undergraduates at Louisiana State University participated to earn extra credit in psychology courses. These students had not participated in Experiment 1. Twelve of these participants were assigned to each of the syntactic frame conditions.
Stimuli and Procedure

The stimuli were parallel to those of Experiment 1 with one major difference; the items were based on pictures of familiar objects and animals rather than novel shapes (see Appendix B for a listing of these items). Items were selected on the basis of pretesting with young children (ages 2-4 years) to ensure that the objects would be familiar to the children participating in this experiment and presumably to the adults as well. For the texture items, object shapes were cut from the various materials. For the damaged items, line drawings of damaged objects were provided (e.g., broken bottles, dirty shoes). For the color items, pictures of objects were printed on colored paper and cut out. For the emotion items, cartoon-like drawing of animals included varying facial expressions. Thus, the distinction between Experiment 1 and Experiment 2 was that in Experiment 1, the stimuli were based on novel abstract shapes, whereas in Experiment 2 the stimuli were based on pictures of familiar items. The procedures for children and adults were identical to those used in Experiment 1.
Chapter 6: Results and Discussion of Experiment 2

Data analyses were identical to those used in Experiment 1. First child data are presented, then adult data, and finally the analysis of adult and child data combined.

Results: Child Data

Data gathered from children were analyzed in a four-way mixed design ANOVA with two between-subjects factors: syntactic frame (adjective noun, and no-word) and age group (older and younger children) and two within-subjects factors: domain (texture, damage, color, and emotion) and shape consistency (consistent and inconsistent). Additionally, for analysis across items, domain was a between-items factor; age, syntactic frame, and shape consistency were within-items factors. Table 6 lists cell means.

Predictions

As for Experiment 1 the predictions were as follows: (a) Syntactic frame: Relative to the no-word baseline condition, the shape bias should be lower in the adjective condition and greater in the count-noun condition; (b) Domain: The shape bias should be highest on the color trials, intermediate on the texture trials, and lowest on the emotion and damage trials; (c) Shape consistency: The shape bias would be lower when labeled items were inconsistent in shape rather than consistent with each other; (d) Age: Between children the shape bias should be higher for older children than younger children. Older children should demonstrate a stronger effect of syntactic frame.

Syntactic Frame

The main effect of syntactic frame was significant, $F(2, 30) = 5.98, p < .01$, $MSE = 0.300; F(2, 24) = 20.24, p < .0001$, $MSE = 0.059$. As predicted, the shape bias
Table 6

Responses of children in Experiment 2: Mean percentages of shape-based choices (and standard deviations)

<table>
<thead>
<tr>
<th></th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjective</td>
<td>41.7</td>
<td>16.7</td>
<td>83.3</td>
<td>58.3</td>
</tr>
<tr>
<td></td>
<td>(49.2)</td>
<td>(25.8)</td>
<td>(25.8)</td>
<td>(37.6)</td>
</tr>
<tr>
<td>No Word</td>
<td>75.0</td>
<td>58.3</td>
<td>100.0</td>
<td>83.3</td>
</tr>
<tr>
<td></td>
<td>(27.4)</td>
<td>(37.6)</td>
<td>(0.0)</td>
<td>(25.8)</td>
</tr>
<tr>
<td>Noun</td>
<td>41.7</td>
<td>25.0</td>
<td>91.7</td>
<td>41.7</td>
</tr>
<tr>
<td></td>
<td>(37.6)</td>
<td>(27.4)</td>
<td>(20.4)</td>
<td>(37.6)</td>
</tr>
<tr>
<td>Old</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjective</td>
<td>0.0</td>
<td>8.3</td>
<td>66.7</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(20.4)</td>
<td>(40.8)</td>
<td>(41.8)</td>
</tr>
<tr>
<td>No Word</td>
<td>75.0</td>
<td>58.3</td>
<td>91.7</td>
<td>58.3</td>
</tr>
<tr>
<td></td>
<td>(27.4)</td>
<td>(37.6)</td>
<td>(20.4)</td>
<td>(37.6)</td>
</tr>
<tr>
<td>Noun</td>
<td>66.7</td>
<td>58.3</td>
<td>83.3</td>
<td>75.0</td>
</tr>
<tr>
<td></td>
<td>(40.8)</td>
<td>(49.2)</td>
<td>(40.8)</td>
<td>(41.8)</td>
</tr>
</tbody>
</table>
was significantly lower when children heard novel words in an adjective frame (M = 53.1%, SD = 22.2) as compared to the noun frame (M = 69.8%, SD = 24.0) and the no-word condition (M = 80.2%, SD = 7.45) according to a Newman-Keuls post hoc test; Qs(3, 33) = 2.98, 4.85, respectively, p < .05. However, there was not a greater shape bias in the noun condition over the no-word condition as was predicted.

**Domain**

The main effect of domain was significant, F(3, 90) = 25.88, p < 0001, MSE = 0.074; F(3, 12) = 10.43, p < .01, MSE = 0.123. As for children in Experiment 1, the shape bias was significantly lower for the texture items (M = 43.8%, SD = 35.0) as compared to items of the three other domains, color (M = 75.7%, SD = 22.8), damage (M = 71.5%, SD = 26.8), and emotions (M = 79.9%, SD = 26.6). Statistics from post hoc Tukey HSD tests were, Qs (4, 140) = 6.80, 5.92, and 7.69, respectively, ps < .05.

**Shape Consistency**

As in Experiment 1, the main effect of shape consistency was significant, F(1, 30) = 22.59, p < .0001, MSE = 0.089; F(1, 12) = 14.77, p < .01, MSE = 0.090. As predicted, children preferred shape more frequently on consistent shape trials (M = 76.0%, SD = 20.6) than on inconsistent shape trials (M = 59.4%, SD = 21.1).

**Age Differences**

The main effect of age group was not significant. The shape bias did not vary with the age of children. The overall level of shape preference was roughly the same between the older (M = 68.4%, SD = 23.9) and younger children (M = 67.0%, SD = 20.4). Additionally, older children did not exhibit a greater sensitivity to syntactic frame, contrary to predictions.
Discussion: Child Data

Syntactic Frame

Children who heard novel words within an adjective syntactic frame were less likely to extend the novel words on the basis of shape than children who heard no words or novel words presented as nouns. This result replicates previous findings (Hall, et al., 1993; Landau, et al., 1992; Smith, et al., 1992; Taylor & Gelman, 1988). But failing to fully match predictions, children did not increase their use of the shape bias within the noun condition relative to the no-word baseline condition.

It is interesting to note that, although not statistically significant, the shape bias was actually lower in the noun condition than in the no-word condition in Experiment 2. This trend appears to contradict previous findings of a greater shape bias when novel nouns are presented than when no words are presented (e.g., Baldwin, 1986, 1989; Denney 1972; Hall, et al., 1993; Landau, et al., 1992; Smith, et al., 1992; Taylor & Gelman, 1988). But note that the shape bias was quite high in the no-word condition--for these familiar objects depicted, children were quite biased to match based on shape or whole-object categorization. When faced with novel words, even nouns, the shape bias lowered. Possibly children were following the word learning principles of $N_3C$ (Golinkoff et al., 1994), contrast (Clark, 1983), and mutual exclusivity (Markman & Wachtel, 1984), which predict that children avoid extending novel words to objects for which they already know a word. As the children already knew words to label the objects based on object kind or shape, they did lower their preference for shape relative to the no-word baseline.
Domain

It was predicted that children would have low shape bias for emotion and damage items, an intermediate shape bias for the texture items, and a high shape bias for the color items. Instead, in Experiment 2 children demonstrated the least preference for shape when texture (e.g., furry) was presented as an alternative to shape and a high shape bias for the other domains of color (e.g., peach), damage (e.g., ripped), or emotion (e.g., happy). This finding is similar to Experiment 1. Although this low shape bias for texture items was not originally predicted, the fact that children's use of the shape bias varied across domains demonstrates that children can alter their use of the shape bias related to the nature of objects' semantic properties. This finding is congruent with experimental findings of Smith et al. (1992) who found that the shape bias varied when the property presented as the alternative to shape (surface coloration and how it was presented) was changed.

As in Experiment 1, to explore children's initial perceptions of the stimuli, outside of the word-learning task, a post hoc study was conducted. Four children (mean age 37 months) were asked to describe what they saw on each presentation page. Figure 6 depicts children's free responses (mean percent of shape-based responses) on this task along with the experimental data. Note that nearly all of the responses in the post hoc follow-up reflected shape. That is, children labeled the whole objects (e.g., cat, truck). No responses focused solely on the targeted attributes. Thus, from this follow-up data it cannot be determined which of the four types of attributes was more salient to the children as their tendency to name whole objects overrode any mention of the targeted attributes.
Figure 6

Child shape-based responses from Experiment 2 and post hoc follow-up
Shape Consistency

As originally predicted and in replication of Experiment 1, when shape was incongruent between labeled objects, children lowered their use of the shape bias. For instance, when children saw two stars labeled with a novel word, they were more likely to extend the novel word on the basis of shape than when the word labeled a star and a house. This finding emphasizes the fact that the shape bias is not an absolute constraint on children's word learning but that children can take into account many sources of information, in this case the level of consistency between shapes that a novel word labels.

Age Differences

It had been predicted that older children would show a greater shape bias than younger children. Although this prediction was confirmed in Experiment 1, the results of Experiment 2 provide no evidence for age-based differences in preschoolers' use of the shape bias. Possibly, the age difference disappeared in Experiment 2 as children of both ages found the shape bias quite compelling for the familiar objects. In neither experiment did the older children demonstrate a greater response to syntactic frame.

Results: Adult Data

Data from adults were analyzed by ANOVA with a 3-way design identical to that of Experiment 1: Syntax (adjective, no-word, and noun) x Domain (texture, damage, color, and emotion) x Shape Consistency (consistent and inconsistent). Cell means are presented in Table 7. Predictions for adults were identical to those for children.
Table 7

Responses of adults in Experiment 2: Mean percentages of shape-based choices (and standard deviations)

<table>
<thead>
<tr>
<th></th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjective</td>
<td>20.8</td>
<td>12.5</td>
<td>0.0</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>(25.7)</td>
<td>(22.6)</td>
<td>(0.0)</td>
<td>(19.5)</td>
</tr>
<tr>
<td>No Word</td>
<td>70.8</td>
<td>25.0</td>
<td>62.5</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>(39.6)</td>
<td>(39.9)</td>
<td>(22.6)</td>
<td>(39.9)</td>
</tr>
<tr>
<td>Noun</td>
<td>20.8</td>
<td>8.3</td>
<td>41.7</td>
<td>20.8</td>
</tr>
<tr>
<td></td>
<td>(25.7)</td>
<td>(19.5)</td>
<td>(35.9)</td>
<td>(33.4)</td>
</tr>
</tbody>
</table>
Syntactic Frame

As predicted, the main effect of syntactic frame was significant, $F(2, 33) = 10.59, p < .001, \text{MSE} = 0.231; F(2, 24) = 26.78, p < .0001, \text{MSE} = 0.030$. The shape bias was significantly lower in the adjective condition ($M = 14.6\%, \text{SD} = 10.8$) than in the noun ($M = 33.3\%, \text{SD} = 20.7$) or no-word conditions ($M = 46.4\%, \text{SD} = 18.0$). These differences were significant by a Tukey HSD post hoc test, $Qs(3, 33) = 3.82, 6.47$, respectively, $ps < .05$. This effect was modified by an interaction with domain as detailed below. Note however that contrary to predictions, the shape bias between the noun and no-word conditions did not vary significantly.

Domain

The main effect of domain was significant over subjects but not items, $F(3, 99) = 4.23, p < .01, \text{MSE} = 0.074; F(3, 12) = 1.94, p = .1774, \text{MSE} = 0.054$. The shape bias was greater for the color items ($M = 40.3\%, \text{SD} = 24.1$) than for texture and damage items ($Ms = 26.4\%, 26.4\%, \text{SD} = 26.0, 29.2$, respectively) according to a series of paired $t$ tests with Bonferroni corrections significant at $p < .05$. (The Bonferroni method rather than the Tukey or Newman-Keuls was used here, as the data did not meet the assumption of sphericity necessary for either of the latter two methods.) The shape bias on the emotion items ($M = 32.6\%, \text{SD} = 29.8$) was not significantly different than any of the other three domains.

Syntactic Frame x Domain

An interaction between syntactic frame and domain was significant over subjects and approached significance over items, $F(6, 99) = 2.54, p < .05, \text{MSE} = 0.074; F(6, 24) = 2.06, p < .10, \text{MSE} = 0.030$. See Table 8 for means relevant to this interaction.
Table 8

Responses of adults in Experiment 2: Mean percentages of shape-based choices (and standard deviations) for syntactic frame by domain

<table>
<thead>
<tr>
<th></th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjective</td>
<td>16.7 (16.3)</td>
<td>4.2 (9.7)</td>
<td>25.0 (18.5)</td>
<td>12.5 (16.9)</td>
<td>14.6 (10.8)</td>
</tr>
<tr>
<td>No Words</td>
<td>47.9 (29.1)</td>
<td>43.8 (26.4)</td>
<td>52.1 (19.8)</td>
<td>41.7 (30.8)</td>
<td>46.4 (18.0)</td>
</tr>
<tr>
<td>Noun</td>
<td>14.6 (16.7)</td>
<td>31.3 (32.2)</td>
<td>43.8 (26.4)</td>
<td>43.8 (30.4)</td>
<td>33.3 (20.7)</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>26.4 (26.0)</td>
<td>26.4 (29.2)</td>
<td>40.3 (24.1)</td>
<td>32.6 (29.8)</td>
<td>31.4 (21.2)</td>
</tr>
</tbody>
</table>
The lower shape bias for the adjective condition relative to the no-word and noun conditions was significant within the emotion and damage items. A similar difference between syntactic frames was present but not statistically significant within the color items. Within the texture items, a different pattern occurred. Namely, in both the noun and adjective conditions the shape bias was lower than in the no-word control condition.

**Shape Consistency**

As predicted, the main effect of shape consistency was significant, $F(1, 33) = 42.76, p < .0001, \text{MSE} = 0.108; F(1, 12) = 69.79, p < .0001, \text{MSE} = 0.023$. Shape based selections occurred at a higher level on consistent shape trials ($M = 44.1\%, SD = 27.3$) than on inconsistent shape trials ($M = 18.8\%, SD = 22.1$). This main effect of shape consistency was qualified by two interactions described below.

**Shape Consistency x Syntactic Frame**

According to an interaction between shape consistency and syntactic frame, $F(2, 33) = 5.30, p < .05, \text{MSE} = 0.108; F(2, 24) = 3.71, p < .05, \text{MSE} = 0.052$, the effect of shape consistency was limited to the noun and no-word conditions (according to a Newman-Keuls post hoc test, $Q_s (6, 66) = 4.90, 6.48$, respectively, $ps < .05$). Within the adjective condition a floor effect yielded a low shape bias overall. See Table 9 for means relative to this interaction.

**Shape Consistency x Domain**

The interaction between shape consistency and domain was significant, $F(3, 99) = 3.91, p < .05, \text{MSE} = 0.077; F(3, 12) = 4.29, p < .05, \text{MSE} = 0.023$. See Table 10 for relevant means. Although the mean level of shape bias was greater on consistent over inconsistent trials across all domains, the difference was significant only within the color
Table 9

Responses of adults for Experiment 2: Mean percentages of shape-based choices (and standard deviations) for shape consistency by syntactic frame

<table>
<thead>
<tr>
<th></th>
<th>Consistent</th>
<th>Inconsistent</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjective</td>
<td>18.8 (11.3)</td>
<td>10.4 (14.9)</td>
<td>14.6 (10.8)</td>
</tr>
<tr>
<td>No Words</td>
<td>65.6 (17.0)</td>
<td>27.1 (27.1)</td>
<td>46.4 (18.0)</td>
</tr>
<tr>
<td>Noun</td>
<td>47.9 (27.1)</td>
<td>18.8 (21.0)</td>
<td>33.3 (20.7)</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>44.1 (27.3)</td>
<td>18.8 (22.1)</td>
<td>31.4 (21.2)</td>
</tr>
</tbody>
</table>

Table 10

Responses of adults in Experiment 2: Mean percentages of shape-based choices (and standard deviations) for shape consistency by domain

<table>
<thead>
<tr>
<th></th>
<th>Texture</th>
<th>Damage</th>
<th>Color</th>
<th>Emotion</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent</td>
<td>37.5 (38.5)</td>
<td>34.7 (35.5)</td>
<td>62.5 (38.5)</td>
<td>41.7 (40.5)</td>
<td>44.1 (27.3)</td>
</tr>
<tr>
<td>Inconsistent</td>
<td>15.3 (28.8)</td>
<td>18.1 (21.0)</td>
<td>18.1 (27.1)</td>
<td>23.6 (34.8)</td>
<td>18.8 (22.1)</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>26.4 (26.0)</td>
<td>26.4 (29.2)</td>
<td>40.3 (24.1)</td>
<td>32.6 (29.8)</td>
<td>31.4 (21.2)</td>
</tr>
</tbody>
</table>
items, according to a Tukey HSD post hoc test, $Q(8, 280) = 3.62, p < .05$. Additionally, the effect of domain was significant only within the consistent shape trials. In particular, within the consistent-shape trials, the shape bias was significantly higher on the color items ($M = 62.5\%, SD = 38.5$) than on either the emotion ($M = 41.7\%, SD = 40.5$), texture ($M = 37.5\%, SD = 38.5$), or damage items ($M = 34.7\%, SD = 35.5$), according to a Newman-Keuls post hoc test, $Q(2, 280) = 3.60, Q(3, 280) = 4.31, Q(4, 280) = 4.79$, respectively, $ps < .05$. Within the inconsistent shape trials, a floor effect provided a low shape bias for items from all domains.

**Discussion: Adult Data**

**Syntactic Frame**

As predicted and similar to the results of Experiment 1, adults showed a lower shape bias in the adjective condition as compared to the noun and no-word conditions. However, in Experiment 2, this effect was significant only within the emotion and damage items, although the trend was present for the color items as well. Additionally, note that there was no evidence that adults relied on the shape bias more heavily in the noun condition than in the no-word condition.

**Domain**

Adults provided a higher shape bias when color, rather than emotions, texture or damages were presented as the alternative to shape. These findings are similar to those found for adults in Experiment 1. But additionally in Experiment 1, there had been a significantly lower shape bias for the emotion items as compared to the texture, color, and damage items.
As in Experiment 1, to further explore adults’ perceptions of the stimuli representing the four domains, a post hoc study was conducted. In this follow-up study 22 adults, who had not participated in the experiment, were shown only the presentation page for each trial and were asked to briefly describe what they saw. Figures 7 and 8 illustrate the comparison between the free responses gathered in this post hoc follow-up test and the forced-choice responses from the experimental procedure. Generally, the a priori levels of salience for each domain, as measured by the free responses, correlate with how often adults attended to that property when extending novel words in the experimental task. One exception to this trend appears for the non-shape attribute responses on texture items. Adults’ preference for texture was not high when adults provided free descriptions of the texture stimuli but was high in the experimental task. However, the overall findings provide some support for the notion that the relative salience of object properties influences word learning strategies.

Shape Consistency

As predicted and replicating Experiment 1, adults less often extended novel words on the basis of shape when objects of different shapes were labeled rather than objects sharing a common shape. Here in Experiment 2, this trend occurred across all domains but most strongly among the color items.

Comparing Children and Adults

Adult and child data were combined in a single analysis in order to determine whether children and adults varied in their strategies for novel word interpretation. A mixed model ANOVA used the following design: 3 (syntactic frame) x 4 (domain) x 2 (shape consistency) x 2 (age: children versus adults). Again, for this analysis children’s
Figure 7

Adult shape-based responses from Experiment 2 and post hoc follow-up
Figure 8

Adult non-shape responses from Experiment 2 and post hoc follow-up
data were collapsed across the two age groups. Note that statistics are reported here only for the main effect and interactions involving age. For effects that duplicate those reported in previous analyses, statistical values are not repeated.

Overall Shape Bias

Children (M = 67.7%, SD = 21.9) showed an overall higher shape bias than adults (M = 31.4%, SD = 21.2), as indicated by a main effect of age, \( F(1, 66) = 71.43, p < .0001, \text{MSE} = 0.265; F(1, 12) = 115.25, p < .0001, \text{MSE} = 0.055 \). Based on previous work (Landau, et al., 1992) it had been predicted that the reverse would be true, that adults would show the greater shape bias. Instead, children began with a strong baseline preference to match the objects by familiar whole-object categorization, rather than by the other properties available. It is not clear, however, why adults exhibited an opposite trend. Possibly children simply found the familiar objects a very appealing basis for categorization, whereas adults found other attributes more salient than did the children.

Syntactic Frame x Age

Both children and adults showed attention to syntactic frame. However, adults were not more sensitive to the syntactic frame as had been predicted. In fact for adults only, the effect of syntactic frame was limited to the damage, color, and emotion items, as indicated by an interaction between domain, syntactic frame, and age, significant over subjects but not in the items analysis, \( F(6, 198) = 2.32, p < .05, \text{MSE} = 0.076; F(6, 24) = 1.66, p < .18, \text{MSE} = 0.035 \).

Domain x Age

Children and adults provided different patterns of responses related to the varying attribute domains, as indicated by an interaction between age and domain, \( F(3, 198) = \)
8.75, $p < .0001$, $\text{MSE} = 0.076$; $F(3, 12) = 4.06, p < .05$, $\text{MSE} = 0.055$. Children showed a high shape bias across all domains except for the texture items, which had a significantly lower shape bias than the other items. Adults showed a different pattern with a significantly higher shape bias for color items than for the other three domains. Shape Consistency x Domain x Age

Both children and adults were less likely to extend novel words on the basis of shape when the novel words labeled two objects of different rather than identical shapes. For adults only, this effect of shape consistency varied within domain, as demonstrated by an interaction between domain, shape consistency, and age, $F(3, 198) = 3.73, p < .05$, $\text{MSE} = 0.081$; $F(3, 12) = 3.98, p < .05$, $\text{MSE} = 0.025$. Specifically, for adults the effect of shape consistency occurred primarily within the color trials.
Chapter 7: Cross-Experiment Comparisons

Recall that the single difference between the two experiments was that Experiment 1 included novel objects, and Experiment 2 included familiar objects. It was predicted that the shape bias would be lower with the familiar objects. This prediction was based on the lexical principles of N3C (Golinkoff, et al., 1994), contrast (Clark, 1983) and mutual exclusivity (Markman & Wachtel, 1988).

To test this hypothesis and how the variable of object familiarity might interact with the other variables included, data from Experiments 1 and 2 were combined and analyzed within a mixed design ANOVA: 2(object familiarity: novel versus familiar, between-subjects and within-items) x 3(syntactic frame: between-subjects and within-items) x 4 (domain: within-subjects and between-items) x 2 (shape consistency: within-subjects and items ) x 2 (age: for children only, between-subjects and within-items).

Child and adult data were analyzed separately. Statistics are provided only for the main effect and interactions involving object familiarity. For effects that parallel those reported in the previous analyses, statistics are not reported.

Children

Overall Level of Shape Bias

A comparison between the overall shape bias for novel and familiar objects can determine whether children were less prone to interpret novel words on the bias of shape when the words referred to familiar objects, as predicted. It seems that children did not follow this principle but instead showed the opposite pattern with a higher shape bias for
familiar objects \((M = 67.7\%, SD = 21.9)\) over novel objects \((M = 47.9\%, SD = 22.4)\), 
\(F(1, 60) = 5.64, p < .0001, MSE = 0.333; F(1, 12) = 35.38, p < .0001, MSE = 0.106.\)

A comparison across experiments starting with the no-word control condition helps to explain this finding. In Experiment 1, which included the novel objects, children in the no-word condition chose shape approximately 50% of the time, and this level of shape preference did not vary with the introduction of novel words. In contrast, with the familiar objects, of Experiment 2, children's preference to match by object shape jumped to 80% within the no-word condition (and when asked to describe the stimuli in the post hoc follow-up, children named the items by whole-object shape at a rate of nearly 100%). But in reference to this high baseline shape bias, children showed a lower preference for shape when novel words were presented. Apparently with the novel shapes in Experiment 1, children did not find the novel geometric forms to provide a strong basis for categorization. For one, the unusual irregular shapes may have been less salient to children than forms representing known objects such as pencils, trucks, or cats. The children also may have found the novel shapes to be ambiguous and more difficult to match together than the familiar objects. In order to match by shape on the novel forms, children would have to determine how to categorize such forms, whereas the categorization would already be established for the familiar objects.

Perhaps, children found that although mutual exclusivity was violated, they could still accept a second label for the objects. Indeed, Savage and Au (1996) found that approximately half of children (ages 3-5 years) tested were willing to accept two novel labels for a single referent (a novel object), suggesting that simply hearing an adult use a second label for an object might allow children to abandon mutual exclusivity.
Additionally, the principles of N, C (Golinkoff, et al., 1994), contrast (Clark, 1983) and mutual exclusivity (Markman & Wachtel, 1988) need not be limited to nouns. In regard to adjectives these principles would predict that children should be reluctant to extend novel adjectives to properties for which they already know a word, just as they should be reluctant to extend novel nouns to objects already named. Applied to the results of this experiment, if children were familiar with adjectives that could label the attributes tested, then this familiarity with such adjectives might balance out any effect of object familiarity, leaving other factors to determine children's hypotheses about novel words.

**Syntactic Frame**

For both experiments it was predicted that relative to the no-word condition, the adjective frame would yield a lower shape bias and the noun frame a higher shape bias. Recall that in Experiment 1, with the novel items, children did not show an effect of syntactic context. Yet, this effect did occur with the familiar items of Experiment 2, with a lower shape bias in the adjective condition. The interaction between object familiarity and syntactic frame approached significance within the subjects analysis and was significant across items, $F_1(2, 60) = 2.49, p < .10$, $MSE = 0.333, F_2(2, 24) = 9.64, p < .001$, $MSE = 0.057$. It is not clear why the effect of syntactic frame occurred in one experiment and not the other. It is possible that the distinction reflects differences between the children sampled for the two experiments or variations between the stimulus sets. For instance, in Experiment 1, the unusual novel shapes may have drawn heavily on children's memory capacity leaving less processing ability for syntactic information. Further research would be necessary to address this issue definitively.
Additionally, note that whereas the shape bias greatly increased from novel to familiar items across the noun and no-word conditions, the difference was much smaller within the adjective condition. Thus, the presence of novel adjectives served to keep the shape bias at a relatively constant level even in the face of children’s strong tendency to match familiar objects by whole object shape.

**Domain**

In both experiments, children were less inclined to interpret novel words on the basis of whole-object shape when texture was offered as the alternative to shape rather than damage, colors, or emotions. The strong appeal of texture, resulting in a lower shape bias for the texture items may have occurred simply because the texture stimuli were more perceptually salient to the children.

**Shape Consistency**

With both familiar and novel items, when children saw two different shapes labeled with the same novel word, they were less likely to interpret the novel word on the basis of shape than when a novel word labeled two objects of identical shape, as predicted. Although this effect of shape consistency occurred across both experiments, the effect was larger for the familiar items of Experiment 2, as indicated by an interaction between shape consistency and object familiarity, which was significant in the subjects analysis and marginal within the items analysis, $F(1, 60) = 5.06, p < .05, \text{MSE} = 0.077$; $F(1, 12) = 3.80, p < .08, \text{MSE} = 0.068$. For the novel items (Experiment 1), the effect of shape consistency only occurred within the texture and emotion items, but for the familiar items (Experiment 2) the shape consistency effect was present across all four domains.
Age Differences

Interestingly, with the familiar objects there was not an increase in the shape bias corresponding with age as occurred with the novel items in Experiment 1. Possibly the shape bias did not vary with age with for familiar items because the familiar objects, with known labels, provided a strong basis for all children to match objects categorically (i.e., by shape). The interaction between familiarity and children’s age was marginally significant within the analysis by subjects and significant over items, $F(1, 60) = 3.53, p < .07$, $\text{MSE} = 0.333$, $F(1, 12) = 26.51, p < .001$, $\text{MSE} = 0.030$.

Adults

Overall Level of Shape Bias

As predicted, adults lowered their preference for shape when familiar ($M = 31.4\%, \text{SD} = 21.2$) rather than novel items ($M = 48.0\%, \text{SD} = 28.0$) were labeled with novel words, $F(1, 78) = 11.36, p < .01$, $\text{MSE} = 0.396$; $F(1, 78) = 11.36, p < .01$, $\text{MSE} = 0.396$.

Syntactic Frame

For the syntactic frames presented it was predicted that relative to the no-word condition the shape bias would be lower in the adjective condition and higher in the noun condition. Across the two experiments with adults, there was a similar effect of syntactic frame, with adjectives yielding a significantly lower preference for shape than the noun and no-word conditions. It is interesting that adults’ preferences varied from the no-word baseline when adjectives but not count nouns were presented. Without further work, it is not certain why adjectives had this unique effect. Possibly, adults’ interpretations of the novel nouns coincidentally matched their preferences in the no-
word condition. Or alternatively, within the experiments the adjective frame may have been more salient.

**Domain**

The effect of attribute domain influenced responses differentially across novel and familiar items, as indicated by an interaction between domain and object familiarity, $E_i(3, 234) = 7.35, p < .0001, \text{MSE} = 0.095; E_i(3, 234) = 7.35, p < .0001, \text{MSE} = 0.095$.

For the novel items of Experiment 1, color yielded a shape bias significantly higher than in the other three domains and emotions yielded a preference for shape significantly lower than for the other three domains. For the familiar items of Experiment 2, the same held true for the high shape bias linked to color items, however, the shape bias for emotion items was now matched by a low shape bias over the texture and damage items.

**Shape Consistency**

The predicted effect of shape consistency occurred across both experiments, that is among both novel and familiar objects. Particularly, adults were more likely to extend novel words on the basis of shape when the novel words originally labeled two objects of identical shape rather than two items that contrasted in shape. This effect however, was not consistent across all conditions, as evidenced by an interaction between shape consistency, syntactic frame, and object familiarity, $E_i(2, 78) = 4.36, p < .05, \text{MSE} = 0.142; E_i(2, 78) = 4.36, p < .05, \text{MSE} = 0.142$. For the familiar items only, the effect of shape consistency was significant only within the adjective frame condition.

**Summary**

As predicted by word learning principles (N, C: Golinkoff, et al., 1994; contrast: Clark, 1983; and mutual exclusivity: Markman & Wachtel, 1988), adults lowered their
shape bias when novel words labeled familiar rather than unnamed objects as
demonstrated in a comparison between Experiments 1 and 2. Surprisingly, children
provided opposite results with a high shape bias for the familiar objects. This
unexpected result demonstrates that word learning principles are not invariant but can be
overridden by other sources of information.
Chapter 8: Conclusions

Discussion of Results

This study explored children's and adults' interpretations of novel adjectives and nouns within an experimental word learning setting. The experiments tested whether participants would choose test items that matched a labeled object on either the basis of shape or another attribute. Influenced by several factors, children and adults varied their tendency to extend the novel words on the basis of shape. Below these findings are summarized and their implications are discussed. For a summary chart of all results, refer to Table 11.

Syntactic Frame

Relative to the no-word control condition, it was predicted that individuals in the adjective condition would show a lower shape bias and individuals in the noun condition would show a greater shape bias. Unexpectedly, children in Experiment 1 did not demonstrate any effect of syntactic frame. Children's overall preference for shape did not vary depending on whether a novel word was framed as an adjective or a count noun or if no word was presented at all. In Experiment 2, with stimuli based on familiar rather than novel objects, children did show some response to syntactic frame: namely their preference for extending novel words on the basis of shape was significantly lower for adjectives relative to count nouns, paralleling previous results (Hall, et al., 1993; Landau, et al., 1992; Smith, et al., 1992 Taylor & Gelman, 1988). However, children in the noun condition did not show a greater shape bias than did the children in the no-word condition as had been predicted.
**Table 1**

### Summary of predictions and results

<table>
<thead>
<tr>
<th>Predicted</th>
<th>Children Expt 1</th>
<th>Children Expt 2</th>
<th>Adults Expt 1</th>
<th>Adults Expt 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Syntax</strong></td>
<td>adj &lt; no word &lt; noun</td>
<td>no effect</td>
<td>adj &lt; noun &amp; no word</td>
<td>adj &lt; noun &amp; no word</td>
</tr>
<tr>
<td><strong>Domain</strong></td>
<td>damage &amp; emotion &lt; texture &lt; color</td>
<td>texture &lt; others</td>
<td>texture &lt; others</td>
<td>color &gt; others</td>
</tr>
<tr>
<td><strong>Shape Consistency</strong></td>
<td>inconsistent &lt; consistent</td>
<td>inconsistent &lt; consistent</td>
<td>inconsistent &lt; consistent</td>
<td>inconsistent &lt; consistent</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>older &gt; younger children</td>
<td>older &gt; younger</td>
<td>no effect</td>
<td>no effect</td>
</tr>
<tr>
<td><strong>Object Familiarity</strong></td>
<td>novel &gt; familiar</td>
<td>familiar &gt; novel</td>
<td>novel &gt; familiar</td>
<td>no effect</td>
</tr>
</tbody>
</table>
Adults appeared to be somewhat more sensitive to syntactic frame than were children. Across both experiments, adults choose shape-based items less often when novel words were presented as adjectives rather than as count nouns or when no words were presented. However, as with children there was not a significant difference between the no-word baseline and the noun condition, with a greater shape bias in the noun condition as had been predicted. More research would be necessary to determine why only the adjectives but not nouns varied individuals' preferences from the no-word baseline. Possibly, preferences for extending the novel nouns happened to match preferences for matching objects within the no-word condition, or alternatively, the adjective frame may have been more salient. For instance, the slightly longer length of the adjective frame (See Figure 1) or particular features of the adjective frame may have made this context more effective than the noun frame.

The effect of syntactic frame for adults was not uniform across the four domains offered as alternative to shape on the test trials. Specifically, for adults in Experiment 1, the effect was limited to the emotion items; in Experiment 2 the effect occurred across all domains except the texture items.

Therefore, the previously demonstrated effect of syntactic frame (e.g., Hall et al., 1993; Landau et al., 1992; Smith et al., 1992; Taylor & Gelman, 1988) did not thoroughly extend to the methodology used in this study. Any of several variations in methodology may have changed the essential nature of the word learning task, influencing children's use of syntactic information. In the previous studies, children saw actual three-dimensional objects rather than pictures as in this study. It is possible that children's word learning strategies vary when presented with pictures in a book rather
than three-dimensional objects, which have various properties not present in two-dimensional representations. Between pictures and objects, children might find different properties more or less salient or important when hypothesizing about novel word meanings. It might be of future research interest to formally test this hypothesis.

However, in the work examining how children classify objects when labeled with novel words (e.g., superordinate or subordinate) children did respond differently to novel adjectives and nouns even when stimuli were photographs or drawings rather than actual objects (Waxman 1990; Waxman & Kosowski, 1990). Although, these studies look at classification in a different fashion than in this study.

Other differences in the methodology may have been influential as well. For instance, in this study children saw each novel word label two objects, rather than only a single object. There was also a great deal more variability among the stimulus items in this study than in past experiments. As the attributes available (i.e., texture, damages, color, and emotions) and shape consistency varied across trials, children may have attended to information from these sources at the expense of syntactic information. Additionally, the stimuli in Experiment 1, in which there was no effect of syntactic frame at all for the children, were unusual novel objects that the children could never have seen before. It is possible that with the novelty of these unfamiliar items drawing on children’s processing abilities, the children had little capacity remaining to focus on syntactic information.

Thus, any of several differences in the stimuli and procedure may have changed the nature of the word-learning task sufficiently to alter children’s strategies or how they chose to attend to the various types of information present. It would be of future
research interest to systematically explore how differences in the presentation of labeled items influences children's use of syntactic information.

For future research regarding syntactic frame and adjectives, researchers might compare how well children distinguish adjectives from other types of words other than count nouns, such as prepositions, verbs, mass nouns, or adverbs. Additionally, it could be explored how children differentially interpret adjectives presented in various syntactic contexts. For instance, experimental data provide some evidence that children more easily learn adjectives that are presented in the prenominal position (e.g., "The red ball") versus the predicate form (e.g., "The ball is red"; Prasada, 1997). This finding mirrors trends in early adjective development. In their earliest use of adjectives, young children more often produce adjectives in the prenominal form than the predicate (Nelson, 1976).

The syntactic frame of a novel adjective could also be varied in order to emphasize a particular attribute by providing a frame unique to that domain of adjectives. Rather than the generic, "This is very X", more informative sentence frames could be presented. For emotions a suitable frame might be "He is feeling very X today", for textures "Feel how X it is", for damages or other transient states, "What happened to this? It is X" and for colors, "What color is this? It is X". With such explicit syntactic frames, children should have little difficulty in determining the meanings of adjectives. However, it might be of interest to determine the earliest age at which children begin to use this specialized syntactic information.
Discussion

Summary of Results. In these experiments, four different attributes were presented as the alternative to shape for the extension of novel words. Originally, it was hypothesized that children would show a high shape bias on the color items, an intermediate shape bias on the texture items, and a low shape bias on the emotion and damage items. These predictions were based on previous findings of observational and experiment research on adjective development (Bornstein, 1985a & b; Dromi, 1987; Fenson et al., 1994; Gruendel, 1977; Jones et al., 1991; Nelson, 1973, 1976; Smith, 1995). However, this predicted pattern of results did not occur. Instead children showed a different pattern of results across the four domains.

A look at child and adult responses to the four domains provides an interesting contrast. For children in both experiments, the shape bias was significantly lower on the texture items. Children did not follow the prediction that the shape bias would be lowest on the emotion and damage items, intermediate on the texture items, and highest on the color items. Adults also varied their shape preference with domain but showing different trends than the children and somewhat following the predicted pattern of results. In Experiment 1, adults showed a low shape bias on emotion items. In both experiments, adults showed a high shape bias on color items.

Attribute Salience. After seeing that word learners vary their use of the shape bias depending on what attribute is available as an alternative to shape, one might ask why this variation affects learners in such a fashion. A simple explanation for the results is that learners vary their hypotheses according to the relative salience of an object’s properties. For instance, in the no-word condition, children found texture the most...
salient of the four attributes, both measured with the experimental procedure and also with the free response descriptions elicited as a follow-up to Experiment 1. This high baseline level of perceptual salience for texture is mirrored in children's choices for the referents of novel words—here too children chose texture more often than the other attributes, resulting in a low shape bias on texture trials.

These results are congruent with the hypothesis that children map novel words to the most salient or attractive properties of an object. This hypothesis is subsumed by the principle of relevance (Bloom, et al., 1993). According to the principle of relevance, because the textures in this experiment were quite appealing to the children before novel words were introduced, the children would find the textures more relevant in guessing about the meaning of the novel words.

Explaining children's word learning strategies in terms of what is salient leads to the question of what makes texture so relevant or salient to the children and the other attributes less so. One might guess that the tactile nature of the texture stimuli was especially attractive to children, relative to the other stimuli that did not have interesting textures. In other words, in comparison to the other items, the three-dimensional nature of the materials used to create the texture items, such as fake fur and sand paper, may have attracted children with their appeal to the modality of touch, which was not emphasized by the plain textures of the other stimuli. It would be of interest to determine if textures must be presented along with the other attributes for texture's level of salience to remain high. Alternatively, the relative salience of texture might disappear if the attributes were varied between subjects rather than within subjects as in this study.
It is of interest to note that texture was especially salient to children because it is texture that has typically been included as the alternative to shape in studies examining adjectives and the shape bias (e.g., Hall, et al., 1993; Markman & Wachtel, 1988; Taylor & Gelman, 1988; Smith et al., 1992). Accordingly, one should be cautious in assuming that the results of those studies that only tested one attribute (which appears to be a very strong alternative to the shape bias for children) would generalize across other types of attributes. The interaction between syntactic frame and domain in this study illustrates that certain effects might not be consistent across all attributes. Similarly, Landau et al. (1992) demonstrated that syntactic frame played a greater role related to texture than size. For future research, it is suggested that the stimuli include multiple types of attributes and possibly that researchers systematically control for \textit{a priori} levels of perceptual salience across attribute domain.

Other research also provides a link between perceptual salience and children's extensions of novel words. For example, Kagan and Lemkin (1961) found that in matching objects by perceived similarity, young children matched most often by shape, secondly by color and rarely by size. This relative lack of emphasis on size is paralleled in children's word learning strategies; Landau, et al. (1992) demonstrated that children do not find size to be important when extending novel words, whether nouns or adjectives.

It is surprising to see that for adults their shape bias was consistently low on the emotion items, but for children this trend reversed; their shape bias was high on the emotion items. This contrast suggests that children gave less attention to the emotions than did adults. One reason for this might have been that children were not able to
identify or discriminate emotions represented by line drawings. However, Walden and Field (1982) demonstrated that children (ages 3-5 years) were able to discriminate emotions based on line drawings of faces. Likewise, informal testing of some children who participated in this study confirmed that they easily distinguished the emotions as depicted in the stimuli.

Also, children may have discounted the emotions because there were no contextual cues (e.g., events or situations) to help indicate why certain emotions were expressed. But providing evidence against this possibility, Hoffner and Badzinski (1989) found that young children actually rely more on facial expression itself than on contextual cues for determining emotions.

It seems clear that children in this study should have easily perceived the emotions, and an inability to do so could not account for children not attending to the emotions. In place of focusing on specific emotions, it seems that children focused on the general characteristic of animacy, which was unique to the emotion items. In their free response descriptions of the stimuli during the follow-up study of Experiment 1, children rarely described the particular emotions ($M = 11\%$) but frequently gave responses that focused on the animate nature of the creatures ($M = 61\%$). For example children listed facial features (e.g., eyes, mouth) or gave animal names, which reflected both shape and animacy (e.g., worm, fish). Thus, the salience of the general characteristic of animacy (which was present in both the shape and non-shape test items) may have precluded children from attending to the emotions. In contrast, adults describing the same stimuli mentioned the specific emotions at a mean rate of $75\%$.
Considering that attribute salience appears to play an important role in children's word learning strategies, it could be informative to explore attribute salience in various manners. For one, researchers could simply vary salience in the creation of stimuli. For instance, Smith et al. (1992) found that in extending novel adjectives, children attended more to surface texture and less to object shape when the surface texture was made extremely salient (i.e., sparkling glitter under a spotlight).

Beyond changing the attributes themselves, the salience of attributes can be manipulated in other ways. For instance, Gottfried and Tonks (1996) found that children (ages 4–5 years) could more easily learn a novel color term if it was presented in relation to a known color term (e.g., either contrasted, "See, it's not purple; it's mauve" or included, "See, it's mauve, a kind of purple) rather than presented in a more ambiguous context (e.g., "See, it's mauve"). The sentences relating the novel color terms to familiar color terms allowed children to more easily learn that the words referred to colors rather than shapes. Au and Markman (1987) reported similar results in relation to texture terms as well. Thus, appropriate sentence contexts appear to increase the salience of a given attribute, in these cases color and texture; similar results should occur when teaching children novel adjectives across other domains, such as emotions, damages, other transient states or properties, evaluative terms, and so forth.

As described in the previous section concerning syntactic frame, the syntactic context of adjectives could be varied to highlight certain attributes (e.g., "Feel how X it is" for a texture term). Besides varying the syntactic frame of isolated sentences, certain attributes could be made more salient by presenting them within a narrative in which the attributes of objects are relevant to the story. Attributes might also become more salient
if incongruent attributes were displayed (e.g., discolored food, clothing made of odd materials) or if they were viewed as more important toward defining a category. For instance, it has been established that children attend to surface covering more for animate than inanimate objects (Jones et al., 1991; Smith, 1995). This might be due to the fact that the material that covers an animal’s skin helps in defining categories of animals--mice are furry, birds have feathers, and fish are covered with scales. Other types of properties that also help to discriminate categories of objects, such as color (e.g., lemons versus limes) or size (e.g., baby versus adult) might be more salient because of this defining function.

Shape Consistency

It was predicted that word learners would be less likely to extend novel words on the basis of shape when two objects that differed in shape were labeled rather than two objects that were identical in shape. This hypothesis was supported throughout the study. These results demonstrate that word learners do not use the shape bias invariably but instead strategically determine when it might be more or less relevant to the meaning of a word. This flexibility of the shape bias, and the word learning principles that lead to the shape bias, has been discussed previously. The shape bias is not an innate universal constraint but learned as children acquire object labels and realize that the shape bias correlates with certain word extensions (Smith, 1995; Smith, Jones, & Landau, 1997). Further, Gathercole and Min (1997) provided evidence that acquiring the shape bias depends on the nature of a child’s native language. Finally, Markman (1994) noted that although word learners make use of principles or constraints, the principles interact with one another and are influenced by the linguistic and nonlinguistic context of words and
children's more general cognitive abilities. In the case of shape consistency, children are able to determine that when shape varies between referents of a word, then shape should receive less priority when children choose among various possible word meanings.

Relevant to shape consistency, it has not been investigated how different two shapes must be to lower the shape bias. Although categories of objects share similar shapes, the exact shapes frequently vary across category members, for instance tables, chairs, and cars all differ in their particular shapes. One might ask how large a difference in shape is necessary to create objects that appear to belong to different categories and thus violate the shape bias. In the current study, the inconsistent shapes contrasted to a large degree. However, the differences in shape between multiple referents of a word need not be so large. Future research could determine the degree of difference necessary to alter the shape bias.

Further, the manner in which shape is varied could affect performance as well. For instance, changing the body shape of an animal might have a different effect on word learning hypotheses than changing the shape of arms and legs; variations in the shape of essential functional features (e.g., shape of bike wheels) might have a greater impact than variations on less functionally important features (e.g., shape of bike seat), or similarly for aspects of shape that provide more or less information about category membership. Other various types of changes might be more or less influential on the shape bias. For example, a shape composed of jagged angular lines could be changed in shape by producing a similar shape but with smooth and flowing lines or by creating a
different shape that includes jagged angular lines. Whether and how such differences in shape variation influence the shape bias remains to be explored.

Also, in place of varying the consistency of shape, the consistency of other properties could be varied to explore how this would effect children's acquisition of adjectives. Such a study could determine to what degree properties of objects can vary but still be considered referents of the same novel adjective. This type of research could also determine what aspects of properties are important in children's hypotheses for adjective learning. For instance, in extending color terms, hue might be a more important aspect than brightness.

Age Differences

Children. Two predictions were made concerning the relation between children's age and the use of the shape bias: (a) Older children would exhibit a greater shape bias; and (b) Older children should show greater differences in the shape bias across syntactic frames.

In Experiment 1 with the novel items, as predicted older children generally exhibited a greater preference for shape than younger children in hypothesizing novel word meanings. This finding is not new but replicates previously established results (Landau, et al., 1992). This effect of age was not consistent across all the conditions tested. Namely, the age difference disappeared or slightly reversed in four cells within the consistent shape trials. There is no clear explanation for this discrepancy.

In Experiment 2, with familiar rather than novel items, there was no significant difference between the older and younger children. For these stimuli, the children at the younger age level had already reached a high shape bias, limiting the potential for an age
effect. It is also possible that across the two experiments, there was not a consistent age effect simply because the older and younger children were actually quite close in age. In contrast, when Landau et al. (1992) found an increased shape bias with age, their two age ranges were separated by two years (children were 3 and 5 years old). Indeed, a look at the overall shape preference for the four youngest and oldest children within Experiment 2 (Ms = 60.9%, 71.9%, SDs = 16.4, 27.2, respectively) suggest that if the age groups had been further apart, a significant age effect might have occurred. Thus, it appears that measurable differences in children's use of the shape bias may develop at some point over the course of a year.

In neither experiment did the older children show a greater sensitivity to syntactic frame than did the younger children. In Experiment 1 there was no overall effect of syntactic frame for children. In Experiment 2, children did respond to syntactic frame but not differently across age groups. These results suggest that possibly, children's use of syntactic frame does not increase to a measurable degree between the ages of 3 and 4 years.

Children versus Adults. Two predictions were made regarding children and adults: (a) Adults would show a greater shape bias; and (b) Adults would show more variation in the shape bias across the syntactic frames.

In comparing children and adults within Experiment 1, there was no evidence for an overall difference in preference for shape. Nonetheless, other age-based differences occurred. For one, as predicted, adults demonstrated more sensitivity to variations in syntactic frame than did children. In other age-related distinctions, children and adults responded differently across the four adjective domains of texture, damage, color, and
emotion. It appears that responses may have been driven by initial levels of perceived salience, which vary for children and adults.

In Experiment 2, there was a significant overall difference between child and adult performance. But contrary to the prediction that adults would show a higher shape bias than children, the reverse was true; children chose shape-based test items at a much higher rate than adults. For some reason, children found matching by known categories (e.g., cats, cups, trucks) much more attractive than did adults, resulting in a higher shape bias.

In Experiment 2, there was not evidence that adults were more sensitive to syntactic frame than were children. In fact, adults showed a more limited response to syntactic frame, demonstrating it only for the emotion and damage items, whereas for children, the effect of syntactic frame was consistent across the four domains.

Object Familiarity

Three word learning strategies, N3C (Golinkoff, et al., 1994), contrast (Clark, 1983) and mutual exclusivity (Markman & Wachtel, 1988) predict that a child should be less likely to use the shape bias if the child knows a name for the object rather than if he or she does not know an object label. Indeed, past experiments have provided evidence that children do use such word learning strategies (Hall et al., 1993; Markman & Wachtel, 1988; Taylor & Gelman, 1988). In order to extend this finding, Experiments 1 and 2 varied only in the familiarity of their stimuli. It was predicted that the shape bias would be greater with the novel items of Experiment 1 than for the familiar items of Experiment 2. This relationship did hold true for the adults participating in the study.
Yet, for children the opposite trend occurred. Children were much more inclined to match by object type (shape) for the familiar objects. However, this effect was moderated by linguistic input; namely, the increase in shape bias on familiar items was not large among children in the adjective condition. A tendency to avoid the shape bias with adjectives constrained the rise in the shape bias between novel and familiar items.

Nevertheless, an important question remains—why the familiarity effect was reversed in this study as compared to previous findings (Hall et al., 1993; Markman & Wachtel, 1988; Taylor & Gelman, 1988). A simple explanation is that within this study the familiar items attracted children more to shape-based categorization than did the items used in past studies. Unfortunately, the past studies only compared noun and adjective frames and did not include a no-word control condition, so it is impossible to compare levels of perceptual salience without the presence of novel words. However, various differences in methodology may have been important. For example, in the previous studies, the stimuli included actual objects for both the familiar and unnamed items. The unnamed objects were objects that might have been familiar to children, although without familiar names (e.g., tongs, garlic press). However, in this study, the unnamed items were unusual geometric shapes that would not have been familiar to children in any way. Possibly for these novel shapes, children found it more difficult to match by similar shape. Also, a feature unique to this study is that the stimuli were presented as pictures in a book rather than as actual objects as were used in past studies. Perhaps children learn to modify their word learning strategies when faced with pictures in books rather than actual objects, as also mentioned earlier in this chapter in reference to syntactic frame. The hypothesis that children respond differently to words presented

100
with pictures rather than objects remains to be tested but could be an important issue from both practical and theoretical viewpoints.

Regardless of why this study produced results opposite to that of previous researchers, one fact remains clear—contrary to the predictions of word learning principles, object familiarity did not serve to reduce the shape bias. Instead, children were more inclined to extend novel words on the basis of whole-object shape when they already knew words for those objects than when novel objects were presented. These results appear to violate the principles of N3C, contrast, and mutual exclusivity. However, it is important to emphasize the very high (80%) preference for shape in the no-word baseline control condition. When children were very strongly attracted to match objects by whole-object shape without the presence of novel words, this appeared to override any effects of N3C, contrast, or mutual exclusivity.

Perhaps children did use those word learning principles to avoid redundant labels, but not in the manner expected. When confronted with shapes and other attributes, children may have paid less attention to attributes for which they already knew adjectives. For instance, children showed a large shape bias on the emotion items, or stated in the converse, children were reluctant to assign emotions as the referents of novel words. Assuming that the children already knew names for the emotions represented (see Ridgeway, Waters, & Kuczaj, 1985) then a tendency to avoid redundant labels would inhibit their focus on emotions, just as it would for whole-object shape. In general, for all the domains if children knew words for both the whole object and the targeted property, then the word learning principles would not play a large role but
instead other factors, such as perceptual salience, shape consistency, or syntactic frame, would influence children's strategies in extending the novel words.

**Adjectives and Lexical Principles**

Returning to principles of word learning that began this work, one might ask how these principles would guide children's acquisition of adjectives. Some of the principles make general predictions about word learning and could easily extend to adjectives; others would not apply as well. Possibly, other principles are necessary to account for adjective development. The application of lexical principles to children's acquisition of adjectives is discussed below.

**Reference**

Reference simply tells a child that speakers use language to refer to events and objects in the world, that language is used for communication (Golinkoff, et al., 1994). As reference merely provides children with this very basic and fundamental information about language, it applies equally well to all classes of words.

**Extendibility**

Like reference, the principle of extendibility provides only basic information about words; in this case, that words refer to exemplars beyond those explicitly labeled with a word (Golinkoff et al., 1994). Although children seem to prefer shape as the basis of extension, they are not solely limited to shape but also extend words on the basis on other attributes, such as size, texture, or taste, allowing children to find the correct referents of adjectives (Clark 1977, 1983). Thus, the principle of extendibility can be a useful principle for children in learning adjectives.
Object Scope

The principle of object scope (Golinkoff et al., 1994) definitely would not help children in determining the correct meanings of adjectives. Object scope states that words refer to whole objects, leading to a shape bias, which children generally do not follow in hypothesizing about novel adjectives. Thus, to account for children’s success in learning adjectives, perhaps a new principle must be proposed.

A New Principle for Adjectives: Property Scope

Although some previously proposed principles of word learning are general enough to encompass many types of words including adjectives, no principles have been put forth to specifically account for adjectives. One candidate for a principle specific to adjectives that propose here is a principle of property scope. The possible dimensions of this principle are outlined below.

When children determine that a word is an adjective through syntactic or morphological information, they should apply the principle of property scope rather than object scope as they would for nouns. According to property scope, adjectives describe a single property or attribute of an object.

Based on linguistic analysis of the adjectival category (Bhat, 1994), there are additional features that should be included within property scope as a principle unique to adjective learning. For one, an adjective can name a property across objects regardless of variations in object type or shape (e.g., when red labels both an apple and a stop sign). Further, adjectives are specific in that they refer to a single property rather than to a cluster of properties as do nouns (Bhat, 1994). Whereas nouns typically refer to objects that share many properties—frequently shape but often others as well such as texture,
color, and size—adjectives focus on a single property of an object. Note that this would allow children to distinguish adjectives from mass nouns as well as count nouns. Whereas a mass noun refers to a particular substance, or category of substances that share several common properties (e.g., milk refers to a white edible liquid of a certain taste, smell, thickness, and so on), an adjectives refers to a single property of a substance (e.g., white, or wet, or cold).

Property scope indicates to children that any property of an object might be the referent of a novel adjective. The properties considered need not relate to the shape of an object. How the child chooses what property to focus on will depend on various sources of information. Perceptual salience, other semantic influences, or linguistic information (e.g., syntactic frame) can help children to determine to which specific property an adjective refers.

For children following property scope, one way to determine the relevant property would be to search for a property common across all objects that an adjective labels. Children should most easily learn adjectives when they refer to multiple referents that share only the relevant property and vary across other dimensions. It should be more difficult for children to learn an adjective that is only used to refer to one object. Also more difficult to acquire would be adjectives that refer to objects that share more than one property. For instance, children might have difficulty determining that a word refers to the color brown if the word labeled several furry brown small four-legged animals (e.g., a cat, dog, and rabbit) but might more easily learn the color term if applied to objects that share the color brown but vary along other dimensions (e.g., a brown cat, car, and table). Some evidence for this hypothesis comes from the current study.
Children were more able to attend to non-shape properties when shape varied between referents of novel words.

Although children can consider shape under property scope, a shape bias does not result as shape must compete with all other properties available. In the few cases in which shape is related to the correct meaning of an adjective (e.g., square, round, pointy, tubular) children should extend the adjective to objects of like shape even if the object type changes (e.g., a square pillow and a square pencil cup) but not if the type remains constant and the shape changes (e.g., a square pillow and a round pillow).

Because children acquire adjectives more slowly than nouns, it is likely that children develop the principle of property scope relatively late and not until after they begin to distinguish adjectives from nouns on the basis of syntactic or morphological input.

**Categorical Scope**

Categorical scope states that words label objects of a common basic level category (Golinkoff, et al., 1994). Basic level categories organize objects, however adjectives refer not to categories of objects but to categories of properties. In order to determine whether children follow a sort of categorical scope principle for adjectives, it would first be necessary to determine how individuals categorize relevant properties. Like the categorization of objects, the categorization of properties may take on a hierarchical nature with basic-level, superordinate and subordinate categories. For example, certain color terms (e.g., green) might label basic categories of colors that incorporate subordinate level exemplars (e.g., mint green, pine green, and chartreuse).
Or a basic level texture term might be soft, with subordinate terms of furry, velvety, and silky.

However, object properties might not fall into a clearly delineated categorization system with superordinate, basic, and subordinate levels; alternatively some other organizational scheme might be used for attributes and might even vary across different types of attributes. Further, the category of properties that an adjective refers to varies with the object that it modifies. Adjectives’ meanings are not absolute but depend on the nature of the that noun they modify. For instance, the range of colors that are categorized under red vary between the phrases red ink and red hair. Similarly, dimensional terms, such as long, short, small, and big are relative terms that depend on the nouns that they modify. A big mouse does not share the same size as a big elephant.

Assuming that properties do not fit well into basic level categorization, categorical scope is not a principle that would apply well to adjectives. Indeed, Gross, Fischer, and Miller (1989) have suggested that adjectives typically describe properties that are not organized in superordinate, basic, and subordinate categories but the properties vary along a bipolar range (e.g., dark, light; or even multi-polar ranges, such as red, green, yellow, blue).

One specific prediction of the categorical scope principle could be applied to adjectives. Namely, in reference to nouns categorical scope states that children extend words not on a thematic basis but by basic level categorization (Golinkoff et al., 1994). For adjectives as well, children should not use thematic relations but instead extend novel adjectives on the basis of property scope. For example, upon hearing a novel adjective label a sad baby, a child should extend the adjective to another referent sharing
a common property (e.g., a sad turtle) rather than sharing a thematic relation with the baby (e.g., a bottle).

N.C. Mutual Exclusivity and Contrast

The three word-learning principles of N3C (Golinkoff et al., 1994), contrast (Clark, 1983) and mutual exclusivity (Markman & Wachtel, 1988) can guide children in the acquisition of adjectives. Specifically, when children already know a name for an object, upon hearing a novel word children should move away from the whole-object shape and focus on other properties or parts of the object. This shifting of focus to other properties can lead children to the correct non-shape properties that adjectives label. Beyond helping children to move from shape to other properties of objects, these word learning principles make other predictions relevant to children’s acquisition of adjectives.

For one, children should be more apt to extend words to unfamiliar properties, for which they do not have a name than to familiar and named properties. Thus, unfamiliar properties should provide a stronger alternative to the shape bias than familiar properties (e.g., unusual colors versus primary colors). It is possible that within the current study, children found texture to be an appealing alternative to shape because they were less likely to have words to describe the textured materials than the attributes of the other three domains.

Additionally according to the three word learning principles, upon hearing a novel adjective, children should prefer to extend it to unfamiliar, unnamed properties rather than familiar named properties. For instance, children should be more likely to map a novel adjective to an unfamiliar color (e.g., gray-green) rather than a more basic and
familiar color (e.g., primary green). The same pattern would also be predicted across domains other than color. Thus, after property scope moves children to focus on properties of objects, N, C, contrast, or mutual exclusivity can help children to narrow the range of properties considered.

**Conventionality**

The principle of conventionality (Clark, 1983) is a general word learning principle that directs children to adopt standard word forms rather than using their own unconventional formations. Children can use the principle of conventionality to guide their acquisition of all classes of words. For adjectives, like all other word classes, coined forms (e.g., salter for more salty) should be replaced by conventional forms.

**Relevance**

The principle of relevance (Bloom et al., 1993) was developed to help account for children's word learning across lexical classes rather than in regard to nouns only. Thus, relevance is a general principle that is pertinent to adjectives. Relevance might work with property scope in guiding children's interpretations of novel adjectives. After property scope directs children's attention to properties, relevance can indicate which particular property to focus on.

Based on the results of this study, relevance seems to play an important role in adjective learning through perceptual salience. When children find a property of an object to be relatively salient it becomes more relevant to the word learning strategy and thus, following the principle of relevance, children map novel words to salient properties. For instance, in this study children appeared to find the textures particularly salient resulting in a low shape bias within the no-word baseline condition. This
preference for texture was paralleled in children’s responses when asked to extend novel words. Similarly, when children in the no-word condition found shape more salient for familiar over novel objects so did children when hypothesizing about novel words.

Whereas the principle of relevance states that adjectives should be mapped to properties that a child finds relevant or salient, the principles of N3C (Golinkoff et al, 1994), contrast (Clark, 1983) and mutual exclusivity (Markman & Wachtel, 1988) predict that children should map novel adjectives to properties that were previously unnamed. To test which principle children follow when in a conflicting situation, children could be presented with a novel adjective and be asked to extend the adjective to either a salient but familiar property (e.g., bright pink) or a less salient but unnamed property (e.g., a pale grayish brown). The principle of relevance predicts that children should choose the salient property, whereas the other three principles (N3C, contrast, and mutual exclusivity) predict that children should choose the less salient but unnamed property.

**Conclusion**

In this study, several factors were explored relative to children’s and adults’ hypotheses about novel adjectives and nouns and how the shape bias varied in response to variations in the stimuli. Children and adults were flexible in their use of the shape bias and varied their preference for shape in response to both linguistic and nonlinguistic information. This work contributes to the understanding of children’s adjective learning.

However, many questions remain to be answered before a full account of adjective acquisition can be developed. Particularly, it will be necessary to ascertain
what specific principles or biases children follow to guide them toward the correct meanings of adjectives. Golinkoff et al. (1994) have provided a lexical principles framework composed of six principles that do well to explain children's development of nouns. However, in order to fully account for vocabulary development, the framework must include additional principles that can encompass the acquisition of all types of words. By adding the principle of property scope, as proposed in this paper, as well as the principle of relevance (Bloom et al., 1993) the lexical principles framework could move beyond nouns to account for the acquisition of adjectives as well.
References


112

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Appendix A

Statistical Abbreviations

**ANOVA**: Analysis of variance, used to detect differences between conditions among several factors and levels; effects are indicated by $F$ statistics

**M**: Arithmetic mean

**SD**: Standard deviation

**$F_1$**: Test statistic derived from ANOVA based on analysis over subjects

**$F_2$**: Test statistic derived from ANOVA based on analysis over items

**$p$**: Probability value

**MSE**: Mean square error

**Q**: Test statistic for determining differences between means in post hoc tests

**t**: T-test statistic, used to detect differences between pairs of means
Appendix B

Objects depicted in Experiment 2

**Texture**
- balloon, flower, umbrella
- shirt, ball, hat
- star, house, tree
- pencil, cup, bone

**Emotions**
- cat, turtle, dog
- ant, frog, bear
- butterfly, mouse, fish
- pig, rabbit, worm

**Color**
- popsicle, feather, houseplant
- scissors, block, table
- hamburger, paintbrush, safety pin
- truck, ice-cream cone, school

**Damages**
- chair, toothbrush, crayon
- boot, hand, apple
- bottle, eyeglasses, lightbulb
- wagon, shoe, bell
Vita

Lenore Carol Frigo was born in LaCrosse, Wisconsin. She received a Bachelor’s degree from Marquette University (Milwaukee, Wisconsin) in 1993 with a major in psychology and minor in Spanish. At Louisiana State University (Baton Rouge, Louisiana), she has earned the degree of Doctor of Philosophy, with a major in Cognitive Psychology, under the supervision of Dr. Janet McDonald, and a minor in Communication Sciences and Disorders, under the supervision of Dr. Janna Oetting. Her research interests include language acquisition, psycholinguistics, memory and learning.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Lenore Carol Frigo

Major Field: Psychology

Title of Dissertation: Adjective Acquisition: Developmental Changes in the Use of the Shape Bias, Syntax, Shape Consistency, and Semantic Attributes

Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

March 20, 1998