THE STRUCTURE AND MEANING OF COMPOUNDS IN CHILD AND ADULT GRAMMARS

By

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ABSTRACT

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This dissertation presents a series of studies examining the structure and meaning of compounds, such as *mouse-trap* and *mouse-catcher*, in child and adult grammars. The first part of this dissertation examines how adults interpret compounds and the second part examines how children acquire the adult compounding system. The goals are (i) to argue that a generative lexical semantics is necessary to understand how speakers use compounds and (ii) to argue that children use the same generative mechanism as adults to build compound interpretations.

In the first part of this dissertation two adult studies examine the role of a generative syntax and a generative lexical semantics (Pustejovsky 1995) in the interpretation of compounds. The first study asks adults to interpret novel noun-noun compounds and verbal compounds. The results support the hypothesis that organized lexical information, including natural classes, must be taken into account in addition to syntactic structure to determine the most likely meaning of compounds. The second study asks adults to rate different interpretations of verbal compounds. The results support the hypothesis that the syntax of verbal compounds constrains the relationship between the verb and modifier to a single verb-internal argument interpretation. Taken together, these results support a model where both the syntax and the lexical semantics are active, generative mechanisms.

In the second part of this dissertation five child studies test the hypothesis that, given compositionality, children's knowledge of syntax and lexical semantics go hand in hand with their interpretation. Three studies examine children's production and interpretation of noun-

noun compounds, with the goal of determining if children use lexical structure in the same way as adults when producing and interpreting compounds. The first noun-noun study is a corpus study. The results support the hypothesis that children and adults produce novel noun-noun compounds according to the natural classes of the constituents in compounds, but not the individual words in compounds. The second noun-noun compound study is an elicited production task. The results provide evidence for children's production of compounds for the same range of meanings as adults, albeit to a lesser degree overall. Finally, the third noun-noun compound study is a forced-choice interpretation task. The results support the hypothesis that children interpret novel compounds according to their knowledge of natural class behavior, rather than individual word behavior.

Next, two studies examine children's production and interpretation of verbal compounds. The goal of these studies is to examine whether children's knowledge of verbal compound syntax, as evidenced by their production, makes predictions about children's comprehension of verbal compounds. The first study is an elicited production task. The results provide evidence for the idea that children's non-adult verbal compound forms (*catch-mouse* and *catcher-mouse* but not *mouse-catch* for *mouse-catcher*) reflect the steps in the adult derivation of verbal compounds. The second study is a forced-choice interpretation task. From the results we observe that children constrain their interpretation of verbal compounds based on their knowledge of the verbal compound structure.

In summary, the results of the child studies provide evidence that children use the same system as adults to interpret compounds, and any deviations from adult-like interpretations can be explained by non-adult syntactic or lexical semantic knowledge.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.0 Introduction

The goal of this dissertation is to argue that children and adults interpret compounds in the same way. Compounds serve as an interesting window into the acquisition of language because of their ability to create a rich array of meanings from limited linguistic means. A *candy-machine*, for example, could be a machine that makes candy, a machine that sells candy, a machine that is made out of candy, etc. All of these interpretations are available for *candy-machine* even though the components (*candy*, *machine*) and the way in which they are combined (noun-noun compound syntax) do not change. Other compounds allow a smaller array of interpretations. A *candy-maker,* for example, cannot mean a machine that uses candy to make things. The two overarching questions in this dissertation stem from this simple observation.

(1) *Question 1:* How do adults arrive at the interpretation of different types of compounds where the weight of the syntactic and semantic information varies?

Question 2: What process do children go through to arrive at the adult system for interpreting compounds, given its necessarily flexible nature?

The first part of this dissertation defines a compositional system for interpreting two different types of compounds: verbal compounds (*mouse-catcher, truck-driver*) and noun-noun compounds (*mouse-trap, book-shelf*). The goal is to provide evidence that adults use the syntax of compound structures and structured lexical information, including natural class, to interpret novel compounds. The second part of this dissertation examines how children learn to produce and interpret compounds. The goal of the acquisition portion of this dissertation is to provide evidence that children differ in their syntactic and lexical semantic knowledge, but ultimately use the same system as adults to interpret compounds.

1.1 Adults' Interpretation of Compounds

How might adults interpret compounds? As a starting point, let's assume that determining the meaning of a compound minimally requires knowing its syntax and the meaning of its constituents. Depending on the type of compound, the extent to which these sources of information are drawn upon varies. The two compounds under investigation in this dissertation, verbal compounds and noun-noun compounds, are a good example of this shift in relevant information sources. For verbal compounds, the syntax is argued to largely constrain the interpretation of the compound down to one possible relationship between its constituents (Roeper and Siegel 1978, Selkirk 1982, Lieber 1983, Di Sciullo and Williams 1987, Bobaljik 2003). For instance, a *mouse-catcher* can only be a person or thing that catches mice, where *mouse* is the internal argument of the verb *catch*, and therefore is interpreted as its theme (Hale and Keyser 1993). A *mouse-catcher* cannot be a person who catches things using a mouse, *where* mouse serves as an instrument to the verb *catch*. For noun-noun compounds, on the other hand, syntax is argued to play almost no role in constraining the interpretation of the relationship in the compound, beyond determining the head of the compound.

If not syntax, what determines the relationship between the nouns in noun-noun compounds? A majority of the previous work on the interpretation of noun-noun compounds posits that there is a set number of semantic relationships ('in', 'for', 'from', etc.) that exist in compounds (Lees 1960, Gleitman and Gleitman 1970, Levi 1978, Warren 1978). For example, *mouse-trap* and *soup-spoon* both have 'for' relationships; a *mouse-trap* is a trap for (catching) mice, and a *soup-spoon* is a spoon for (eating) soup. While this type of system allows for the classification of compounds based on their interpretations, it fails to explain two things: (i) why a particular set of relationships but not others exist in compounds and (ii) the mechanism by which a speaker decides which relationship exists in a compound.

An improvement on the above system was proposed by Johnston and Busa (1999), who argued that the interpretation of noun-noun compounds is determined by the internal lexical structure of its constituents. The internal structure of a lexical item specifies particular types of information about the lexical item, such as its appearance, function, and part-whole structure (Pustejovsky 1995). Under this system, a compound like *mouse-trap* can be interpreted as a trap for catching mice because *trap* lists "to catch" under its functional specification and mice are something than can be caught. Furthermore, because lexical items are categorized according to the features that they share with other lexical items, the classes of constituents in a compound determine their most likely interpretation. For example, *mouse-trap* is most likely to be interpreted with a functional reading because *trap* is an artifact and artifacts are defined by their function. In fact, Downing (1977) noted that the relationship in a compound was related to the natural class of the constituents in the compound. In her study, compounds with artifact head nouns often had function-related interpretations, while animate natural kinds often had appearance- or origin-related interpretations. This finding is in line with the way that natural classes are generally defined (Rips 1989). This approach, which employs a generative lexical semantics, helps to explain both (i) why a particular set of relationships exists and (ii) why a particular relationship is most likely to be intended.

In this dissertation I explore an interpretation system for compounds that uses Johnston and Busa's theory for compound interpretation in conjunction with current theories of compound syntax. The adult studies in this dissertation aim to test three hypotheses.

Figure 1. Hypotheses for Adults' Interpretation of Compounds

Adult Hypothesis 1: Syntactic structure is deterministic in its assignment of a relationship to a compound.
Adult Hypothesis 2: Lexical structure supplies the possible relationships in compounds.
Adult Hypothesis 3: Natural class membership is a relevant element to determine the relationship in a compound.

The first hypothesis is that syntactic structure is deterministic in its assignment of a relationship to constituents of a compound. This hypothesis predicts that when the syntax of a compound defines a particular relationship between its constituents, the compound has to be interpreted using that relationship. Verbal compound syntax, for example, is predicted to always impose a verb-internal argument relationship on its constituents. That is, *mouse* in *mouse-catcher* must be interpreted as the internal argument of catch when *mouse-catcher* is parsed with verbal compound syntax.

The second hypothesis is that the lexical structure supplies the possible relationships in compounds (Johnston and Busa 1999). This predicts that compounds can only be assigned a particular relationship if that relationship is specified in the lexical structure of its constituents. *Scissors*, for example, has a functional specification (what it is for, to cut), but *salamander* does not have an inherent functional specification. Therefore, compounds with the head noun *scissors* are likely to receive a functional interpretation while compounds with the head noun *salamander* are not likely to receive a functional interpretation.

The third hypothesis is that natural class membership is relevant in determining the relationship in compounds. This hypothesis predicts that the subclasses of words that make up the compound, in absence of other information, narrow down the possible relations. Artifacts, for examples, are likely to lead to functional interpretations, while animals are likely to lead to an appearance- or origin-related interpretation. Therefore, *paper-scissors* is likely to

receive a functional interpretation (scissors for cutting paper), and *paper-salamander* is likely to receive an appearance interpretation (a salamander that looks like paper). This is not to say that other interpretations are not possible, only that these are the likely interpretations if category membership is prominent in the absence of context.

1.2 Children's Interpretation of Compounds

In determining the system that adults use to interpret compounds, we also distinguish the system that children are targeting during the acquisition process. The goal of the second part of this dissertation is to provide evidence that children interpret compounds using the same system as adults. As outlined above, the target adult system has two components that must be learned: the syntax of compounds and the lexical structure of the words in a compound including their natural classes. Any deviations from adult interpretations of compounds should be attributable to lacking syntactic or lexical semantic knowledge in children's grammar.

A wealth of work has already set up a good foundation for how children acquire compounds. We know that children learn noun-noun compound syntax around age two (Clark 1981, Snyder 1995), but because of the simple morphological structure of noun-noun compounds and the early age at which its syntax is mastered, little is known about the acquisition process. Children learn verbal compound syntax around age 5 (Clark, Hecht, and Mulford 1986) and have been repeatedly shown to only produce a particular subset of possible non-adult forms (*catch-mouse* and *catcher-mouse,* but not *mouse-catch* for *mouse-catcher*). These forms are argued to be a result of particular frequencies in the input (Clark et al. 1986, Nagpal and Nicoladis 2009) or a reflection of the steps in the adult derivation that children are acquiring (Gamache and Schmitt to appear).

Relatively less work has examined how children interpret compounds. We know that children understand headedness by age 3 (Clark, Gelman, and Lane 1985). When choosing between competing relationships in compounds, two recent studies have shown apparent biases in children's interpretation of noun-noun compounds. In one study, children were shown to interpret novel compounds in analogy to known compounds with the same head noun (Krott, Gagne, and Nicoladis 2009). For instance, if a *blueberry-spoon* was known to be a spoon for eating blueberries, then a *cake-spoon* was interpreted as a spoon for eating cake. In another study, children were shown to nonce word compounds with a bias towards interpretations where the head and modifier noun were physically related (Krott, Gagne, and Nicoladis 2010). For example, a *wug-moop* was interpreted as a moop that has a wug, or a moop that is next to a wug, rather than a moop that was used to do something to the wug.

No studies to date have shown how children interpret the relationship between the verb and the modifier in verbal compounds. Therefore, it is an open question if children restrict the meaning of *mouse-catcher*, for example, to a person who catches mice, as adults do, or if children allow a wider set of interpretations, such as a person who uses mice to catch other things.

The goal of the acquisition portion of this dissertation is to build on previous findings and examine (i) how children learn the syntax of compounds and (ii) if children use the same system as adults to interpret compounds, taking into account their possibly different syntactic and lexical semantic knowledge. The child studies in this dissertation test two hypotheses about how children acquire compound structures and meanings.

Figure 2. Hypotheses for Children's Interpretation of Compounds

Child Hypothesis 1: The strong continuity hypothesis is correct for the acquisition of compound structures.
Child Hypothesis 2: Given principles of compositionality, children's knowledge of syntax and lexical semantics go hand in hand with their interpretation.

The first hypothesis is that the strong continuity hypothesis is correct for the acquisition of compound structures (Pinker 1984). This predicts that all forms that children produce are steps in the adult derivation, and that these forms are subject to the same constraints as the adult structures. For example, the only forms that children should produce when acquiring verbal compounds are those which are consistent with an adult derivation of verbal compounds. This hypothesis is in direct opposition to any hypothesis that suggests that the mechanism that children have at their disposal while learning syntax is different from the mechanism that adults use in their grammar (e.g, Tomasello 2000).

The second hypothesis is that, given principles of compositionality, children's knowledge of syntax and lexical semantics go hand in hand with their interpretation. This hypothesis predicts that, from the beginning, children use syntax and lexical information to interpret compounds and any deviations from adult interpretations are attributable to children's deficiency in one of these areas. For syntax, for example, if a child is unable to produce any verbal compound forms that reflect the merging of the verb with the modifier noun as the internal argument, the child is predicted to allow a much broader range of interpretations for verbal compounds than adults, who only allow a verb-internal argument interpretation. For lexical semantics, for example, if a child encounters a new object, but does not know that it has a function, then the child is not predicted to interpret the compound in a functional way, even though an adult who is aware of an object's function may very well interpret a compound with that object in a functional way.

1.3 Relevance

This dissertation informs a number of areas. First, the results of the studies provide external evidence for the structure of compounds. Assuming a strong version of the Continuity Hypothesis (Pinker 1984), we can use the non-adult forms that children produce when acquiring compounds as evidence for steps in the adult derivation. Given the constrained nature of the non-adult forms that have been found in previous studies examining the acquisition of compound syntax (Clark et al. 1986, Nagpal and Nicoladis 2009, Gamache and Schmitt to appear), this type of data gives us strong evidence for a particular derivation of compounds.

The results of the studies in this dissertation also provide evidence for the components of the system that adults use when interpreting compounds. While syntax and word meanings are always an assumed part of interpretation, I argue that natural class information is relevant to determine the most appropriate relationship for different categories of nouns in the absence of other contextual information. This system for interpreting compounds improves our ability to predict what novel compounds mean, a current topic in natural language processing work (Ó Séaghdha 2008).

Finally, the results of this dissertation bear on our understanding of how children acquire their first language. First, the studies provide evidence suggesting that children are very systematic in their acquisition of compounds syntax. While many permutations of verbal compounds are logically possible, children produce a small subset of these, which are consistent with a particular derivation for verbal compounds. Second, the studies support the idea that, even in the absence of strong syntactic information guiding interpretation, the interpretation of novel compounds is not generated by simple analogy. That is, children use various aspects of what they know about words, as opposed to a single aspect of their

knowledge about a particular word, to interpret compounds. These findings support a generative theory of language acquisition (e.g., Chomsky 1968), where the grammar is continuous from childhood to adulthood (Pinker 1984).

1.4 Organization of Chapters

This dissertation is organized into two parts. The first part of the dissertation investigates the system that adults use for interpreting compounds. Chapter 2 begins by outlining previous research on the syntax and meaning of noun-noun compounds and verbal compounds in the adult grammar. Finding that the proposed theories are insufficient on their own to develop a comprehensive system of compound interpretation, I propose a system for compound interpretation that draws on the strengths of multiple proposals and lay out the hypotheses and predictions of this system.

Chapter 3 presents the results of two studies that examine the hypotheses and predictions put forth by the compound interpretation system outlined in Chapter 2. The first study examines adults' use of syntactic and lexical semantic information in the interpretation of noun-noun compounds and verbal compounds. The second study examines adults' interpretation of verbal compounds, specifically examining their ability to assign interpretations to verbal compounds that should be ruled out by verbal compound syntax.

The second part of this dissertation investigates how child acquire the system that adults use to interpret compounds. Chapter 4 outlines previous research on the acquisition of compounds and the hypotheses and predictions for children's acquisition of compound interpretations, based on the adult system that they are targeting and our current knowledge of children's acquisition of compounds.

Chapter 5 presents three studies on the acquisition of noun-noun compounds. The first study, a corpus study, examines noun-noun compounds in children's speech and child-

directed speech in order to determine at what level children's compound production is influenced by their input (item level, natural class level). The second study, an elicited production task, examines whether or not children attribute noun-noun compound syntax to the same range of relationships as adults. Finally, the third study, a forced-choice interpretation task, examines how children interpret noun-noun compounds given the lexical semantic properties of the nouns involved. Chapter 5 closes by summarizing the acquisition of noun-noun compounds, given the new data, and discusses the findings in terms of different theories of language acquisition.

Chapter 6 presents the results of two studies on the acquisition of verbal compounds. The first study, an elicited production task, examines how children acquire the syntax of verbal compounds by analyzing the non-adult forms that they produce. The second study, a forced-choice interpretation task, investigates children's ability to assign interpretations to verbal compounds that should be ruled out by the adult verbal compound syntax. The results of the elicited production task and interpretation task are then compared to determine if children's syntactic knowledge predicts their interpretation of verbal compounds. Chapter 6 closes by summarizing the acquisition of verbal compounds, given the new data, and discusses the findings in terms of different theories of language acquisition.

Chapter 7 reviews the findings from this dissertation and closes with the implications of these findings on both theoretical and acquisition research.

CHAPTER 2: LINGUISTICS BACKGROUND

2.0 Introduction

The first part of this dissertation examines adults' interpretation of noun-noun compounds and verbal compounds, with the goal of sketching the system that adults use to determine the meaning of compounds. I begin this chapter by making a couple of assumptions about the nature of the linguistic system and I also provide some basics about compounds. Next, I review the literature on adults' interpretation of compounds. Building on previous literature, I outline a proposal that makes crucial use of lexical information in the interpretation of compounds. Finally, I discuss the hypotheses and predictions of this proposal.

2.1 Basic assumptions

In this dissertation I assume a Distributed Morphology (Halle and Marantz 1993) approach to syntax. Under this approach, syntax and morphology are a single, generative component. As such, compounds are generated in the syntax and are subject to all of the constraints therein (Harley 2009).

The second assumption is that lexical items have internal structure that organizes key information about their physical properties and the way in which they interact with the world (Pustejovsky 1995). The lexical structure for a lexical item is based on a speaker's experience with that lexical item. Because of this, the lexical structure for the same lexical item may differ from speaker to speaker, based on their experience with it.

The final assumption is that the grammar and the parser are the same system (Lewis and Phillips in press). That is, the same set of rules that exists in the grammar is the set of rules that guides the parser. This runs contrary to a two-system model where the grammar and sentence production and comprehension operate over two separate, but necessarily

similar, sets of rules (e.g., Ferreira and Patson 2007, Trotzke, Bader, and Frazier 2013). Given the assumption of a one-system model, processing-related findings, such as evidence of a garden path, can be equated back to the nature of the grammar.

2.2 Compound Basics

Compounds loosely fall into two categories: endocentric compounds and exocentric compounds. Endocentric compounds have a clear head noun that defines the syntactic category (noun, verb, adjective, etc.) and semantic category (*dog, fish, table*) of the compound. If the head of an endocentric compound is a noun, the entire compound is treated syntactically as a noun. If the head of an endocentric compound is *door*, then the entire compound is a type of door. In English, compounds are mostly right-headed (Williams 1981) and therefore the right-hand element determines the category of the referent. The modifier, which is the left-hand element, restricts that referent to a particular subcategory (Downing 1977). For example, *dog-house*, *cat-house*, and *bird-house* all refer to types of houses, while *house-dog*, *house-cat*, and *house-bird* refer to different types of animals and not types of houses. In English, noun-noun compounds and synthetic compounds can both be thought of as endocentric compounds.

Exocentric compounds are defined by their lack of a clear head, due to the misalignment of their syntactic and semantic properties (Bisetto and Scalise 2005). Exocentric compounds sometimes have a syntactic head or a semantic head, but these features are not present on a single lexical unit. Take for example *yellow-jacket*. *Yellow-jacket* has a syntactic head; *jacket* is a noun and *yellow-jacket* is treated syntactically as a noun. *Yellow-jacket*, however, does not have a semantic head; a *yellow-jacket* is not a jacket or a yellow. Therefore, *yellow-jacket*, and adjective-noun compounds like it, are considered exocentric. If we look to a compound like *lava-platos* (Spanish, lit. *clean-dishes*, "dishwasher"), we see that it

lacks both a syntactic head and a semantic head. Syntactically, *platos* ("dishes") is a noun and *lava-platos* is a noun, which suggests that *platos* could serve as the syntactic head, but *platos* is marked as plural and *lava-platos* can be singular. That is, one dishwasher is not **lava-plato* and *lava-platos* does not necessarily refer to more than one dishwasher. Therefore, *platos* fails to be a proper syntactic head. Semantically, *lava-platos* refers to a machine, but neither *lava* nor *platos* refers, on its own, to a machine and, as such, *lava-platos* also lacks a semantic head. Exocentric compounds' lack of consistent head information makes them an interesting, but separate[1], inquiry for language acquisition, which will be left aside for the purposes of this dissertation.

2.3 Deriving Interpretations

How do we define the meaning of endocentric compounds like noun-noun compounds or verbal compounds? If we take as our starting point a basic equation of compositionality (Frege 1884), the meaning of a complex expression is determined by the meaning of its parts (word meanings) and the way in which those parts are put together (syntax), then we must first understand how syntax influences compound interpretations.

2.3.1 The Syntax of Compounds

For the purposes of this dissertation, we are interested in a particular aspect of the syntax of compounds: the type of relationship that compound structures establish between their constituents. Given the breadth of work on compounds, I will focus on only the work that is directly relevant to this aspect of compounds.

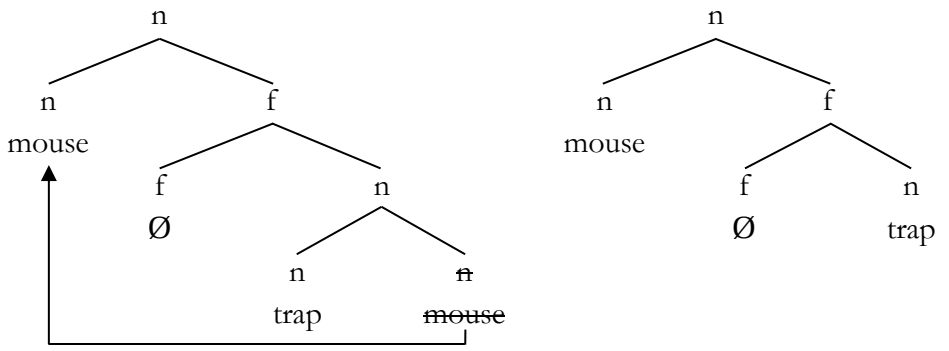
2.3.1.1 The Syntax of Noun-Noun Compounds

The proposed structures for noun-noun compounds can be divided into two classes: structures involving movement and structures involving no movement. In the movement

[1] It may be possible to treat exocentric compounds as cases of metonymy and explain them in a similar manner to the endocentric compounds explored in this dissertation.

structure, shown in (2a), the modifier noun *mouse* merges with the head noun *trap* and then moves to the specifier of a functional element that mediates the relation between the two nouns (Roeper and Snyder 2005, Delfitto, Fábregas, and Melloni 2009, Harley 2009). In the non-movement structure, shown in (2b), the modifier noun *mouse* adjoins to the head noun *trap*, which is sometimes argued to be mediated by a functional element (Di Sciullo 2005, Mukai 2008). Evidence for the functional element is apparent in languages such as Dutch, which have linking elements (LE) that appear between the constituents of a compound (Delfitto et al. 2009). For example, *pan-cake* in Dutch is *pan-en-koek* (lit. pan-LE-cake).

(2) a. b.

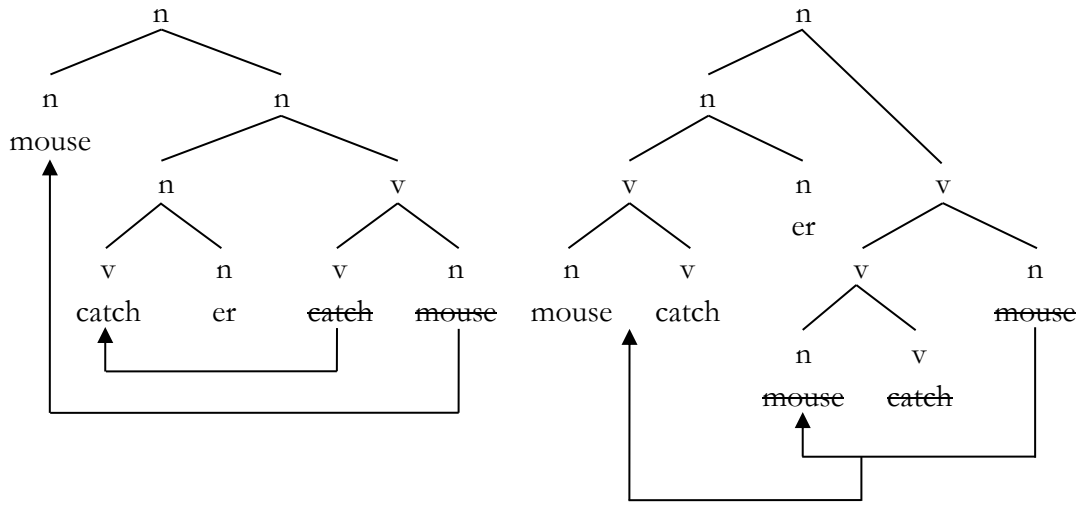


While there is a question of whether or not movement is necessary for noun-noun compounds, the important aspect of these structures for this dissertation is the way in which the nouns are merged together. It can be seen from both (2a) and (2b) that the structure of noun-noun compounds itself does not define the relationship between its constituents. That is to say, neither the noun-noun compound structure with movement nor the structure without movement explains why we should treat *mouse* in *mouse-trap* as the thing that is caught by the trap, rather than the shape of the trap, or the agent who built the trap, on the assumption that *trap* does not assign a role to *mouse*, at least not obligatorily.

2.3.1.2 The Syntax of Verbal Compounds

The proposed structures for verbal compounds also fit into two classes. In one type of structure, shown in (3a), the verb and internal argument merge first, followed by the merging of *–er* into the structure. The verb then incorporates into *–er* and the internal argument moves up to the specifier of V-*er* (Gamache and Schmitt to appear). In the alternate type of structure, shown in (3b), the verb and internal argument merge first, followed by the incorporation of the internal argument into the verb, and finally the incorporation of this complex element into *–er* (Roeper and Siegel 1978; Harley 2009; Borer 2012).

(3) a. b.



What is apparent from both of these structures is that a key aspect of verbal compound syntax is the merging of the verb with the modifier noun as its internal argument. Unlike the structure for noun-noun compounds, the structure for verbal compounds does constrain the interpretation of verbal compounds; since the verb assigns a role to *mouse*. Since *mouse* receives the role from the verb, it must be interpreted as the theme of the verb (Hale and Keyser 1993). The modifier noun of verbal compounds cannot be interpreted in a way denoting any other relationship to the verb. For instance, a *towel-cleaner* must be a person

or machine who cleans towels (internal argument), and cannot be a person or machine that cleans things using a towel or cleans things on a towel (adjunct).

2.3.1.3 Summary of the Role of Syntax in Compound Relationships

The syntax of noun-noun compounds and verbal compounds differ substantially in the extent to which they determine the relationship in compounds. The syntax of verbal compounds completely constrains the relationship between its constituents, allowing for only a verb-internal argument interpretation. The syntax of noun-noun compounds does not constrain the relationship in noun-noun compounds at all. Therefore, we have to go elsewhere to determine the relationship that exists in noun-noun compounds.

2.3.2 Determining the Relationship in Noun-Noun Compounds

Since the relationship in noun-noun compounds is not defined by their syntax, where does the relationship arise from? Previous literature has laid out two possibilities. The first possibility is that there is a set of relationships that exist in compounds, and this list is drawn on to produce or interpret compounds. We will call this the extrinsic approach to compound relationships since the relationships are generated external to the constituents of individual compounds. The second possibility is that the lexical structure of a compound's head noun defines the possible relationships that exist between the head and modifier of the compound, and the lexical structure of the head and modifier taken together determine the most likely relationship. We will call this the intrinsic approach since the relationships are generated internal to the lexical structure of the compound in question. Each approach is discussed in turn below.

2.3.1.1 Extrinsic Approach to Compounds

Under an extrinsic relationship approach, a predefined set of relationships is posited to exist between the constituents in a compound (Lees 1960, Levi 1978, Warren 1978). Take,

for example, Levi's (1978) system of possible compound relationships, shown in Table 1. In this system, compounds are interpreted with one of 12 possible relationships. For example, *mouse-trap* would be defined as a trap for mice where 'for' is the extrinsic relationship. Levi argued that these relationships are generated in the base form of a compound, which is something like a relative clause. These relationships are established by recoverably deletable predicates which exist in the base form of compounds, something akin to a relative clause, and are deleted in the transformation process. Levi argued that it is this set of predicates alone that can be deleted in the transformation process, which restricts the set of possible compound interpretations.

Table 1. Levi's (1978) Noun-Noun Compound Relationships

Relationship	**Examples**
'cause' (first element subject of cause)	*drug-death, viral-infection*
'cause' (first element object of cause)	*tear-gas, mortal-blow*
'have' (first element subject of have)	*lemon-peel, feminine-intuition*
'have' (first element object of have)	*picture-book, industrial-area*
'make' (first element subject of make)	*daisy-chain, consonantal-pattern*
'make' (first element object of make)	*honey-bee, sebaceous-glands*
'use' (instrumental)	*steam-iron, solar-generator*
'be'	*soldier-ant, consonantal, segment*
'in'	*field-mouse, marital-sex*
'for'	*horse-doctor, avian-sanctuary*
'from'	*olive-oil, solar-energy*
'about'	*abortion-vote, criminal-policy*

The extrinsic approach falls short in a couple of ways. First, why should compounds be restricted to this set of relationships and not others? Levi's account restricts the possible interpretations to a particular set, but her account does not explain why compounds exhibit this specific pattern. Second, the list of relationships, while a good description of the ways in which people paraphrase compounds, does not explain why people interpret compounds in the way that they do. That is, how do speakers know, without explicit and directed context,

which relationship is intended in a novel compound? It must be associated to some sort of preference, but Levi does not specify where this preference arises from.

2.3.1.2 Intrinsic Approach to Compounds

Under an intrinsic approach, the relationships that exist in compounds are generated from the lexical structure of the head noun in compounds (Johnston and Busa 1999). Johnston and Busa proposed that the machinery in Pustejovsky's (1995) Generative Lexicon system be extended to define the possible relationships that exist in compounds. Pustejovsky's system defines four levels of lexical representation, listed in (4). Each level of lexical representation specifies a different type of information about a lexical item.

(4) Levels of Lexical Representation in Pustejovsky's (1995) System

a. Argument Structure: The behavior of a word as a function, with its arity specified. This is the predicate argument structure for a word, which indicates how it maps to syntactic expressions.

b. Event Structure: Identification of the particular event type for a word or phrase: e.g. as state, process, or transition.

c. Qualia Structure: The essential attributes of an object as defined by the lexical item.

d. Inheritance Structure: How the word is globally related to other concepts in the lexicon.

For the purposes of interpreting compounds, Johnston and Busa proposed that the Qualia Structure of a lexical item, further defined in (5), organizes the different attributes of an object and how it relates to other lexical items. There are four attributes of a lexical item that can be modified and therefore four types of relationships that exist in compounds.

(5) The Structure of Qualia

a. Formal Role: that which distinguishes the object within a larger domain -- orientation, magnitude, shape, dimensionality, color, position

b. Constitutive Role: the relation between an object and its constituents, or proper parts -- material, weight, parts and component elements

c. Telic Role: purpose and function of the object -- purpose that an agent has in performing an act, built-in function or aim that specifies certain activities

d. Agentive Role: factors involved in the origin or "bringing about" of an object -- creator, artifact, natural kind, causal chain

The Qualia Structure for the lexical item *knife* is shown in Figure 3. To give an example of how Johnston and Busa's system works, consider the types of things that could be in each of *knife*'s Qualia Roles. For example, *metal-knife* is an example of a modification of the Constitutive Role (a knife made of metal), *bread-knife* is a modification of the Telic Role (a knife for cutting bread), and *machine-knife* is a modification of the Agentive Role (a knife made by a machine).

Figure 3. The Qualia Structure of *knife*

knife

$$\text{QUALIA} = \begin{pmatrix} \text{FORMAL} = x \\ \text{CONSTITUTIVE} = \{\text{blade, handle, metal}\ldots\} \\ \text{TELIC} = \text{cut\_act} \\ \text{AGENTIVE} = \text{make\_act} \end{pmatrix}$$

Modified from Johnston and Busa (1999, pg 80).

While Johnston and Busa only begin to outline how the Generative Lexicon could be applied to compounds, there is at least one other aspect of Pustejovky's system that furthers our understanding of compound semantics. Types, which categorize lexical items into

groups, are created by unifying the qualia structure of lexical items that share particular features. For example, Pustejovsky gives the example of *food* as a type. This type is created by the unification of the formal specification "physical object" and the telic specification "to eat". See Figure 4 for the qualia structure of *food.* Any lexical item that shares the properties would be considered a member of the *food* type and would behave similarly to other items in this group under particular conditions. A single lexical item is categorized according to a number of types. For example, *clementine* could be categorized as a *food* type, a *physical object* type, and a *natural kind* type, and therefore is expected to pattern with each of these types, depending on the context.

Figure 4. The Qualia Structure of the Unified Type *food*

food

$$\text{QUALIA} = \begin{bmatrix} \text{FORMAL} = \text{physical object} \\ \text{TELIC} = \text{eat\_act} \end{bmatrix}$$

Modified from Pustejovksy (1995, pg 146).

Types serve to create classes of words that are predicted to behave in similar ways. We empirically know that adults use natural classes in their interpretation of compounds. Downing (1977)[2] found that participants in her study systematically interpreted compounds differently based on the class of a compound's head noun (see Table 2).

[2] See also Leonard (1984) and Štekauer (2005).

Table 2. Most Frequent Relationship Types by Head Noun Class

Class	**Relationships**	**Examples**
Humans	Occupational Sexual Identity Racial Identity	*police demonstrators* *women officers* *Negro women*
Animals	Appearance Habitat	*giraffe bird* *Salt Creek coyotes*
Plants	Appearance Habitat	*trumpet plants* *Texas roadside flowers*
Natural objects	Composition Origin Location	*granite out-croppings* *cow hair* *Montana beach*
Synthetic objects	Purpose	*banana fork*
Modified from Downing (1977, pg. 831).		

This finding closely aligns with related research on speakers' categorization of natural classes and the properties that define them (e.g., Gelman 1988, Rips 1989). Artifacts, for example, tend to be defined in terms of their function and natural kinds are generally defined in terms of their appearance or origin.

The intrinsic approach is an improvement on the extrinsic approach for three reasons. First, the intrinsic approach explains why there is a particular set of relationships in compounds; particular relationships exist in compounds because these relationships are specified by the Qualia Structure of compounds' head nouns. Moreover, the intrinsic approach explains the existence of the set of relationships in compounds without adding any machinery to our notion of compositionality. This approach to compound interpretation suggests that, rather than simple word meanings, we need to consider a generative lexical semantics with structured lexical information that defines the way in which words interact with one another. Finally, the intrinsic approach explains why speakers choose to interpret compounds using particular relationships instead of others, given that multiple relationships

are possible. Lexical item are categorized into many types, or classes, and these classes are interpreted in particular ways in particular contexts.

2.4 A Proposed System for Compound Interpretation

The goal of the first half of this dissertation is to develop a comprehensive system of compound interpretation. Considering syntax alone, we were able to determine the sole relationship that exists between the verb and modifier in a verbal compound; the syntax of verbal compounds requires the verb and modifier noun to be interpreted with a verb-internal argument relationship. Syntax does not determine the relationship that exists in noun-noun compounds, however, aside from assignment of the head. We then considered previous proposals to generate the relationships that exist in noun-noun compounds. The intrinsic approach (Johnston and Busa 1999), which extends Pustejovsky's Generative Lexicon to compounds, provided a more defined notion of word meanings, which prescribes the possible relationships that are available for modification and the way in which words are organized into various natural classes.

In the production and comprehension of compounds, there are three pieces of knowledge that must be in place. First, a speaker must know the syntax of a compound. This part of the system determines any syntactic constraints that must be imposed on the interpretation of the compound. For example, the syntax of verbal compounds constrains the interpretation of their constituents to a verb-internal argument relationship.

Second, a speaker must have a structured lexical entry for the head noun of a compound that defines the ways in which the noun interacts with others concepts. This part of the system determines the range of relationships that are possible for a compound with a specific head noun. For a given relationship to be possible the Qualia Role corresponding to that relationship must be specified on the head noun. For example, the Telic Role of *scissors*

is specified as "to cut" while the Telic Role of *salamander* is likely unspecified as salamanders are not functional.

Finally, from the Qualia Structure, a speaker must know which information is privileged according to the natural classes of the constituents in a compound and the tendencies of these natural classes to behave in particular ways. This part of the system determines which Qualia Role is the most likely to be used in interpretation of the compound. For example, artifacts are most likely to have a purpose and therefore access the Telic Role and animate natural kinds are most likely to be defined by their appearance and therefore access the Formal Role. For this reason a *strawberry-bowl* is most likely to be a type of bowl that is used for strawberries, while a *strawberry-fish* is most likely to be a fish that looks like a strawberry.

Figure 5 lays out the way in which a speaker would interpret a novel compound according to this system. In Step 1, a speaker identifies the morphemes that make up a compound. In parallel, speakers begin constructing interpretations based on the syntax and semantics. In Steps 2 and 3 in the syntax, speakers parse the morphemes into a compound structure and assign any relationships to those morphemes that are imposed by the syntax. I make an assumption here that given a transitive verb, a speaker always tries to first parse the string noun-verb-*er* with verbal compound syntax. In Step 2 of the semantics speakers access the lexical structure of the head noun and determine the set of possible relationships. For noun-noun compounds this is the second noun. For verbal compounds this is most simply the verb-*er* noun, but more specifically it could be considered the morpheme *–er* which is specified by the verb for its Telic Role. In Step 3 speakers determine the semantic natural class of the constituents in order to determine which of the possible Qualia Roles is the most likely to be picked up. This Qualia Role is then checked to determine if the modifier noun is

an appropriate fit for that Role. In Step 4, the speaker determines if the relationships generated by the syntax and semantics are compatible. In the case of noun-noun compounds, the syntax only generates an unspecified, abstract relationship between the constituents that is compatible with any interpretation generated by the lexical semantics. In the case of verbal compounds, the relationships generated by the syntax and lexical semantics can either be compatible, when a Telic relationship is generated by the lexical semantics, or incompatible, when any other relationship (Agentive, Constitutive, Formal) is generated by the lexical semantics. In cases of incompatible relationships, the compound must be reanalyzed by using a different part of the head nouns' Qualia Structure.

Figure 5. Proposed Compound Interpretation System

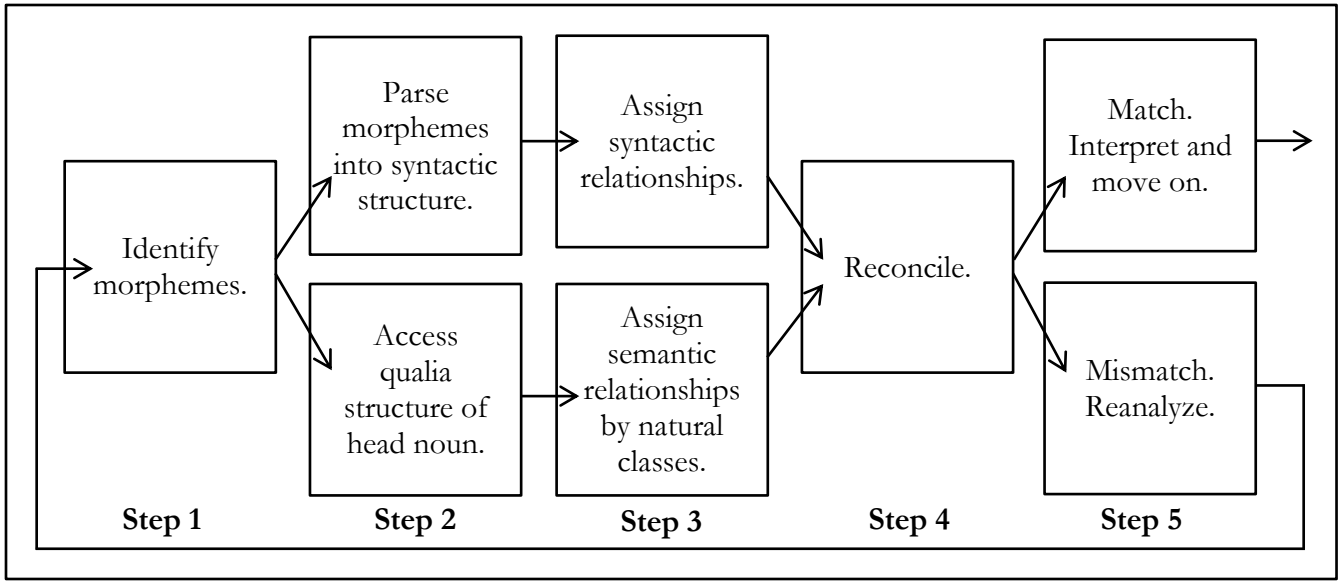


Figure 6 shows how a speaker would determine the meaning of four different compounds in this system. The first example, *table-soap*, is a noun-noun compound with an artifact head noun that has a canonical Telic interpretation. The morphemes *table* and *soap* are parsed into noun-noun compound syntax. The head noun *soap* is specified for all four Qualia Roles, but its status as an artifact favors the Telic relationship in compounds. The Telic role of *soap* is checked first to see if *table* can reasonably modify *soap* in a functional way. As a function of *soap* is to clean, and a table is a reasonable thing to clean, a Telic relationship is satisfied in the lexical semantics. The relationships proposed by the syntax and semantics are found to be compatible and the speaker successfully interprets *table-soap* as soap for cleaning tables.

The second example in Figure 6, *bleach-soap*, is an example of a noun-noun compound with an artifact head noun that has a non-canonical, Constitutive interpretation. The morphemes *bleach* and *soap* are parsed into noun-noun compound syntax. The head noun *soap* is specified for all four Qualia Roles, but its status as an artifact favors the functional, Telic relationship in compounds. The Telic role of *soap* is checked first to see if *bleach* can reasonably modify *soap* in a functional way. As *bleach* is not a reasonable thing to clean, the Telic Role is not satisfied and a different Qualia Role is considered. Finding that *bleach* can reasonably modify soap in a part/whole way, a Constitutive relationship is satisfied in the lexical semantics. The relationships proposed by the syntax and semantics are found to be compatible and the speaker successfully interprets *bleach-soap* as soap that contains bleach.

The third example in Figure 6, *table-cleaner*, is an example of a verbal compound that converges on the first attempt to determine its meaning. The morphemes in *table-cleaner* are parsed into verbal compound syntax and a verb-internal argument relationship is assigned to

clean and *table* by the syntax. As the function of a cleaner is to clean, and a table is a reasonable thing to clean, a Telic semantic relationship is satisfied in the lexical semantics. The relationships proposed by the syntax and semantics are found to be compatible and the speaker successfully interprets *table-cleaner* as a person who cleans table.

The final example in Figure 6, *bleach-cleaner*, is an example of a compound that is first parsed as a verbal compound, but is then needs to be reanalyzed because, without context, a verb-internal argument relationship is an unlikely interpretation. On the first pass, the morphemes in *bleach-cleaner* are parsed into verbal compound syntax and a verb-internal argument relationship is assigned by the syntax to *clean* and *bleach*. Semantically, the function of a cleaner is to clean, but bleach is not a reasonable thing to clean. Rather, bleach is a reasonable thing to use to clean and *bleach-cleaner* is assigned a formal relationship by the semantics. The relationships proposed by the syntax and semantics are found to be incompatible and *bleach-cleaner* must be reanalyzed. On the reanalysis, the morphemes are parsed into a noun-noun compound structure, leading to an unspecified, abstract relationship by the syntax. The lexical semantics again is satisfied by the Formal Role and the speaker successfully interprets *bleach-cleaner* as a cleaner that cleans using bleach. Note that a different reanalysis is possible for *bleach-cleaner*. Rather than reanalyzing the syntax, the lexical semantics could have been reanalyzed to force a telic relationship between *bleach* and *cleaner*, leading to the interpretation of someone or something that cleans bleach.

Figure 6. Examples of Compound Interpretation in Proposed System

Example	Example Type	Step 1	Step 2		Step 3	Step 4	Step 5
table-soap	noun-noun with typical artifact Qualia Role	table soap	syn.	[table-soap] noun-noun compound syntax	modifier-head relationship	Match.	Interpret.
			sem.	table = artifact (furniture) soap = artifact that cleans	Telic (functional) relationship (soap that cleans tables)		
bleach-soap	noun-noun with non-typical artifact Qualia Role	bleach soap	syn.	[bleach-soap] noun-noun compound syntax	modifier-head relationship	Match	Interpret.
			sem.	bleach = artifact (chemical) soap = artifact that cleans	Constitutive relationship (soap that contains bleach)		
table-cleaner	noun-verb-er with "good" internal argument noun	table clean -er	syn.	[[table-clean]-er] verbal compound syntax	table = internal argument, -er = external argument	Match.	Interpret.
			sem.	table = artifact (furniture) clean = verb -er = human/machine	Telic (functional) relationship (table-cleaner cleans tables)		
bleach-cleaner and reanalysis	noun-verb-er with "bad" internal argument noun	bleach clean -er	syn.	[[bleach-clean]-er] verbal compound syntax	bleach = internal argument, -er = external argument	*Mismatch.*	*Reanalyze.* →
			sem.	bleach = artifact (chemical) clean = verb -er = human/machine	Formal relationship (cleaner uses bleach to do cleaning)		
		bleach clean -er	syn.	[bleach-[clean-er]] noun-noun compound syntax	modifier-head relationship	Match.	Interpret.
			sem.	bleach = artifact (chemical) clean = verb -er = human/machine	Formal relationship (cleaner uses bleach to do cleaning)		

2.5 Hypotheses and Predictions for Adults' Interpretation of Compounds

This system relies on four hypotheses, shown in Table 3, about the role of syntax and lexical semantics on the interpretation of noun-noun compounds and verbal compounds. Each hypothesis is discussed in turn, along with any predictions that the hypothesis makes about adults' behavior.

Table 3. Hypotheses and Predictions of New Interpretation System

Hypothesis	Predictions
Hypothesis 1: Syntactic structure is deterministic in its assignment of a relationship to a compound.	**Prediction 1:** Morphemes that are parsed with verbal compound syntax are always assigned a verb-internal argument relationship by the syntax and morphemes that are parsed with noun-noun compound syntax are always assigned an unspecified, abstract relationship by the syntax.
Hypothesis 2: The Qualia Structure of the head noun in a compound supplies the range of possible relationships for that compound.	**Prediction 2:** Compounds can only be interpreted with relationships that are specified in the Qualia Structure of their head noun. Compounds whose head nouns are nonce or novel should defer to the lexical structure of the modifier noun.
Hypothesis 3: Semantic natural classes strongly influence the most likely aspect of a lexical structure to be accessed for compound interpretation.	**Prediction 3:** Compounds are interpreted in line with the tendencies of their natural classes (e.g., artifacts as functional, animate natural kinds as appearance- or origin-related).
Hypothesis 4: The relationships supplied by the syntax and semantics must be reconcilable.	**Prediction 4:** Compounds composed of the string noun-verb-*er* garden path when the semantics of the string generates a a non-telic relationship. Compounds composed of the string noun-noun never garden path because of the syntactic structure imposed on them.

The first hypothesis is that syntactic structure is deterministic in its assignment of a relationship to constituents of a compound. This hypothesis predicts that, given a transitive verb, verbal compound syntax always imposes a verb-internal argument relationship on its constituents and noun-noun compound syntax always proposes an unspecified, abstract relationship on its constituents. Verbs that do not require an internal argument, either because of their transitivity or because of their telic properties (Borer 1994), should be

parsed with noun-noun compound syntax and allow a wider range of interpretations than verbs that do require an internal argument.

The second hypothesis is that the Qualia Structure of the head noun supplies the possible relationships in compounds (Johnston and Busa 1999). This predicts that the possible relationships for compounds differ based on the lexical structure their constituents. *Scissors*, for example, has a functional specification (to cut), but *salamander* does not usually have a functional specification. Therefore, *paper-scissors* are likely to be scissors that cut paper, while a *paper-salamander* is not likely to be a salamander that does something to paper. Another prediction made by this hypothesis is that words without lexical structure (novel or nonce words) will defer to the other constituent in the compound, as the lexical structure of a novel or nonce word is almost or completely unspecified.

The third hypothesis is that semantic natural class membership strongly influences the most likely aspect of a lexical structure to be accessed for a compound's interpretation (Downing 1977). This hypothesis predicts that the mostly likely relationship in a compound is determined by the natural classes of its constituents. Compounds with artifact head nouns, for examples, are likely to lead to functional, Telic interpretations, while compounds with animate head nouns are likely to lead to appearance-related, Formal interpretations. Given that a single lexical item can belong to multiple classes, for example, *scissors* refers to both an artifact and a physical object, no single class can definitely predict the relationship.

Finally, the fourth hypothesis is that the relationships supplied by the syntax and semantics must be reconcilable. This predicts that the string noun-verb-*er* causes a speaker to garden path when the relationship generated by the lexical semantics is anything other than a Telic interpretation. Recalling the *bleach-cleaner* example, the syntax assigns a verb-internal

argument relationship to *clean* and *bleach*, but the lexical semantics assigns a Formal relationship, forcing a reanalysis of the structure.

2.6 Summary

In this chapter I reviewed previous work on the syntax and interpretation of noun-noun compounds and verbal compounds. A basic notion of compositionality was found to be sufficient for interpreting verbal compounds, whose syntax defines the relationship between their constituents. In order to interpret noun-noun compounds, however, we showed that we must assume a dynamic semantics that considers class membership in the ordering of possible interpretations. Under this system, different relationships are privileged for different noun-noun combinations, based on the class membership of those nouns. In the next chapter I present the results of two studies that test the predictions made by this system for interpreting novel compounds.

CHAPTER 3: ADULT COMPOUND TASKS

3.0 Introduction

In Chapter 2 I sketched a system for how adults use syntactic and lexical semantic knowledge to interpret compounds. This chapter presents the results of two studies that test the predictions made by this system. The first study examined how adults interpret compounds based on their syntactic structure (verbal compounds and noun-noun compounds), lexical status (known words and nonce words), and natural class (animate natural kinds, inanimate natural kinds, locative/temporal nouns, humans, artifacts). The second study examined adults' ability to assign interpretations to verbal compounds that are either predicted to be allowed by verbal compound syntax (modifier as internal argument) or not allowed by verbal compound syntax (modifier as adjunct). The goal of these two studies was to better understand the way in which adults interpret compounds, such that we can define the target state for children.

3.1 Adult Study 1: Interpretation of Noun-Noun Compounds and Verbal Compounds

The first study examined adults' interpretation of noun-noun compounds and verbal compounds using a free interpretation task. There were two goals of this study. The first goal was to examine the role of syntax on the interpretation of compounds. The second goal was to examine the role of lexical semantics on the interpretation of compounds, namely the role of the Qualia Structure (Johnston and Busa 1999) and natural class tendencies (Downing 1977). I address the background and predictions for each of these goals in turn.

3.1.1 The Role of Syntax on the Interpretation of Compounds

One goal of this study was to examine the role of syntax in the interpretation of compounds. More specifically, the goal was to provide evidence that, even in the absence of lexical information, the syntax of verbal compounds restricts the range of possible

interpretations, while the syntax of noun-noun compounds does not constrain the interpretations. As discussed in Chapter 2, the syntax of verbal compounds defines the relationship that exists between the constituents; the modifier noun merges as the internal argument of the verb and, as such, the modifier is interpreted as the theme of the verb. The syntax of noun-noun compounds, however, does not establish a particular relationship between its constituents. Rather, the syntax of noun-noun compounds establishes that there is an unspecified, abstract relationship between the constituents and it is left to another system, namely lexical semantics, to define the particular relationship.

This study was designed to examine the impact of syntax on the interpretation of compounds in two ways. First, the stimuli used in the experiment were either noun-noun strings or noun-verb-*er* strings, which were predicted to be parsed as noun-noun compounds and verbal compounds, respectively. This allowed us to compare the range of interpretations that these two structures lead to. Second, the stimuli were designed to lessen any bias from prior exposure and lexical structure by (i) randomly pairing the head and modifier nouns and (ii) including a set of nonce words. This allowed us to abstract away from the behavior of individual items as much as possible and instead see the behavior of these compound classes as a whole.

The hypotheses put forth in this dissertation made two predictions about the role of syntax on the interpretation of compounds. First, noun-verb-*er* strings were predicted to be parsed as verbal compounds and interpreted with verb-internal argument relationships. This was predicted to happen even when the verb in the verbal compound was a nonce verb. For example, both *towel-cleaner* and *towel-wugger* were predicted to be interpreted as a person who cleans/wugs towels. Second, noun-noun strings were predicted to be parsed as noun-noun

compounds and, as such, be interpreted with any of the four relationships specified by Qualia Structure of the head noun (Agentive, Constitutive, Formal, Telic).

3.1.2 The Role of Lexical Semantics on the Interpretation of Compounds

The second goal of this study was to examine the role of lexical semantics on the interpretation of compounds. The proposed system uses lexical semantics in two ways. First, following Johnston and Busa (1999), the Qualia Structure of the head noun in a compound defines the possible interpretations for the compound. In order for a compound to be interpreted as associated with a particular relationship made available in the Qualia Structure (Pustejovsky 1995). Second, following Downing (1977), the tendencies of the natural classes in a compound determine the compound's most likely interpretation. For example, artifacts, which are defined in terms of their function, are likely to lead to Telic interpretations, while animate natural kinds, which are defined in terms of their appearance or origin, are most likely to lead to Formal interpretations.

This study was designed to examine the role of lexical semantics in two ways. First, nonce words were included as a class of nouns in the study. By pairing the nonce class of words with real natural classes of words, we could determine a baseline for the contribution of different natural classes in modifier and head noun positions without influence from the other word in a compound. For example, in the compounds *wug-bike* or *bike-wug*, the nonce word *wug* allowed us to determine the most likely contribution of the artifact *bike* as both a head noun and a modifier noun, without interference from *wug*. Second, nouns were chosen for inclusion on their membership in one of five natural classes: animate natural kinds, inanimate natural kinds, locative/temporal nouns, human nouns, and artifacts. Therefore, we could systematically examine the impact of different natural classes on the relationship in a compound. For example, we could determine how likely a compound with an artifact head

noun is to receive a functional, Telic interpretation as compared to how likely a compound with an animate natural kind head noun is to receive the same type of interpretation. For the full list of noun classes used in the study, see Table 4.

Table 4. NNC and VC Interpretation: Noun Classes

Class	Defining Features	Example
Verb-*er*	transitive verb with *–er* affix	drinker, carrier
Nonce-*er*	English nonce word with *–er* affix	daxer, lainter
Nonce	English nonce word	wug, moop
Animate Natural Kind	naturally occurring, sentient	cow, dolphin
Artifact	functional, manmade objects	spoon, box
Human	human	boy, lawyer
Inanimate Natural Kind	naturally occurring, non-sentient	rock, wind
Locative/Temporal	defined by physical or temporal space	circus, summer

Notice that this is just one set of classes. On top of these classes there are simultaneous classifications that unify some lexical items that are members of different classes under this system, and also simultaneous classifications that divide lexical items that are members of the same class under this system. For example, *stone* and *scissors* exist in different classes under the system used here, animate natural kind and artifact, respectively, but under a class of physical objects, they would be grouped together. It should be kept in mind that this classification system is by no means the only system at work.

The hypotheses put forth in this dissertation made three predictions about the role of lexical semantics on the interpretation of compounds. First, known and nonce head nouns of noun-noun compounds were predicted to behave in different manners. Known head nouns were predicted to be interpreted in line with their inherent lexical properties. Compounds whose head nouns do not have certain specifications were predicted to not receive those types of interpretations. For example, if *salamander* did not have a functional specification for a speaker, then a compound with the head noun *salamander* should not have

been interpreted in a functional way, in the absence of a special context. Nonce head nouns, on the other hand, were predicted to be less constrained in their interpretations since they can only be interpreted with respect to the modifier noun that they are paired with. For instance, since *wug* is a nonce word, when it is paired with *bike* in *bike-wug*, it could lead to any interpretation that *bike* can reasonably fit into. For example, a *bike-wug* could be a wug made by a bike (agentive), a wug that is a part of a bike (constitutive), a wug that looks like a bike (formal), or a wug that makes bikes (telic).

The second prediction was that compounds composed of different natural classes should be interpreted using different relationships, in line with the tendencies of those natural classes. For example, compounds with artifact head nouns such as *scissors, spoon*, and *blanket* were predicted to lead to Telic interpretations. Compounds with animate natural kinds such as *dog, horse*, and *chipmunk* were predicted to lead to Formal interpretations.

The third prediction was that interpretations were more likely to appear in contrastive cases, since by their nature, compounds introduce a restriction on the interpretation of the head noun. For example, *bike-lock* contrasts with other types of locks. Certain Qualia properties do not restrict the interpretation of the head because without context, a default interpretation is the only option.

3.1.3 Method

3.1.3.1 Participants

25 adults (20 F, 5 M) were recruited from an undergraduate linguistics course at Michigan State University. The subjects received extra credit in their course for their participation.

3.1.3.2 Materials and Procedure

Lists of words were generated based on the categories in Table 4. The categories were fully crossed to create 64 item types. Each participant received two of each item type for a total of 128 items. The compounds were generated by randomly pairing words from each category. For any given combination of words, one set of participants saw the compound as word1-word2, and another set of participants saw the compound as word2-word1. For example, some participants saw *rock-circus* and some *circus-rock*. A total of three pairings were generated and also reversed (turning heads into modifiers and modifiers into heads) for a total of six lists that participants were randomly assigned to and 768 compounds. See Appendix A for the full list of nouns used in this study.

Participants were tested individually on a PC using E-Prime experimental software. Participants were presented with novel compounds and instructed to give short descriptions. *Dog-house* and *book-shelf* were given as examples of compounds, with "a house that dogs live in" given as an example description for *dog-house*. All compounds were presented in the frame "What's a ___?" with a box below the prompt for the participants to give their descriptions.

3.1.3.3 Coding and Analysis

Prior to coding, all the items that had either a nonce modifier or a nonce-*er* modifier (N = 800) were removed from the analysis due to a high proportion of adjectival interpretations (for example, *wug-summer* as "a summer that is wug").

All other items (N = 2400) were coded according to the scheme in Table 5, which was loosely based on the scheme in Johnston and Busa (1999) for Pustejovky's (1995) Qualia Structure. Any descriptions that were coded as unusable (21.7%, N = 521), reversal (9.1%, N = 218), or no response (<1%, N = 5) were excluded from the analysis. A total of 69% (N = 1656) of the coded items were used in the analysis.

All responses were coded by the author. Additionally, 10% of the responses were coded by a second trained coder. Cohen's kappa (Cohen 1960), a measure of inter-rater reliability, was found to be .64, which is considered to be a good level of agreement (Altman 1990).

Table 5. NNC and VC Interpretation: Coding Scheme

Relation	**Defining Features**	**Example Description**
Agentive	relation that involves the creation of an object	"a hole created by a bullet" for *bullet-hole*
Constitutive	part/whole relation, including material, parts, and contents	"a book about cowboys" for *cowboy-book*
Formal	descriptive relation, including age, location/origin, shape	"a lion that lives in the mountains" for *mountain-lion*
Telic	function, capability	"a knife for cutting bread" for *bread-knife*
Reversal	head and modifier switched in description	"a couch that boys sit on" for *couch-boy*
Unusable	ambiguous – cannot reliably be placed in a single category	"a vacuum for birds" is ambiguous between Telic (used to suck up birds) and Formal (used by birds) for *bird-vacuum*
	metaphorical – does not directly relate the two lexical items	"a person who spends too much time in the sun" for *lobster-eater*
	wrong word(s) – one or more real words was misread	"a coach of baseball" for *baseball-couch*
	unclear – description given by participant is undecipherable	"likes to eat coconuts" for *ocean-hugger*
No Response	no response entered by participant	---

The results of the study were analyzed in two ways. First, to examine the role of syntax on the interpretation of compounds, all items were collapsed into four categories: verbal compounds with known head nouns, verbal compounds with nonce head nouns, noun-noun compounds with known head nouns, and verbal compounds with nonce head nouns. See Table 6 for the number of items in each category. The items were then recoded to isolate each relationship (Agentive, Constitutive, Formal, Telic) as the dependent variable

for four separate ANOVAs[3]. For example, for the Agentive ANOVA, items with Agentive interpretations were coded as "1" and all other items (Constitutive, Formal, Telic) were coded as "0". For each of the four analyses, the proportion of the relationship in question (Agentive for the Agentive ANOVA) served as the dependent measure for a 2 Syntax (Noun-Verb-*er*, Noun-Noun) X 2 Head Lexical Status (Known, Nonce) repeated-measures ANOVA. Note that the Syntax variable refers to likely syntax that is applied to these strings: noun-noun compounds syntax for noun-noun strings and verbal compound syntax for noun-verb-*er* strings. This is not necessarily the syntax that participants use to interpret these strings. For example, noun-verb-*er* can be interpreted as either a verbal compound or a noun-noun compound (see Experiment 2).

Table 6. Count of Items for Syntax X Head Lexical Status Analysis

	Noun-Noun String	**Noun-Verb-*er* String**	**Total**
Known Head	1038	227	**1265**
Nonce Head	184	207	**391**
Total	**1222**	**434**	**1656**

Second, to examine the role of semantic natural class on the interpretation of compounds, all noun-noun compounds constructed of known head and modifier nouns (animate, inanimate, locative/temporal, human, artifact) were analyzed. See Table 7 for the number of items in each natural class. As in the above analysis, the items were recoded to isolate each relationship (Agentive, Constitutive, Formal, Telic) as the dependent variable for four separate ANOVAs. For each of the four analyses, the proportion of the relationship in question served as the dependent measure for a 5 Head Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) X 5 Modifier Class (Animate, Inanimate,

[3] The author recognizes that mixed effects modeling may be a more appropriate way to analyze this type of data. This will be left for future research. This comment holds for all ANOVAs in this dissertation.

Locative/Temporal, Human, Artifact) repeated-measures ANOVA. A Bonferroni correction was used for all post-hoc tests to adjust for multiple comparisons.

Table 7. Count of Items for Head Natural Class X Modifier Natural Class Analysis

		Modifier Natural Class					
		Animate	**Inanimate**	**Locative/ Temporal**	**Human**	**Artifact**	**Total**
Head Natural Class	Animate	47	42	42	33	30	**194**
	Inanimate	31	37	32	22	23	**145**
	Loc/Temp	33	32	28	39	32	**164**
	Human	40	29	37	39	40	**185**
	Artifact	40	48	41	40	43	**212**
Total		**191**	**188**	**180**	**173**	**168**	**900**

3.1.4 Results

3.1.4.1 The Role of Syntax on Interpretation

Table 8 show the distribution of relationships for noun-noun and noun-verb-*er* strings with known and novel head nouns.

Table 8. Proportion (and Count) of Items by Relationship, Syntax, and Lexical Status

		Noun-Noun String	**Noun-Verb-*er* String**	**Overall**
Agentive	Known Head	.02 (22)	.00 (0)	.02 (22)
	Nonce Head	.06 (11)	.00 (0)	.03 (11)
	Agentive Overall	.03 (33)	.00 (0)	**.02 (33)**
Constitutive	Known Head	.05 (50)	.00 (0)	.04 (50)
	Nonce Head	.11 (20)	.01 (2)	.06 (22)
	Constitutive Overall	.06 (70)	.00 (2)	**.04 (72)**
Formal	Known Head	.74 (770)	.28 (64)	.66 (834)
	Nonce Head	.63 (115)	.36 (75)	.49 (190)
	Formal Overall	.72 (885)	.32 (139)	**.62 (1024)**
Telic	Known Head	.19 (196)	.72 (163)	.28 (359)
	Nonce Head	.21 (38)	.63 (130)	.43 (168)
	Telic Overall	.19 (234)	.68 (293)	**.32 (527)**

3.1.4.1.1 The Role of Syntax on Agentive Interpretations

A 2 Syntax (Noun-Noun, Noun-Verb-*er*) X 2 Head Lexical Status (Known, Nonce) ANOVA was carried out on the proportion of Agentive responses. The main effect of Syntax was significant ($F(1, 24) = 22.117$, $p < .001$); Noun-Noun received Agentive interpretations significantly more often than Noun-Verb-*er*. The main effect of Lexical Status was marginally significant ($F(1, 24) = 4.121$, $p = .054$); compounds with Nonce heads received Agentive interpretations marginally more often than compounds with Known heads. The interaction between Syntax and Lexical Status was also marginally significant ($F(1, 24) = 4.121$, $p = .054$); Noun-Verb-*er* never received Agentive interpretations, whether the head was Known or Nonce, while Noun-Noun received slightly more Agentive interpretations when the head was Nonce as opposed to Known.

3.1.4.1.2 The Role of Syntax on Constitutive Interpretations

A 2 Syntax (Noun-Noun, Noun-Verb-*er*) X 2 Head Lexical Status (Known, Nonce) ANOVA was carried out on the proportion of Constitutive responses. The main effect of Syntax was significant ($F(1, 24) = 26.197$, $p < .001$); Noun-Noun received Constitutive interpretations significantly more often than Noun-Verb-*er*. The main effect of Lexical Status was also significant ($F(1, 24) = 5.337$, $p = .030$); compounds with Nonce heads received Constitutive interpretations significantly more often than compounds with Known heads. The interaction between Syntax and Lexical Status was not significant ($p = .219$).

3.1.4.1.3 The Role of Syntax on Formal Interpretations

A 2 Syntax (Noun-Noun, Noun-Verb-*er*) X 2 Head Lexical Status (Known, Nonce) ANOVA was carried out on the proportion of Formal responses. The main effect of Syntax was significant ($F(1, 24) = 163.749$, $p < .001$); Noun-Noun received Formal interpretations

significantly more often than Noun-Verb-*er*. The interaction between Syntax and Lexical Status was also significant ($F(1, 24) = 13.799$, $p = .001$); Noun-Noun strings with Known heads received significantly more Formal interpretations than Noun-Noun strings with Nonce heads, while Noun-Verb-*er* strings with Known heads received significantly less Formal interpretations than Noun-Verb-*er* strings with Nonce heads. The main effect of Lexical Status was not significant ($p = .829$).

3.1.4.1.4 The Role of Syntax on Telic Interpretations

A 2 Syntax (Noun-Noun, Noun-Verb-*er*) X 2 Head Lexical Status (Known, Nonce) ANOVA was carried out on the proportion of Telic responses. The main effect of Syntax was significant ($F(1, 24) = 222.756$, $p < .001$); Noun-Verb-*er* received Telic interpretations significantly more often than Noun-Noun. The interaction between Syntax and Lexical Status was also significant ($F(1, 24) = 4.880$, $p = .037$); Noun-Noun strings with Known heads and Noun-Noun strings with Novel heads received Telic interpretations to the same degree, while Noun-Verb-*er* strings with Known heads received more Telic interpretations than Noun-Verb-*er* strings with Nonce heads. The main effect of Lexical Status was not significant ($p = .214$).

3.1.4.1.5 Summary of the Role of Syntax on Interpretation

For each type of relationship, Agentive, Constitutive, Formal, and Telic, the syntax of the compound was a significant predictor of how often it would be used. Agentive, Constitutive, and Formal relationships were used more often for noun-noun strings, while Telic relationships were used more often for noun-verb-*er* strings. Importantly, this relationship held regardless of whether or not the head of the compounds was a familiar, known word or an unfamiliar, nonce word, suggesting that the syntax alone drove this

pattern, rather than lexical structure or prior exposure to compounds containing the same lexical items.

The results of these analyses also provide evidence that particular relationships are more likely when there is no constraining lexical information. Both Agentive and Constitutive relationships were more frequent for noun-noun strings with nonce heads than for noun-noun strings with known heads. This likely reflects the ability for nonce words to be interpreted with respect to the modifier noun in any way that the modifier noun prefers. Compounds with known head nouns, on the other hand, are subject to their Qualia Structure and must reconcile the preferences of the head noun with the modifier noun.

3.1.4.2 The Role of Semantic Natural Class on Interpretation

See Figures 7 and 8 for the distribution of relationships by head natural class and modifier natural class, respectively. Table 9 shows the distribution of relationships by both head and modifier natural class.

Figure 7. Distribution of Relationships by Head Natural Class

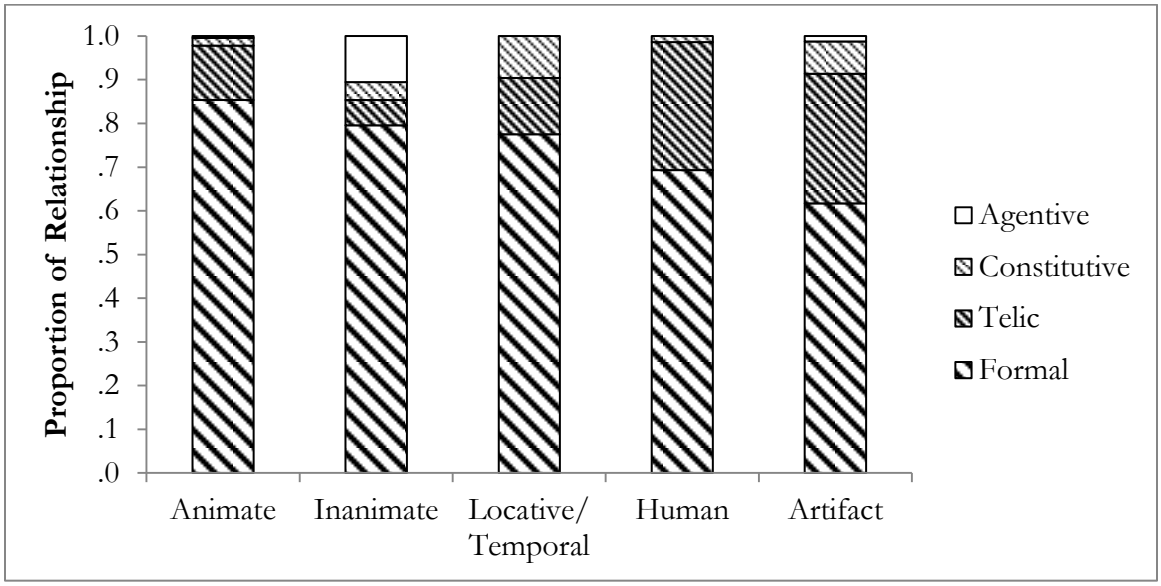


Figure 8. Distribution of Relationships by Modifier Natural Class

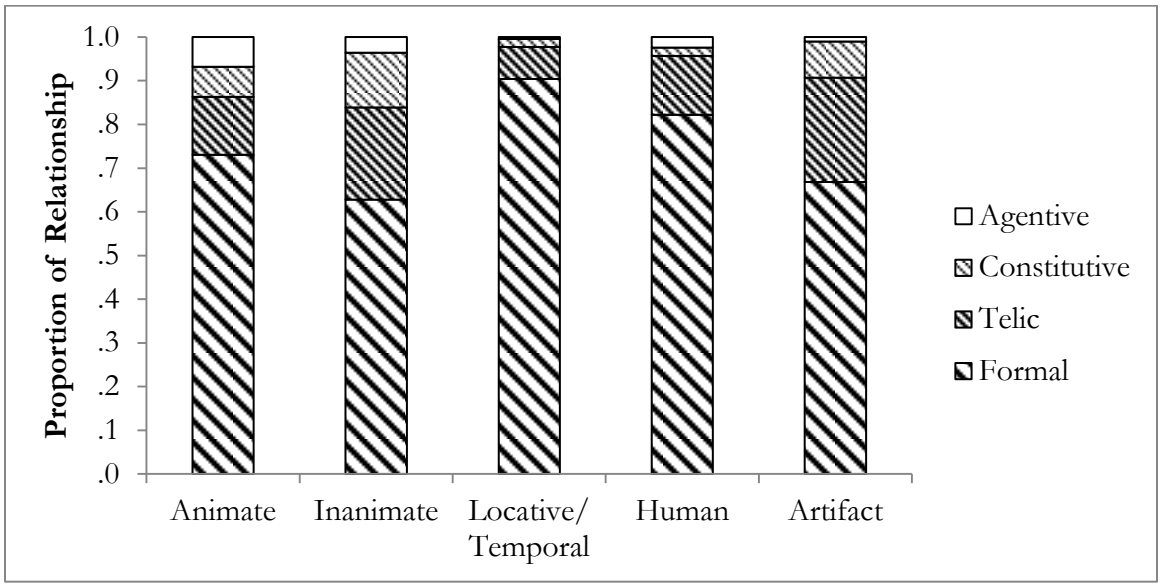


Table 9. Proportion (and Count) of Items by Relationship and Natural Classes

		Animate Head	**Inanimate Head**	**Loc/Temp Head**	**Human Head**	**Artifact Head**	**Overall**
Agentive	Animate Modifier	.00 (0)	.29 (9)	.00 (0)	.00 (0)	.00 (0)	.05 (9)
	Inanimate Modifier	.02 (1)	.05 (2)	.06 (3)	.00 (0)	.00 (0)	.03 (6)
	Location/Temporal Modifier	.00 (0)	.00 (0)	.00 (0)	.00 (0)	.00 (0)	.00 (0)
	Human Modifier	.00 (0)	.18 (4)	.00 (0)	.00 (0)	.00 (0)	.02 (4)
	Artifact Modifier	.00 (0)	.09 (2)	.00 (0)	.00 (0)	.00 (0)	.01 (2)
	Agentive Overall	<.01 (1)	.12 (17)	.01 (3)	.00 (0)	.00 (0)	**.02 (21)**
Constitutive	Animate Modifier	.00 (0)	.03 (1)	.03 (1)	.03 (1)	.15 (6)	.05 (9)
	Inanimate Modifier	.10 (4)	.11 (4)	.22 (7)	.00 (0)	.17 (8)	.12 (23)
	Location/Temporal Modifier	.00 (0)	.00 (0)	.00 (0)	.00 (0)	.05 (2)	.01 (2)
	Human Modifier	.00 (0)	.05 (1)	.05 (2)	.00 (0)	.03 (1)	.02 (4)
	Artifact Modifier	.00 (0)	.04 (1)	.25 (8)	.03 (1)	.00 (0)	.06 (10)
	Constitutive Overall	.02 (4)	.05 (7)	.11 (18)	.01 (2)	.08 (17)	**.05 (48)**
Formal	Animate Modifier	1.00 (47)	.68 (21)	.76 (25)	.75 (30)	.58 (23)	.76 (146)
	Inanimate Modifier	.88 (37)	.84 (31)	.59 (19)	.34 (10)	.52 (25)	.65 (122)
	Location/Temporal Modifier	1.00 (42)	.97 (31)	.93 (26)	.78 (29)	.85 (35)	.91 (163)
	Human Modifier	1.00 (33)	.59 (13)	.85 (33)	.87 (34)	.63 (25)	.80 (138)
	Artifact Modifier	.90 (27)	.83 (19)	.72 (23)	.78 (31)	.51 (22)	.73 (122)
	Formal Overall	.96 (186)	.79 (115)	.77 (126)	.72 (134)	.61 (130)	**.77 (691)**
Telic	Animate Modifier	.00 (0)	.00 (0)	.21 (7)	.23 (9)	.28 (11)	.14 (27)
	Inanimate Modifier	.00 (0)	.00 (0)	.19 (6)	.66 (19)	.25 (12)	.20 (37)
	Location/Temporal Modifier	.00 (0)	.03 (1)	.07 (2)	.22 (8)	.10 (4)	.08 (15)
	Human Modifier	.00 (0)	.18 (4)	.10 (4)	.13 (5)	.35 (14)	.16 (27)
	Artifact Modifier	.10 (3)	.04 (1)	.03 (1)	.20 (8)	.49 (21)	.20 (34)
	Telic Overall	.02 (3)	.04 (6)	.12 (20)	.26 (49)	.29 (62)	**.16 (140)**

3.1.4.2.1 The Role of Semantic Natural Class on Agentive Interpretations

A 5 Head Natural Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) X 5 Modifier Natural Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) ANOVA was carried out on the proportion of Agentive responses. The main effect of Head Natural Class was significant ($F(4, 32) = 9.071$, $p < .001$). Post-hoc comparisons, however, revealed no differences between groups after the Bonferroni correction.

The main effect of Modifier Natural Class was also significant ($F(4, 32) = 4.037$, $p = .009$). Post-hoc comparisons revealed that Animate modifiers were marginally more likely than Artifact modifiers ($p = .085$) and Locative Temporal/Temporal modifiers ($p = .071$) to receive Agentive interpretations.

The interaction between Head Natural Class and Modifier Natural Class was also significant ($F(16, 128) = 5.555$, $p < .001$).

3.1.4.2.2 The Role of Semantic Natural Class on Constitutive Interpretations

A 5 Head Natural Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) X 5 Modifier Natural Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) ANOVA was carried out on the proportion of Constitutive responses. The interaction between Head Natural Class and Modifier Natural class was significant ($F(16, 128) = 1.807$, $p = .037$). The main effects of Head Natural Class ($p = .606$) and Modifier Natural Class ($p = .162$) were not significant.

3.1.4.2.3 The Role of Semantic Natural Class on Formal Interpretations

A 5 Head Natural Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) X 5 Modifier Natural Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) ANOVA was carried out on the proportion of Formal responses. The main effect of Head Natural Class was significant ($F(4, 32) = 3.132$, $p = .028$). Post-hoc comparisons revealed

that Animate heads were more likely than Artifact heads (p = .018), Human heads (p = .033) and Inanimate heads (p = .044) to receive Formal interpretations

The main effect of Modifier Natural Class was also significant (F(4, 32) = 4.049, p = .009). Post-hoc comparisons revealed that Locative/Temporal modifiers were significantly more likely than Inanimate modifiers (p = .018) and marginally more likely than Animate modifiers (p = .058) to receive Formal interpretations.

The interaction between Head Natural Class and Modifier Natural Class was also significant (F(16, 128) = 2.335, p = .005).

3.1.4.2.4 The Role of Semantic Natural Class on Telic Interpretations

A 5 Head Natural Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) X 5 Modifier Natural Class (Animate, Inanimate, Locative/Temporal, Human, Artifact) ANOVA was carried out on the proportion of Telic responses. The main effect of Head Natural Class was significant (F(3, 24) = 12.315, p < .001). Post-hoc comparisons revealed that Artifact heads were more likely than Animate heads p = .006) and Inanimate heads (p = .017) to receive Telic interpretations. Human heads were more likely than Animate heads (p = .002) and Inanimate heads (p = .003) to receive Telic interpretations. Finally, Locative/Temporal heads were marginally more likely than Animate heads to receive Telic interpretations (p = .072).

The interaction between Head Natural Class and Modifier Natural Class was significant (F(16, 128) = 1. 734, p = .048).

The main effect of Modifier Natural Class was not significant (p = .195).

3.1.4.2.5 Summary of the Role of Semantic Natural Class on Interpretation

For almost all relationship types, the semantic natural class of the head and modifier nouns was a significant predictor of how often that relationship would be used. Importantly,

the use of different relationships with different natural classes reflected the way in which we naturally categorize nouns. For example, as head nouns, artifacts and humans, which can be thought of as functional, were interpreted as Telic more often than inanimate natural kinds, animate natural kinds, and locative/temporal nouns, which are thought of less, if at all, as functional. As modifier nouns, locative/temporal nouns, which can serve to define the origin of another noun, were most often interpreted as Formal. These results suggest that determining the natural class of the constituents in a compound can aid in their interpretation, especially in the absence of other relational cues, such as syntax.

3.1.5 Compound Interpretation Study Discussion

The results of the compound interpretation task supported all of our predictions for the interpretation of compounds. For syntax, verbal compounds with both known and nonce verbs were mainly interpreted as Telic, while noun-noun compounds with both known and nonce heads were interpreted with all four possible relationships. This result supports the claim that the modifier of a verbal compound must be interpreted as its internal argument by virtue of merging as the complement of the verb in the derivation (Roeper and Siegel 1978, Selkirk 1982, Lieber 1983, Di Sciullo and Williams 1987, Bobaljik 2003).

The results also supported the prediction that a noun must be specified for a particular qualia role in order to be interpreted using that type of relationship, in the absence of other contextual information. First, when an entire natural class was unlikely to have a particular qualia role specified, that entire natural class did not receive an interpretation based on that qualia role. For example, animate natural kinds are not thought of as functional and compounds with animate natural kind heads only received 2% (N = 3) Telic interpretations. Second, nonce head nouns were more likely than known head nouns to receive Agentive or Constitutive interpretations, which are interpretations that require very

specific conditions to be met between the head and modifier noun. Familiarity with known words makes these conditions very hard to meet, reflected in the 2% (N = 22) of known noun-noun compounds that received Agentive interpretations and 5% (N = 50) of known noun-noun compounds that received Constitutive interpretations. The rate of these interpretations nearly doubled, however, when the head noun was nonce. Noun-noun compounds with nonce head nouns received 5% (N =11) Agentive interpretations and 11% (N = 20) Constitutive interpretations.

Finally, the natural class of the head and modifier nouns was shown to play a significant role in the interpretation of the novel compounds (Downing 1977). Head noun classes that are generally thought of as functional, such as artifacts and humans, were more often interpreted as functional compared to head noun classes that are not thought of as functional, such as animate natural kinds, inanimate natural kinds, or locative/temporal nouns. For example, *blueberry-boy* and *blueberry-bowl* were both likely to be interpreted with functional interpretations, a boy who sells blueberries and a bowl that holds blueberries. Modifier noun classes also patterned according to our organization of the world. When the modifier of a compound was a locative/temporal noun, it was almost always interpreted with a Formal interpretation, where the location/time served as the origin of the head noun. For example, a *lake-pig* was likely to be interpreted as a pig that lives near a lake. One question for further research concerns the relative strength of the head and modifier natural classes in determining the overall interpretation of the compound.

In sum, the results of this study support the proposed system for interpreting compounds. Syntax strongly influenced the interpretation of the different strings in the study; noun-noun strings were parsed as noun-noun compounds by the syntax and were interpreted with many different relationships, while noun-verb-*er* strings were most often

parsed as verbal compounds with a verb-internal argument relationship. The lexical structure of the constituents in the compounds constrained the relationships allowed by a compound to only those specified in their lexical structure. Finally, the natural class of the head and modifier nouns strongly influenced the compounds to be interpreted much in the same way that we define those natural classes outside of compounds.

One question that this study was not able to answer was what types of interpretations are disallowed by the grammar. By its nature, the current task relies on the preferences of the participants' grammars to determine an interpretation, but it only provides evidence for particular interpretations are dispreferred, not disallowed. The next study extends the findings of this study with verbal compounds to determine if non-verb-internal argument interpretations are, in fact, disallowed by the grammars of English speakers.

3.2 Adult Study 2: Acceptable and Preferred Interpretations of Verbal Compounds

This study examined adults' interpretations of verbal compounds using both an acceptability task, which shows a grammar's ability to produce a particular interpretation, and a preference task, which shows a grammar's preference for a particular interpretation. The main goal of this study was to further explore the claim that verbal compounds can only receive a verb-internal argument interpretation (Roeper and Siegel 1978, Selkirk 1982, Lieber 1983, Di Sciullo and Williams 1987, Bobaljik 2003). A secondary goal of this study was to explore the claim that telicity interacts with argument realization (Borer 1994) in the compound domain. I address the background and predictions for each of these goals in turn.

3.2.1 The Role of Syntax in the Interpretation of Verbal Compounds

The main goal of this study was to examine the interpretations that are allowed by the syntax of verbal compounds. The structure of verbal compounds is argued to have a verbal core much like that of a full verb phrase (Harley 2009, Gamache and Schmitt to

appear), where the modifier noun is merged as the complement of the verb and therefore interpreted as its internal argument rather than its adjunct. In Adult Study 1 we saw that adults prefer verb-internal argument interpretations of noun-verb-*er* strings, but we were unable to test whether or not adult grammars disallow other types of readings altogether.

This study was designed to examine this claim by pairing nouns and verbs together where the noun could plausibly serve as either the internal argument of the verb or an adjunct to the verb. For example, *clean* and *towel* were paired since a towel is both something that can be cleaned and can be used to clean. For both the acceptability task and the preference task, two types of descriptions of compounds were given, one that reflects a verb-internal argument relationship and one that reflects a verb-adjunct relationship. For example, a *towel-cleaner* was described as either a person who cleans towels (internal argument) or a person who cleans things using a towel (adjunct).

The hypotheses put forth in this dissertation predicted that speakers should both prefer and allow only verb-internal argument interpretations of verbal compounds. For the acceptability task, I predicted that argument descriptions of verbal compounds would be rated as significantly more acceptable than adjunct descriptions of verbal compounds. As the adjunct interpretation of a verbal compound is ruled out by its syntax, participants should not allow this type of interpretation. Moreover, I predicted that argument descriptions of verbal compounds trigger faster responses than adjunct descriptions of verbal compounds. This delay in response time was predicted to be the product of a syntactic garden path, due to a second possible analysis of the string noun-verb-*er*. If noun-verb-*er* were reanalyzed as a noun-noun compound, the modifier noun would no longer the internal argument of the verb and would not be subject to the argument structure of the verb. In other words, *towel*, in

towel-cleaner could be interpreted as the location or manner in which the cleaning happens with noun-noun compound syntax.

For the preference task, the hypotheses put forth in this dissertation predicted that the argument description will be overwhelmingly preferred to the adjunct description. Since the noun-noun compound reanalysis was proposed as a repair strategy, and the argument description was always present for the preference task, non-argument interpretations should not have been considered.

3.2.2 The Role of Telicity in the Interpretation of Verbal Compounds

The secondary goal of this study was to examine the interaction of telicity with the realization of arguments. Borer (1994) proposed that the difference in argument structure between atelic and telic predicates involves the presence or absence of ASP_Q, a low, functional position that is occupied by the internal argument of the verb. In telic events, ASP_Q is present and the internal argument must be pronounced. In atelic events, ASP_Q is absent and the internal argument may be omitted. If atelic predicates can omit their internal argument, it follows that verbal compounds representing atelic events can omit their internal argument, which is normally realized as the modifier noun. Without the requirement for the modifier noun to be interpreted as the internal argument of the verb, it is possible that the modifier noun could be interpreted as an adjunct to the verb, an interpretation that is possible with noun-noun compound syntax.

This study was designed to examine this claim by systematically choosing verbs that fall into three categories: atelic, telic, and particle. Particle verbs are generally interpreted as strongly telic, creating a range of telicity for the study.

The hypotheses put forth in this dissertation predicted that the extent to which speakers allow and prefer adjunct readings of verbal compounds would be mediated by their

telicity. For the acceptability task, I predicted that adjunct interpretations of verbal compounds would be more acceptable for atelic items as compared to telic and particle items. Given the hypothesized ability for atelic predicates to omit their internal arguments, atelic items should have been more acceptable than telic items and particle items with descriptions where the modifier noun is not the internal argument. Moreover, atelic items as a whole should have been responded to more quickly since they are hypothesized to allow either an internal argument interpretation or an adjunct interpretation.

For the preference task, I predicted that the argument interpretation would be preferred most often for the telic items and particle items, and to a lesser degree for the atelic items. Because atelic items can allow both interpretations, however, they should have been responded to more slowly in the preference task as compared to the telic items and particle items, given the competition between the interpretations for atelic verbal compounds that does not exist for telic verbal compounds and particle verbal compounds.

3.2.3 Method

3.2.3.1 Participants

32 adults (20 F, 12 M) were recruited from an undergraduate linguistics course at Michigan State University. The subjects received extra credit in their course for their participation.

3.2.3.2 Materials and Procedure

Each participant participated in an acceptability task and a preference task. Target items were created for both tasks by pairing verbs with nouns that could reasonably be interpreted as either an internal argument or an adjunct. For example, *towel* in *towel-cleaner* was either what was cleaned (argument) or what was used to clean (adjunct). Eight verbs were chosen for each of the three verb types that were tested, atelic, telic, and particle verbs. The

eight verbs were split across the two tasks with 12 target items (four atelic verbs, four telic verbs, four particle verbs) in each task. See Table 10 for the full list of target items. The verbs were balanced such that all verbs showed up in both the acceptability and the preference task for different participants.

Participants were tested individually on PCs using E-Prime experimental software and Sennheiser headphones. The acceptability task was always carried out first as the preference task calls direct attention to the contrast under examination, the use of argument vs. adjunct interpretations for verbal compounds. All participants participated in both tasks in one session with a two-minute break between tasks.

Table 10. Full Item List for Adult Study 2

Verb Type	**Verb**	**Compound**	**Argument Description**	**Adjunct Description**
Atelic	burn	*candle-burner*	burns candles	burns things using a candle
	carry	*helicopter-carrier*	carries helicopters	carries things using a helicopter
	fight	*robot-fighter*	fights robots	fights things using a robot
	protect	*sword-protector*	protects swords	protects things using a sword
	push	*head-pusher*	pushes heads	pushes things using their head
	pull	*truck-puller*	pulls trucks	pulls things using a truck
	tickle	*toe-tickler*	tickles toes	tickles things using their toes
	wipe	*tongue-wiper*	wipes tongues	wipes things using a tongue
Telic	build	*tool-builder*	builds tools	builds things using a tool
	buy	*phone-buyer*	buys phones	buys things using a phone
	clean	*towel-cleaner*	cleans towels	cleans things using a towel
	cut	*diamond-cutter*	cuts diamonds	cuts things using a diamond
	deliver	*bike-deliverer*	delivers bikes	delivers things using a bike
	fix	*microscope-fixer*	fixes microscopes	fixes things using a microscope
	paint	*hand-painter*	paints hands	paints things using their hands
	wash	*sponge-washer*	washes sponges	washes things using a sponge
Particle	check-out	*computer-checker-outter*	checks out computers	checks out things using a computer
	drop-off	*wagon-dropper-offer*	drops off wagons	drops off things using a wagon
	fill-up	*bucket-filler-upper*	fills up buckets	fills up things using a bucket
	hand-out	*basket-hander-outter*	hands out baskets	hands out things using a basket
	pass-out	*spoon-passer-outter*	passes out spoons	passes out things using a spoon
	pick-up	*stick-picker-upper*	picks up sticks	picks up things using a stick
	set-up	*ladder-setter-upper*	sets up ladders	sets up things using a ladder
	take-away	*car-taker-awayer*	takes away cars	takes away things using a car

3.2.3.2.1 Acceptability Task

On each trial an audio recording first presented a person ("This is a person who cleans towels.") and then gave a potential name for that person ("a towel-cleaner"). The description type was either an Argument description where the modifier of the compound was treated as an internal Argument of the verb ("cleans towels"), or an Adjunct description where the modifier of the compound was treated as an Adjunct to the verb ("cleans things using a towel"). There were a total of 80 trials, 12 target trials and 68 filler trials, presented in a uniquely randomized order for each participant. Description types were counterbalanced across subjects such that for any compound, half of the subjects heard an Argument description and half of the subjects heard an Adjunct description. Participants responded in one of two methods. The Binary Response Group (N = 16) responded with either a "1" if the compound and description matched perfectly, or "0" if the compound meant something slightly or completely different than the description. The Likert Scale Group (N = 16) responded on a Likert scale from 1 to 7, "1" being "That name means something slightly or completely different." and "7" being "I would definitely call them by this name."

3.2.3.2.2 Preference Task

On each trial an audio recording first named a person using a verbal compound ("a towel-cleaner") followed by a 500 ms pause and a screen that showed two possible descriptions ("This is a person who cleans towels." or "This is a person who cleans things using a towel."). There were a total of 48 trials, 12 target trials and 36 filler trials, presented in a uniquely randomized order for each participant. Participants responded by choosing which description better first their interpretation of the compound.

3.2.3.3 Analysis

Responses and responses times were analyzed for both the acceptability and preference tasks. A log transform was conducted on all response times to remove the positive skew associated with the distribution of response times.

For the acceptability task four separate 3 Verb Type (Atelic, Telic, Particle) X 2 Description Type (Argument, Adjunct) ANOVAs were carried out. For the binary response group, one ANOVA was carried out on the dependent measure of proportion of acceptable ("1") responses and one ANOVA was carried out on the dependent measure of log-transformed response times, originally measured in milliseconds. For the Likert response group, one ANOVA was carried out on the dependent measure of average acceptability and one ANOVA was carried out on the dependent measure of log-transformed response times, originally measured in milliseconds.

For the preference task two separate 3 Verb Type (Atelic, Telic, Particle) ANOVAs were carried out, one on the dependent measure of proportion of Argument responses and one of the dependent measure of log-transformed response times, originally measured in milliseconds.

3.2.4 Acceptability Task Results

3.2.4.1 Acceptability Task Response Results

Figure 9 shows the proportion of "1" responses by the Binary Response Group by Verb Type and Description Type. A 3 Verb Type X 2 Description Type ANOVA on the proportion of "1" responses revealed a main effect of Description Type ($F(1, 30) = 77.039$, $p < .001$); Argument descriptions were rated as significantly more acceptable than Adjunct Descriptions. Paired-sample *t*-tests revealed that this pattern reliably held for each Verb Type (Atelic $t(15) = 3.955$, $p =. 001$; Telic $t(15) = 6.455$, $p < .001$; Particle $t(15) = 4.392$, $p = .001$).

The main effect of Verb Type (p = .683) was not significant. The interaction between Description Type and Verb Type (p = .201) was also not significant.

Figure 9. VC Acceptability: Proportion of "1" Responses by Binary Group

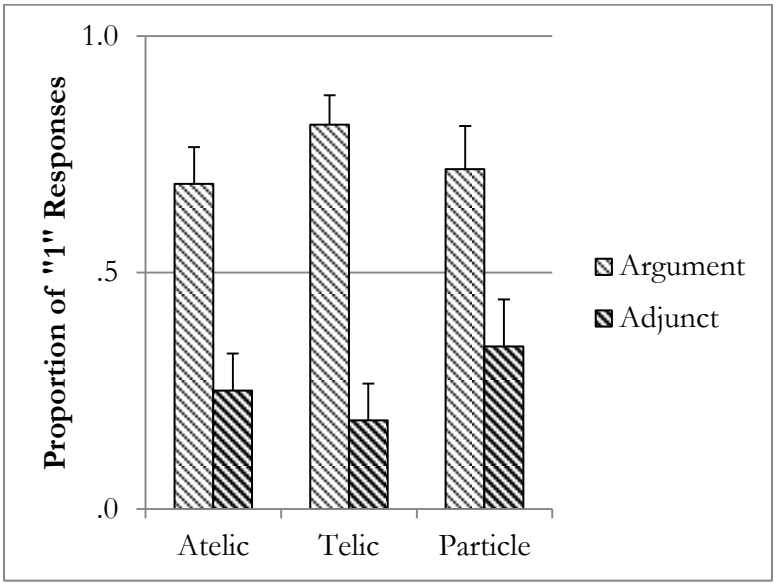
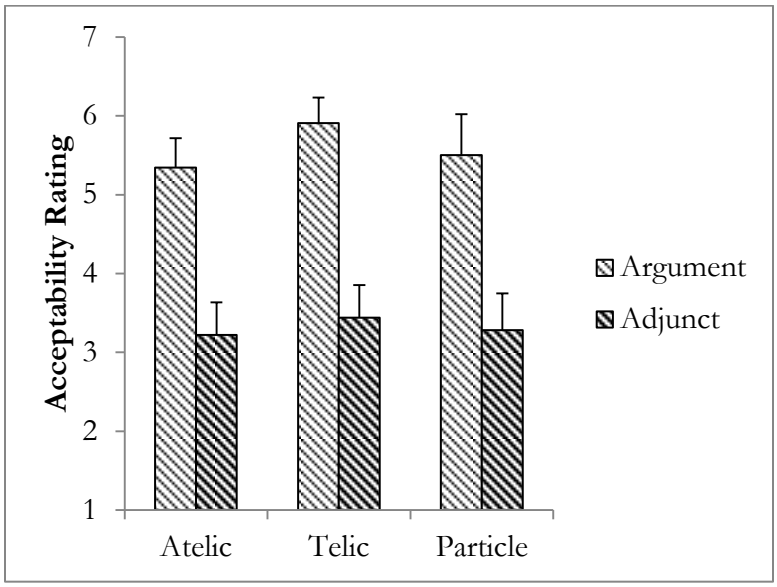


Figure 10 shows the average rating by the Likert Response Group by Verb Type and Description Type. The 3 Verb Type X 2 Description Type ANOVA on the proportion of "1" responses revealed a main effect of Description Type ($F(1, 30) = 36.348$, $p < .001$); Argument descriptions were rated as more acceptable than Adjunct Descriptions. Paired-sample t-tests revealed that this pattern reliably held for each Verb Type (Atelic $t(15) = 3.746$, $p =. 002$; Telic $t(15) = 4.772$, $p < .001$; Particle $t(15) = 4.109$, $p = .001$). The main effect of Verb Type (p = .634) was not significant. The interaction between Description Type and Verb Type (p = .871) was also not significant.

Figure 10. VC Acceptability: Average Acceptability Rating by Likert Group



3.2.4.2 Acceptability Task Response Time Results

Figure 11 shows the log-transformed response times for the Binary Response Group by Verb Type and Description Type. The 3 Verb Type X 2 Description Type ANOVA performed on the log-transformed response times for the binary group revealed a marginally significant main effect of Description Type ($F(1, 30) = 4.085$, $p = .061$); Argument descriptions were responded to slightly faster than Adjunct descriptions. The main effect of Verb Type was not significant ($p = .148$). The interaction between Verb Type and Description Type was also not significant ($p = .361$).

Figure 11. VC Acceptability: log Response Times by Verb Type for Binary Group

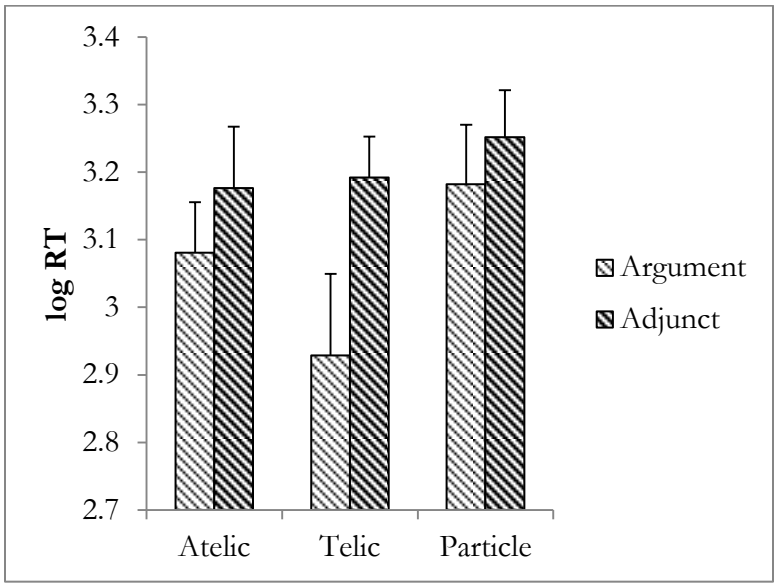
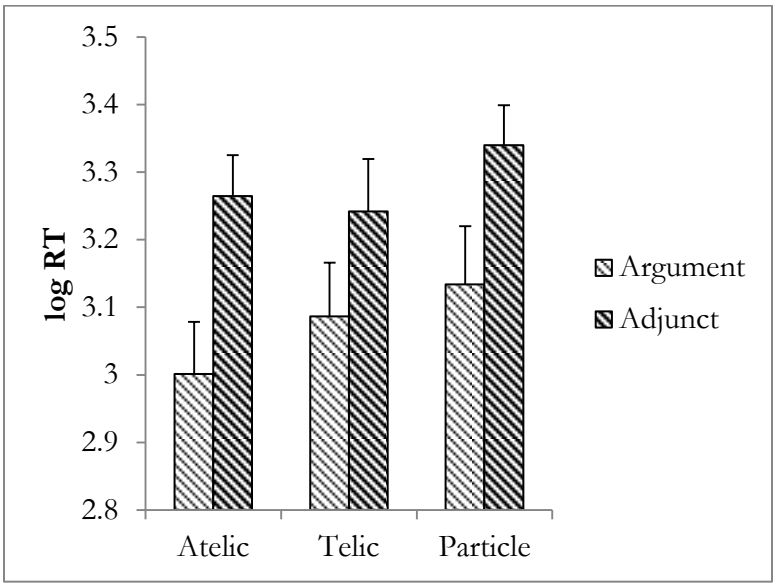


Figure 12 shows the log-transformed response times for the Likert Response Group by Verb Type and Description Type. The 3 Verb Type X 2 Description Type ANOVA performed on the log-transformed response times for the binary group revealed a main effect of Description Type ($F(1, 30) = 12.009$, $p = .003$); Argument descriptions were responded to significantly faster than Adjunct descriptions. Paired-sample t-tests revealed that Argument description response times were significantly shorter than Adjunct description response times for Atelic items ($t(15) = -3.694$, $p = .002$), and Particle items ($t(15) = -2.185$, $p = .045$), and marginally shorter for Telic items ($t(15) = -1.780$, $p = .095$). The main effect of Verb Type ($p = .334$) was not significant. The interaction between Verb Type and Description Type was also not significant ($p = .588$).

Figure 12. VC Acceptability: log Response Times by Verb Type for Likert Group

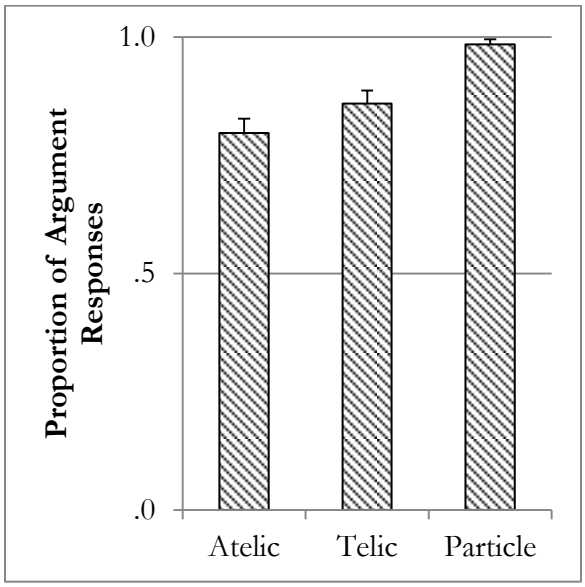


3.2.5 Preference Task Results

3.2.5.1 Preference Task Response Results

Figure 13 shows the proportion of Argument responses by Verb Type and Description Type. The 3 Verb Type ANOVA on the proportion of Argument responses revealed a main effect of Verb Type ($F(2, 62) = 15.500$, $p < .001$). Post-hoc comparisons revealed that Argument descriptions were chosen significantly more often for Particle items than Atelic items ($p < .001$) and significantly more often for Particle items than Telic items ($p < .001$). There was no difference in how often Argument descriptions were chosen for Telic and Atelic items ($p = .441$).

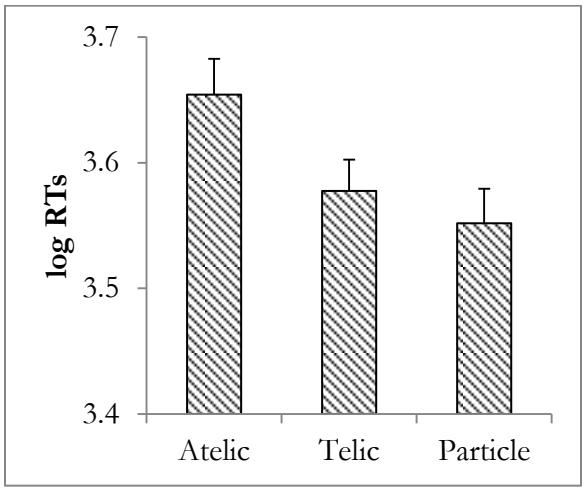
Figure 13. VC Preference: Proportion of Argument Responses by Verb Type



3.2.5.2 Preference Task Response Time Results

Figure 14 shows the log-transformed response times by Verb Type. The 3 Verb Type ANOVA on the log-transformed response times revealed a main effect of Verb Type ($F(2, 62) = 6.924$, $p = .002$). Post-hoc comparisons revealed that responses were significantly faster for Particle items than Atelic items ($p < .001$) and marginally faster for Telic items than Atelic items ($p = .057$). There was no difference in how quickly responses were made for Telic items and Particle items ($p = 1.000$).

Figure 14. VC Preference: log Response Times by Verb Type



3.2.6 Acceptability and Preference Task Discussion

The results of the acceptability and preference tasks supported both predictions of this study. First, both tasks overwhelmingly supported the prediction that the structure for verbal compounds does not allow adjunct interpretations. This was shown in two ways. First, both response groups for the acceptability task failed to rate the adjunct readings as acceptable as compared to the argument readings. For the preference task, participants overwhelmingly preferred the internal argument reading for verbal compounds. Second, when presented with an adjunct interpretation of a verbal compound, participants' responses times increased significantly, suggesting that they initially analyzed the compounds as verbal compounds, which do not allow adjunct interpretations, and were forced to reanalyze the compounds as noun-noun compounds, which do allow adjunct interpretations.

The results also supported the second prediction, that atelic predicates, even in compounds, can omit their internal arguments (Borer 1994). In the preference task, both the response patterns and the response time patterns support a theory where atelic predicates in verbal compounds can omit their internal arguments. For responses, adjunct interpretations were chosen most often for atelic verbal compounds. For response times, atelic verbal

compounds had the longest response times, reflective of the availability of either an argument interpretation or an adjunct interpretation, a choice that was not present for telic verbal compound and particle verbal compounds.

3.3 General Discussion

The goal of this chapter was to test the predictions made by the interpretation system outlined in Chapter 2. The system proposed in Chapter 2 suggests that adults use two types of information when interpreting compounds: syntax and lexical structure, which critically includes natural class information. The two studies presented in this chapter suggested that both of these information sources are, in fact, used in conjunction with one another to arrive on a compound's interpretation. Syntax was shown to systematically determine a relationship for verbal compounds, but not for noun-noun compounds. Importantly, the syntax of verbal compounds only required this relationship when the verb in the verbal compound obligatorily required an internal argument; atelic verbs, which are able to omit their internal arguments, were able to be parsed as noun-noun compounds with adjunct-type readings. For noun-noun compounds, the relationship was determined by the information in the head noun's lexical structure. The set of possible relationships was determined by the qualia roles that were specified for on the head noun, and the most likely relationship was determined by the natural classes of the head and modifier in conjunction with one another. In the second half of this dissertation this system will be treated as the target state for children who are learning the English system of compounds.

CHAPTER 4: ACQUISITION BACKGROUND

4.0 Introduction

The second half of this dissertation examines how children acquire noun-noun compounds and verbal compounds. In Chapters 2 and 3 we found evidence that adults use two aspects of compounds to determine their meaning: their syntax and the lexical structure of their constituents. In the second half of this dissertation I take the position that children use the same compositional system as adults to interpret compounds and any deviations from adult-like interpretations arise from children having different syntactic representations or different lexical knowledge during development. In this chapter I review the work that has been done on children's acquisition of compounds and summarize some questions that remain about this acquisition process.

4.1 Different Approaches to Language Acquisition

Any acquisition research has to consider the existence of an innate component and the influence from the language the learner is exposed to. Current approaches to language acquisition diverge in both qualitative and quantitative terms. On one side we have an approach that assumes an innate component which filters the input in specific ways and on the other hand we have an approach that considers domain general learning mechanisms to be sufficient for language acquisition. Under the latter, children do not come with pre-specified categories and develop their linguistic system by analogy with items in the input. We will call this the usage-based approach (Tomasello 2000). Under the former approach, data from the input is filtered and choices are made based on the input. In other words, in both cases, information from the input is crucial, but in the usage-based case we do not expect deviations from the input but rather a conservative build-up of the system. In the input-filtering mode children may, in the acquisition of the grammar, produce non-adult

forms absent in the input that are related to a particular analysis of the structure. In the next section I review the research on children's acquisition of compounds, bearing in mind these different approaches to language acquisition and the types of data that support each.

4.2 What Children Know about Compounds

This section reviews the acquisition work that has been done on children's acquisition of compound syntax and children's interpretation of compounds. The first section reviews past literature on children's acquisition of noun-noun compound syntax and children's interpretation of noun-noun compounds. The second section reviews past literature on children's acquisition of verbal compound syntax and children's interpretation of verbal compounds.

4.2.1 Children's Acquisition of Noun-Noun Compounds

4.2.1.1 Acquisition of Noun-Noun Compound Syntax

The relatively simple syntax of noun-noun compounds and the early age at which noun-noun compounds become productive makes their acquisition somewhat opaque. Children produce adult-like novel noun-noun compounds by age 3 (Clark 1981, Snyder 1995), and for the most part, produce them without apparent syntactic errors, such as order reversals like *trap-mouse* for *mouse-trap* (Clark et al. 1985, Clark & Berman 1987, Hiramatsu et al. 2000).

In addition to learning the syntax of noun-noun compounds very early, Clark et al. (1985) found that young children also pick up on the distribution with which adults use noun-noun compounds versus other structures. In a production study Clark et al. prompted children to name objects in two images that different by only one feature, for example, a truck that carries a horse and a truck that carries a bike in another. They found that children, like adults, produced compounds in cases of contrast (a *horse-truck* vs. a *bike-truck* for two

trucks whose beds contained those objects). Children and adults also produced compounds more often when the modifier-head relationship defined an intrinsic property of the referent rather than a temporary one. For instance, both children and adults were more likely to use *pumpkin-house* for a house made of pumpkin (intrinsic) than for a house with a pumpkin near it (temporary).

Previous literature has pointed to one aspect of children's production of noun-noun compounds that may give insight into the acquisition process. Hiramatsu et al. (2000) showed that children produce order errors when attempting to produce compounds for particular types of descriptions. In their production study, 3- to 4-year old English-speaking children often reversed the order of the nouns in shape/appearance descriptions such as "a chair shaped like a hand", producing *chair-hand* rather than *hand-chair*. The children in this study did not produce order errors for any of the other tested description types (material, place of origin). Hiramatsu et al. suggest that this pattern may be due to a compound subset principle, where children are using the compound system of a language such as Hungarian, where shape/appearance compounds are not allowed. This pattern, however, failed to hold up in their corpus study, where young children were shown to produce novel adult-like shape/appearance compounds, leaving open the question of whether or not children have non-adult restrictions on their use of compound syntax.

To summarize, by most measures, children learn the syntax of noun-noun compounds very early and use noun-noun compounds in the same scenarios as adults. One area for further research is to determine if children use compound syntax to represent the same range of meanings as adults, or if they use compound syntax in a more restricted way.

4.2.1.2 Children's Interpretations of Noun-Noun Compounds

Turning to children's interpretation of noun-noun compounds, children understand compound headedness by age 3 (Clark et al. 1985). For example, three-year-old children know that a *blueberry-spoon* is a spoon and not a blueberry. Moreover, children understand that compounds create a subset relationship between a basic term and its compound subordinate members (Gelman, Wilcox, and Clark 1989). For instance, young children understand that a *car-fap* is a member of the type *fap*.

Children begin to look less adult-like in studies that ask children to define the meaning of an entire compound. In a production study, Clark and Berman (1987) showed that younger children described compounds only using the head noun and only later in development identified the modifier and the relationship between the two. In their study, three-year-olds identified the relationship between the head and the modifier noun on only 13% of trials, while four-year-olds identified this relationship on 74% of trials. In a similar study, Krott and Nicoladis (2005) showed that the likelihood of a child to include the modifier in their description of a compound was related to the number of compounds in the children's input that shared the same modifier. For example, if children knew many compounds with *chocolate* as the modifier, they were likely to say that a *chocolate-cake* is a cake made of chocolate. If children were not familiar with many compounds with *chocolate* as the modifier, they were more likely to say that a *chocolate-cake* was just a cake, without mention of the modifier *chocolate*. Interestingly, in this study, this pattern did not change over time. The five-year-olds in this study, who presumably had a significantly larger vocabulary than the four-year-olds, were as likely as the four year olds to exclude either the head or modifier nouns from their compound descriptions.

While the Clark and Berman (1987) and Krott and Nicoladis (2005) studies report on children's ability to give a description using both the head and modifier nouns, these studies do not report what type of relationship children ascribed to the compound. In fact, relatively little is known about how children interpret the relationship between the nouns in a noun-noun compound. Recently, Krott et al. (2009) found that the frequency of specific head noun-relationship pairings in the input plays a role in children's interpretations of noun-noun compounds. For example, in their task, a child was better at interpreting *mouse-trap* as a trap that catches mice if the child was familiar with *ant-trap*, *bear-trap*, etc., all of which have *trap* as their head noun and a 'for' relationship. The authors suggest that this ease of interpretation is due to item-specific templates that children develop based on their input.

Two things are of note for this Krott et al. study. First, the children in this study were on average five years old and were still argued to be using templates for compounds. Second, a brief inspection of the items used in the Krott et al. (2009) study reveals that, while it is true that each noun is used most often with a particular relationship, it is also true that different natural classes are each used most often with a particular relationship. For example, the artifacts *basket, table, shoes, rack, suit, foil, helmet,* etc. were all used most frequently with 'for' relationships as head noun. Therefore, while it may appear that children use item-specific templates in their interpretation, it is also plausible that children use natural class level information to interpret novel compounds. Independently of compounds, we have good reason to believe that children would employ natural class information in their interpretation of novel compounds. It has been shown in numerous studies that children use natural class membership to induce properties of novel nouns that are not necessarily apparently in the learning environment (e.g., Gelman 1988, Gelman and Markman 1987, Davidson and Gelman 1990). For example, children are able to instantaneously associate

properties such as "needs lungs to breathe" from a known animal to a novel animal without direct evidence that the novel animal has that property. The same mechanism, capitalizing on commonalities among classes, is used by at least adults when interpreting compounds.

The final finding of note is that in comprehension children appear to prioritize physically apparent information over intrinsic, but possibly not apparent, information. In an interpretation task, Krott et al. (2010) used nonce word compounds to determine how children interpreted compounds without prior experience with the constituents in the compound. Their results suggest a bias towards 'has'- or 'located'-type relations in children's interpretation of compounds, that is not predicted by the relative frequencies in the input. That is, in their study, children were more likely to pick the wug with a moop near it, as opposed to a wug made of woop for *wug-moop*. It is of note, however, that using nonce words does not allow for children to access any of the rich lexical knowledge that we would argue is used in compound interpretation, such as physical appearance, function, etc. Therefore, a safe bet for the child participants, who were unfamiliar with the words, would be to go with the physically apparent relationship, which is easily seen in the images that represent each examples.

To summarize, by some measures, children interpret noun-noun compounds in an adult-like way; children understand headedness and that compounds create subsets of the head noun. Based on the findings to date, however, it is not clear if children are adult-like or not in establishing the relationship between the nouns in a noun-noun compound.

4.2.1.3 Acquisition of Noun-Noun Compounds Summary and Questions

Children begin producing novel noun-noun compounds by age three, and appear to produce them under largely the same circumstances as adults. Less is known, however, about how children interpret novel noun-noun compounds. The only work done to date on how

children determine relationship that exists between the head and modifier in a noun-noun compound suggest that frequencies in the input may play a role in children's interpretation. The previous literature on the acquisition of noun-noun compounds raises three questions for further research:

(6) Questions raised by previous compound acquisition literature

a. Do young children systematically avoid using noun-noun compounds for particular types of descriptions?

b. Are children using templates or a more general mechanism to interpret noun-noun compounds?

c. Why is there a disparity between children's preference for intrinsic relationships when producing novel compounds, but temporary relationships when interpreting novel compounds?

4.2.2 Children's Acquisition of Verbal Compounds

4.2.2.1 Acquisition of Verbal Compound Syntax

Unlike noun-noun compounds, the syntactic complexity of verbal compounds makes their acquisition much more transparent. Children produce adult-like novel verbal compounds around age five (Clark et al. 1986) and adult-like recursive verbal compounds (*mouse-catcher-maker*) around age seven (Hiraga 2010). Clark et al. (1986) were the first to show that children produce a specific set of non-adult forms during the acquisition of verbal compounds; children reliably produce verb-internal argument *catch-mouse* forms and verb-*er*-internal argument *catcher-mouse* forms, but fail to produce logically possible internal argument-verb *mouse-catch* forms. This pattern has been replicated in production studies with English children (Nagpal and Nicoladis 2009, Gamache and Schmitt to appear) and Dutch children (Brisard et al. 2008). Moreover, Clark and Barron (1988) found that children's acceptability

of verbal compound forms largely matched the current state of their own grammar. While all children accepted grammatical verbal compounds (internal argument-verb-*er*), younger children often also accepted non-adult forms and "repaired" non-adult forms to other non-adult forms. For example, a child whose current produces *catcher-mouse* forms might say that *catch-mouse* is bad, but may only repair *catch-mouse* to *catcher-mouse*, instead of the adult *mouse-catcher*.

The locus of the pattern of forms that children produce (*catch-mouse, catcher-mouse,* and *mouse-catcher* but not *catch-mouse*) has been attributed to (i) interference from other frequent nominal constructions in the input (Nagpal and Nicoladis 2009), (ii) interference from verb phrase verb-internal argument order (Clark et al. 1986), and (iii) adherence to the steps in the adult derivation (Gamache and Schmitt to appear).

To address the first claim, that children's non-adult forms are due to influence from verb-internal argument order in phrasal syntax, we turn to Dutch data. In Dutch, the target adult form is the same and children have been shown to produce the same set of non-adult forms (Brisard et al. 2008). However, Dutch children's input is 45% internal argument-verb order (Evers and van Kampen 2001) and they produce no internal argument-verb verbal compound forms, suggesting that it is unlikely simple frequency of phrasal word order drives the pattern of non-adult forms.

The second claim is that *catch-mouse* and *catcher-mouse* forms surface due to interference from other nominal constructions that have verb-noun order, such as *running man* phrasal constructions, or *dump-truck* or *frying-pan* compound constructions (Nagpal and Nicoladis 2009). There are two reasons why this argument is likely to be incorrect. First, one of the tenets of construction grammar is that children are mapping word strings to interpretations. However, the relationship between *catch* and *mouse* in *mouse-catcher* is quite

different than the relationship between the noun and verb in any of the other constructions. In *mouse-catcher* the noun is the object of the verb, while in *running-man* the noun is the agent of the verb, and in *dump-truck* and *frying-pan* the noun is the instrument by which the verb's action is done. If children do not assign thematic relations to these constructions in the same way as adults, then children should be more likely to allow a range of meanings for verbal compounds than adults, which it is not clear that they do. For example, do children allow *catch-mouse* to be a mouse used for catching, as it would if it were assigned the same interpretation as a *dump-truck*-type compound?

The second reason why this argument is unlikely to be correct is because it predicts a wide range of errors that children are not attested to produce. Table 11 shows the type and token count of four different compound constructions in the input to children in the Brown (1973) corpus on CHILDES (MacWhinney 2000). The first thing to note is that, relative to noun-noun compounds, all of the compounds containing verbs are infrequent. The second thing to note is that the compounds contain verbs are roughly equally frequent, relative to one another. Given their equal frequency, they should all affect each other in the acquisition process.

Table 11. Type (and token) count of compounds in adult speech in Brown (1973) corpus

Compound	Example	Input to Adam	Input to Sarah
NV*er* Compound	*mouse-catcher*	15 (103)	8 (34)
VN Compound	*dump-truck*	18 (58)	18 (77)
V*ing*N Compound	*reading-lamp*	6(51)	8 (24)
NN Compound	*book-trap*	200 (~1000)	175 (~700)

Table 12 shows the forms that should be attested in children's speech if all of these compound types are able to affect each other. In these forms, the word order of each compound type is crossed with the morphology of each compound type. Looking first at the predicted forms for the *mouse-catcher* target, we know from the production studies discussed

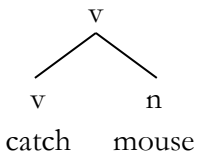
above that the greyed forms are attested in children's speech. However, two logical possibilities *mouse-catching* and *mouse-catch* are not attested in any of the production studies to date, critically to mean *mouse-catcher*. Unfortunately there are no production studies of VN and V*ing*N compounds, but the non-adult form types for *dump-truck* and *reading-lamp* to our knowledge have not been discussed in the literature, despite being quite salient (for example, *lamp-reader* in the place of *reading-lamp*). In other words, there appears to be a unidirectionality of the VN and V*ing*N compounds affecting NV*er* compounds, but NV*er* compounds not affecting VN and V*ing*N compounds. This unidirectionality is not predicted by the usage-based account.

Table 12. Possible non-adult forms for NV*er*, VN, and V*ing*N

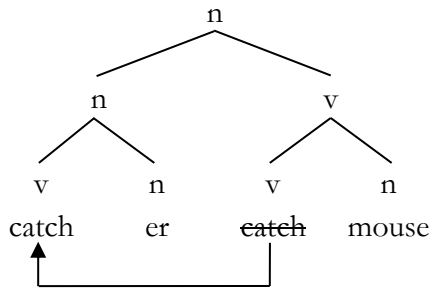
		Morphology		
Target word order and interpretation	**Word Order**	*-er*	*-ing*	*-Ø*
mouse-catcher	VN	catcher-mouse	catching-mouse	catch-mouse
	NV	mouse-catcher	mouse-catching	mouse-catch
dump-truck	VN	dumper-truck	dumping-truck	dump-truck
	NV	truck-dumper	truck-dumping	truck-dump
reading-lamp	VN	reader-lamp	reading-lamp	read-lamp
	NV	lamp-reader	lamp-reading	lamp-read

A generative approach, such as the one we have proposed in Gamache and Schmitt (to appear), straightforwardly explains why children produce this particular set of forms and not others. In line with a strong version of the continuity hypothesis (Pinker 1984), children's non-adult forms are steps in the adult derivation, and therefore only forms that are reflective of steps in the derivation are those produced by children. Shown in (7) – (10), children learn the first step of the derivation, merging the verb and its internal argument, producing *catch-mouse*. In the next step, children merge *–er* in the structure incorporate the verb into *–er,* producing *catcher-mouse.* Finally, children move the internal argument to the specifier of V*er*, producing *mouse-catcher.*

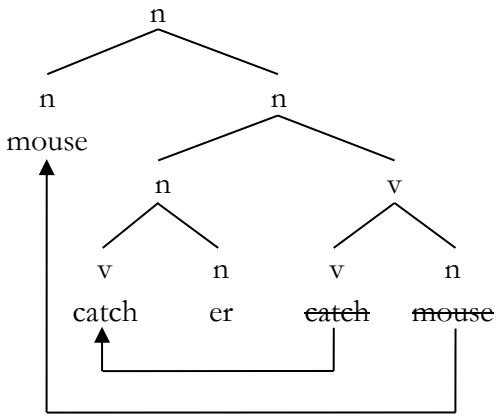
(7) Step 1 *catch-mouse*



(8) Step 2 *catcher-mouse*



(9) Step 3 *mouse-catcher*



4.2.2.2 Children's Interpretation of Verbal Compounds

While we know of no systematic study of how children interpret the modifier in verbal compounds, there is some evidence that children's interpretation of certain aspects of verbal compounds take a while to develop. Gelman and Heyman (1999) found that older children and adults were more likely than younger children to interpret a property as being

stable when referred to with a verbal compound. For example, when called a person was called a *carrot-eater* older children and adults were more likely than younger children to infer that eating carrots was a regularly occurring activity of the named person.

4.2.2.3 Children's Interpretation of Compounds Summary and Questions

Children begin produce adult-like verbal compounds around age five, and prior to target forms, produce a particular set of non-adult forms (*catch-mouse, catcher-mouse,* but not *mouse-catch*). There is no work to date on how children interpret the relationship in verbal compounds. The previous literature on the acquisition of noun-noun compounds raises two questions for further research:

(10) Questions raised by previous child compound interpretation literature

a. Why do children produce the set of forms that they do?

b. What type of relationship do children attribute to verbal compounds and does the relationship change relative to their syntactic knowledge?

4.2.3 Summary of Past Acquisition Research

There are a number of findings that bear on our goal of determining if children use the same system as adults to interpret compounds. For the syntax of noun-noun compounds, children appear to avoid associating the noun-noun compound structure with particular descriptions. This avoidance could be due to a restriction that children have on the compound structure, which might support a generative approach to language acquisition, or it could be due to the compound structure being infrequently associated to this description in the input, which might support a usage-based approach. For the interpretation of noun-noun compounds, children appear to interpret compounds in line with related compounds in their input, which supports a usage-based theory of language acquisition. For the syntax of verbal compounds, children only produce a particular set of forms (*catch-mouse* and *catcher-*

mouse, but not *mouse-catch* for *mouse-catcher*). This pattern has been explained as interference from other constructions in the input, in line with a usage-based account, and as children building the steps in the adult derivation, in line with a generative account. For the interpretation of verbal compounds, the question of how children learn to interpret the modifier in verbal compounds as the internal argument of the verb is still completely open.

4.3 Hypotheses and Predictions for Children's Acquisition of Compounds

In this section I present the hypotheses and predictions for how children acquire compounds. The hypotheses, shown in Table 13, are discussed in turn, along with any predictions that the hypothesis makes about children's behavior.

Table 13. Hypotheses and Predictions for Children's Acquisition of Compounds

Hypothesis	**Predictions**
Hypothesis 1: The strong continuity hypothesis is correct for the acquisition of compounds.	**Prediction 1**: The non-adult compound forms that children produce are steps in the adult derivation of that compound form. **Prediction 2**: Even when producing non-adult forms, children interpret compounds in line with the constraints of their knowledge of compound syntax.
Hypothesis 2: Given principles of compositionality, syntax and interpretation go hand in hand provided that children know the meaning of the words in compounds.	**Prediction 3**: Non-adult compound structures lead to non-adult interpretations of compounds. **Prediction 4**: Incomplete lexical semantic knowledge leads to non-adult interpretations of compounds. **Prediction 5**: Children's use of noun-noun compounds reflects natural class-, not item-, level knowledge.

The first hypothesis is that the strong continuity hypothesis (Pinker 1984) is correct for the acquisition of compounds. This hypothesis predicts that the only non-adult forms that children produce are forms that are steps in the adult derivation. For example, if we assume that the adult derivation begins with the merging of the verb with a noun as its internal argument, then one form that children are predicted to produce is verb-internal argument *catch-mouse*. Moreover, this hypothesis predicts that children's interpretations of compounds are in line with the constraints of the current state of their grammars. For

example, if a child is producing verb-internal argument *catch-mouse* forms, then their grammar has already learned that the first step in the adult derivation of verbal compounds is to merge the verb with the internal argument. Therefore, already at this point in the acquisition process, the child should only allow interpretations where the modifier noun in a verbal compound is interpreted as the theme of the verb.

The second hypothesis is that, given principles of compositionality, syntax and interpretation go hand in hand provided that children know the meaning of the words in compounds. This hypothesis suggests that the mechanism that children are using is the same that adults are using and predicts that any deficiency in the parts of that mechanism, whether syntactic or lexical semantic knowledge, lead to non-adult interpretations. This hypothesis leads to three predictions.

The first prediction is that a child who has not yet acquired the syntax of a structure should allow a different set of interpretations than a child who has acquired the syntax. For example, a child who has not yet acquired any part of the verbal compound structure has also not acquired any of the constraints that are part of that structure. Therefore, this child is predicted to allow interpretations of verbal compounds that would not be allowed by adult speakers, such as an instrument reading of *towel* in *towel-cleaner*.

The second prediction is that a child who does not know the lexical semantic features of a word in a compound should interpret the compound differently than a child who does know those features of the word. For example, if a child knows that an object is an artifact, but does not know what the function of the object is, the child will not be able to have a functional interpretation of the object.

The third prediction is that children's use of noun-noun compounds should reflect natural class-, not item-, level knowledge. Therefore, children are predicted to be able to use

words in compounds that they have previously not heard in compounds. For example, even if a child has not heard the words *hamburger* or *spatula* used in a compound before, they can generate or interpret a novel compound such as *hamburger-spatula* based on their knowledge of how *hamburger* and *spatula* should behave. Children can also use words that they have heard before in compounds, but they can use them in different ways, given the tendencies of the natural classes of the head and the modifier. For example, even if a child has only heard *spatula* used in a functional way, which is likely given its status as an artifact, children would still be able to produce and interpret *beach-spatula*, as a spatula that is used when at the beach, not a spatula that is used to flip the beach.

4.4 Summary

In this chapter I reviewed previous acquisition work pertaining to children's acquisition of compound syntax and children's interpretation of compounds. I then discussed which questions remain for the study of children's acquisition of compounds. Finally, I outlined a series of hypotheses and predictions for children's acquisition of compounds. In the next two chapters I present the results of five studies that test the predictions made by this system for children's acquisition of noun-noun compounds and verbal compounds.

CHAPTER 5: CHILD NOUN-NOUN COMPOUND TASKS

5.0 Introduction

In the first half of this dissertation I outlined a system for how adults interpret compounds. In this system, adults reconcile syntactic and lexical semantic information to arrive at common interpretations of compounds. This chapter presents the results of three studies that examine how children acquire the components of the adult system necessary to interpret noun-noun compounds. The aim of these studies was to provide evidence that children use the same system as adults when interpreting noun-noun compounds, by addressing the questions in (11).

(11) Questions addressed in Chapter 5 Studies

a. Do children use the tendencies of natural classes when producing compounds?

b. Do children use the full range of relationships available from lexical structure when producing compounds?

c. Do children use the tendencies of natural classes when interpreting compounds?

d. Do children use the full range of relationships available from lexical structure when interpreting compounds?

The first study addressed the question in (11a) by examining the behavior of individual nouns and natural classes of nouns in children's production of novel noun-noun compounds in light of their input. The goals of this study were (i) to determine if children produce noun-noun compounds in line with the tendencies of natural classes and (ii) to determine at what level (individual nouns or natural classes of nouns) children's novel noun-noun compound productions mirror their input.

The second study addressed the question in (11b) by examining children's production of noun-noun compounds dependent on which Qualia Role (Pustejvosky 1995)

is being accessed by the compound. The goal of this study was to determine if children produce noun-noun compounds with the full range of meanings that adults do, or if they focus initially on only a subset of meanings.

The third study addressed the questions in (11c) and (11d) by examining children's interpretation of noun-noun compounds. The goal of this study was to determine if children are flexible in their assignment of interpretation of noun-noun compounds based on the lexical semantic features of both constituents in the compound, or if one constituent determines the type of relationship that is assigned to the entire compound.

Taken together, the ultimate goal of this chapter is to provide evidence that children use the same mechanism as adults to produce and interpret noun-noun compounds, and any deviations in previous literature can be explained by the availability of lexical information.

5.1 Child Study 1: Noun-Noun Compounds in Children's Speech and their Input

The first study examined the behavior of individual nouns and natural classes of nouns in children's production of novel noun-noun compounds in light of the behavior of individual nouns and natural classes in their input. Krott et al. (2009) found in an interpretation task that children interpret novel compounds in analogy to known compounds with the same head noun. For instance, if a *blueberry-spoon* was known to be a spoon for eating blueberries, then a *cake-spoon* was interpreted as a spoon for eating cake. They suggest that this ease of interpretation is due to word-specific templates that supply the head noun and the relationship that exists between the head and the modifier noun.

The goal of our first study was to provide evidence that, in fact, children use the natural class information that has been shown to be used by adults (Downing 1977, Chapter 3 of this dissertation), rather than item-specific information, as might be predicted by Krott et al (2009).

To examine the impact of the input on children's production of novel compounds, a corpus study was conducted. We analyzed all noun-noun compounds in the children's speech and all noun-noun compounds in their input. The compounds were analyzed according to (i) the relationship in the compound and (ii) the head and modifier noun in the compound. First, the compounds were analyzed according to the individual nouns. For example, *mouse-trap* was analyzed as a compound with a *mouse* modifier and a *trap* head. The purpose of this analysis was to compare the behavior of particular nouns in the input to the behavior of these same nouns in children's production of novel noun-noun compounds. Second, compounds were analyzed according to the natural classes of the head and modifier nouns. For example, *mouse-trap* was analyzed as a compound with an animate natural kind head and an artifact head. The purpose of this analysis was to compare the behavior of natural classes in the input to the behavior of natural classes in children's production of novel noun-noun compounds.

The hypotheses put forth in this dissertation made two predictions about the relationship between noun-noun compounds in children's input and the novel noun-noun compounds that children produce. The first prediction was that, at the natural class level, children would match their input in terms of the relationships that were used with different head natural classes and modifier natural classes. For example, compounds with artifact head nouns in the input and in children's novel production were predicted to reflect a high level of Telic relationships. The second prediction was that, at the individual noun level, children should not necessarily have matched their input in terms of the relationships that were used with different head nouns and modifier nouns. For example, compounds with the head noun *trap* may have had a different distribution of relationships in the input compared to children's novel productions.

5.1.1 Method

All compounds were extracted from the transcripts of parent/child interactions for two children, Adam (2;3-4;8, 55 sessions) and Sarah (2;3-4;6, 130 sessions), in the Brown (1973) corpus of the CHILDES database (MacWhinney 2000). For this study a compound was operationally defined as two consecutive nouns that denote a single entity. A total of 703 different compounds were extracted from the transcripts. See Appendix B for this list, broken down by the speaker who each compound is attributed to (Adam, Adam's input, Sarah, Sarah's input). Note that all references to counts of compounds refer to compound types rather than tokens.

5.1.1.1 Coding

Compounds and the nouns that they contained were coded in four ways: (i) speaker, (ii) position of noun, (iii) natural class of noun, and (iv) relationship.

For speaker, all compounds that were uttered by an adult, even if after a child had said them in the corpus, were considered as part of the input, and therefore tagged as Adult. All compounds that were only ever uttered by the child were tagged as Child. Speaker was tagged in this way to arrive on the strongest set of compounds that are children's novel productions.

For position, the first noun in the compound was tagged as Modifier and the second compound was tagged as Head.

For natural class, each noun was analyzed according to the natural class that it falls into. The coding of nouns was based on their prototypical properties, rather than meanings that have evolved. For example, *star* was coded as being an inanimate natural kind, referring to the object in space, rather than a concept, referring to the five-pointed shape. To ensure an unbiased analysis of the nouns in each compound, all nouns were extracted from their

context and analyzed in isolation, with the exception of homophones or otherwise unclear examples (for example, a child's made up word). The coding guidelines used are summarized in Table 14.

Table 14. NNC and VC Interpretation: Noun Categories

Category	**Defining Features**	**Example**
Animate Natural Kind	naturally occurring, sentient	*cow, dolphin*
Artifact	functional, manmade objects	*spoon, box*
Concept	non-physical, abstract, rule-governed	*happiness, safety*
Human	human, profession	*boy, lawyer*
Inanimate Natural Kind	naturally occurring, non-sentient	*rock, wind*
Locative	defined by its physical space	*school, lake*
Temporal	defined by its temporal space	*summer,*
Unknown	unsure of classification homophone representing different classes	*moo* *bank*

Finally, for relationship, the compounds were coded according to the type of relation that held between the two nouns in the compound. Guidelines were created that were loosely based on Johnston and Busa's (1996) application of Pustejovsky's (1995) Generative Lexicon theory to compounds. According to Johnston and Busa's analysis, compounds can be interpreted according to the internal lexical properties of the two nouns, which are organized according in their Qualia Structure. Since the meaning of a compound is dependent on the context, the coders had access to the context the compounds appeared in when making decisions. The coding guidelines used are summarized in Table 15. Note that the Agentive role is not part of this coding system because of the ambiguity, even in context, of items to be coded as Agentive or one of the other roles.

Table 15. Coding Scheme

Relation	**Defining Features**	**Example**
Constitutive	part/whole relation, including material, parts, and contents	*cowboy-book*
Formal	descriptive relation, including age, location/origin, shape	*mountain-lion*
Telic	function	*bread-knife*
Lexicalized	one or both nouns no longer contribute transparent meaning	*butter-fly*
Unusable	no sensible relationship can be determined from context	*butter-birdie*

5.1.1.2 Analysis

The data were analyzed at two levels. First, a series of χ^2 analyses were used to compare the distribution of relationships that adults and children used by head and modifier natural classes[4]. For this analysis, all compounds whose head or modifiers were classified as either animate, inanimate, locative/temporal, human, or artifact were included to make the dataset parallel to that done in Adult Study 1. The goal of the first analysis was to determine if children abide by the same tendencies as adults for different natural classes. For example, do children produce more Telic compounds with artifact head nouns than animate head nouns? Yates' correction was used when necessary to adjust for low numbers of items.

Next, the distribution of relationships that adults and children used were compared at the individual noun level. All nouns that were used in at least three compounds by both the child and adult were included. The goal of the second analysis was to determine if children produce novel noun-noun compounds with particular nouns based on the behavior of those same nouns in the input. For example, if adults only used Telic compounds with the head noun *bowl*, do children also only use Telic *bowl* compounds?

[4] χ^2 analyses were used (i) because the categorical nature of the data and (ii) because only four speakers total were being compared. The author recognizes that another option for future research would be to run the same data through a mixed effects modeling analysis.

5.1.2 Results

To summarize the compounds in the corpus, Table 16 shows the count of compound types by speaker(s). Both children used many noun-noun compounds that were not also used by the adults in the corpus (Adam 270 and Sarah 83). These compounds were considered to be the children's novel productions. The other compounds, those used by the adults only or by both the adults and child, were considered to be in the adult input for all analyses, even if not used in the same file. Of course we cannot really say which compounds the children never have heard before, only approximate this set of compounds by ruling out all of those that the adults ever say.

Table 16. Count of Compound Types by Speaker(s)

Corpus	Adult only	Child and adult	Child only
Adam	171	282	270
Sarah	192	89	83

5.1.2.1 Head Noun Natural Class Analysis Results

Considering first the natural class of the heads, Figures 15 and 16 show the distribution of relationships by head natural class and speaker for the Adam and Sarah files, respectively. Considering the overall patterns, the distribution of relationships differs systematically based on the head natural class. For example, compounds with animate natural kind heads were most often formal compounds, while compounds with artifact natural kind heads were often telic compounds.

A series of χ^2 analyses were used to compare the distribution of relationships used for each head natural class in the children's speech and in their input. First, the distribution of relationships was compared for each natural class for the child and the input. See Table 17 for the results of the χ^2 analyses. For both Adam and Sarah, the distribution of relationships

used by the child matched the distribution of relationships used by the adults in the same files.

Figure 15. Distribution of Relationships by Head Class and Speaker for Adam Files

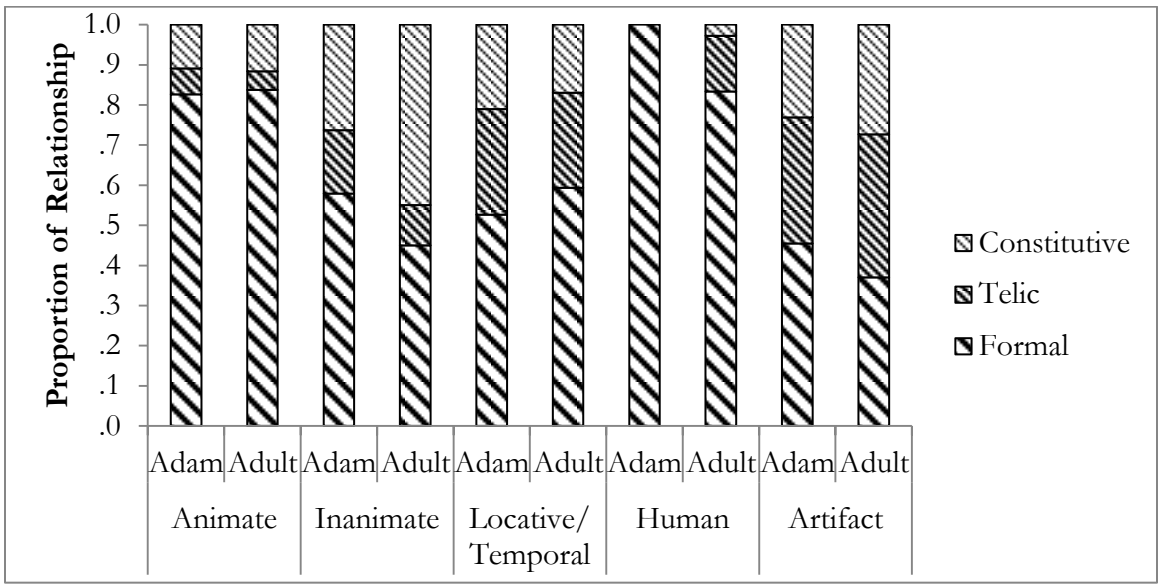


Figure 16. Distribution of Relationships by Head Class and Speaker for Sarah Files

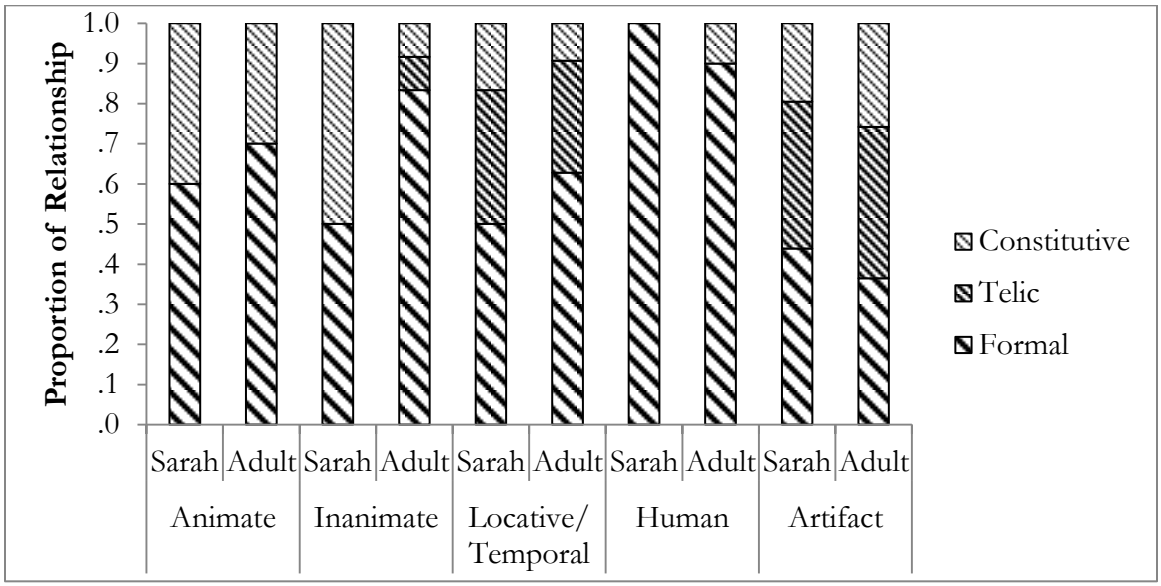


Table 17. χ^2 Results on the Distribution of Relationships by Head Natural Class

Head Natural Class	**Adam vs. Input**	**Sarah vs. Input**
Animate	$\chi^2(2, N = 89) = 0.053, p = .974$	$\chi^2(1, N = 30) = 0.019, p = .890$
Inanimate	$\chi^2(2, N = 39) = 0.616, p = .735$	$\chi^2(2, N = 18) = 1.897, p = .387$
Loc/Temp	$\chi^2(2, N = 78) = 0.034, p = .983$	$\chi^2(2, N = 49) = 0.063, p = .969$
Human	$\chi^2(2, N = 66) = 2.877, p = .237$	$\chi^2(1, N = 23) = 0.276, p = .599$
Artifact	$\chi^2(2, N = 348) = 2.365, p = .307$	$\chi^2(2, N = 192) = 0.598, p = .603$

5.1.2.2 Modifier Noun Natural Class Analysis Results

Considering now the natural class of the modifiers, Figures 17 and 18 show the distribution of relationships by modifier natural class and speaker for the Adam and Sarah files, respectively. Considering the overall patterns, the distribution of relationships differs systematically based on the modifier natural class. For example, compounds with human modifiers were most often formal compounds, while compounds with artifact modifiers were often telic compounds.

Figure 17. Distribution of Relationships by Modifier Class and Speaker for Adam Files

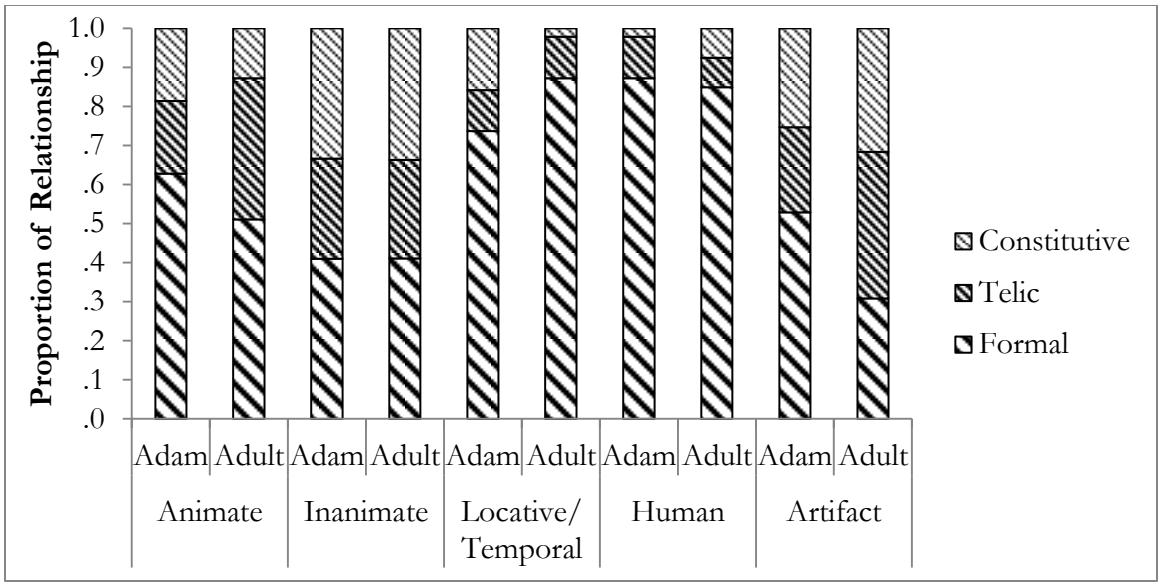
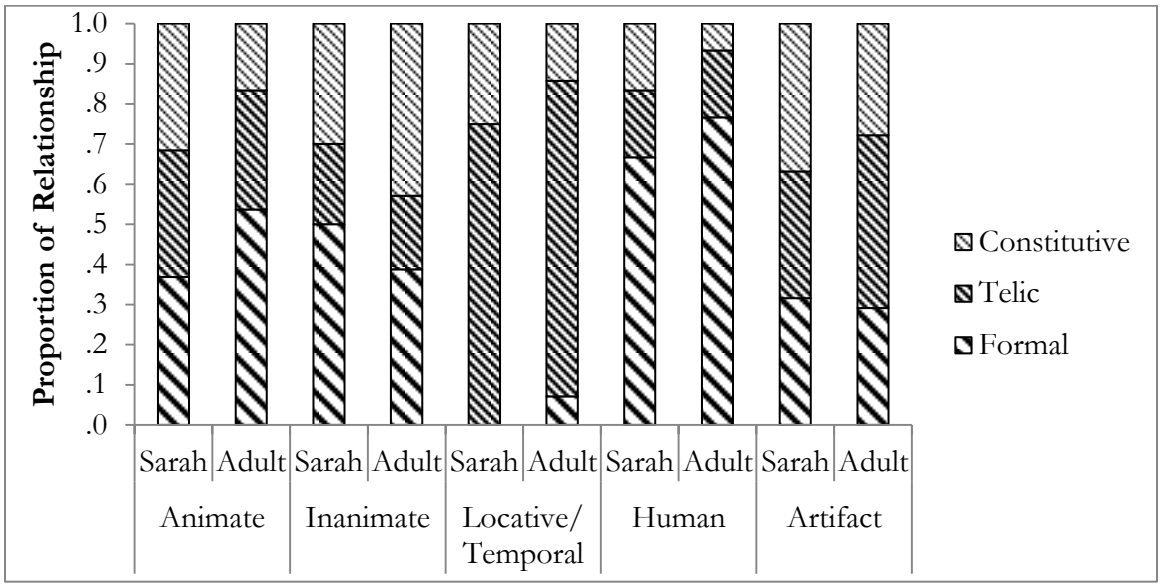


Figure 18. Distribution of Relationships by Modifier Class and Speaker for Sarah Files



A series of χ^2 analyses were used to compare the distribution of relationships used for each modifier natural class in the children's speech and in their input. See Table 18 for the results of the individual χ^2 analyses. For the Sarah files, the distribution of relationships used by the child matched the distribution of relationships used by the adults for all modifier natural classes. For the Adam files, the distribution of relationships used by the child matched the distribution of relationships used by adults for all modifier classes except Artifact.

Table 18. χ^2 Results on the Distribution of Relationships by Modifier Natural Class

Modifier Natural Class	**Adam vs. Input**	**Sarah vs. Input**
Animate	$\chi^2(2, N = 90) = 3.531, p = .171$	$\chi^2(2, N = 73) = 2.349, p = .309$
Inanimate	$\chi^2(2, N = 134) = 0.003, p = .999$	$\chi^2(2, N = 59) = 0.236, p = .889$
Loc/Temp	$\chi^2(2, N = 66) = 2.539, p = .281$	$\chi^2(2, N = 32) = 0.366, p = .832$
Human	$\chi^2(2, N = 100) = 0.613, p = .736$	$\chi^2(2, N = 42) = 0.351, p = .839$
Artifact	$\chi^2(2, N = 223) = 11.378, p = .003$	$\chi^2(2, N = 98) = 0.943, p = .624$

To summarize, at the natural class level, both Adam and Sarah closely matched their input in terms of the distribution of relationships for heads and modifiers. The distribution of relationships used by the adults and children mirrors the findings from Adult Study 1,

which showed that different natural classes behave in different ways. For example, in the current dataset, animate natural kind head nouns were most often part of Formal compounds, while artifact head nouns were often part of Telic compounds.

5.1.2.3 Noun Analysis

Figures 19 and 20 show the distribution of relationships for individual nouns in Adam's speech and in his input. It can be seen that for both head and modifier nouns, Adam used a slightly or completely different distribution of relationships than was used in his input. Sarah's files did not have enough compounds with the same heads and modifiers to look at this comparison.

Figure 19. Distribution of Relationships by Modifier Noun and Speaker for Adam Files

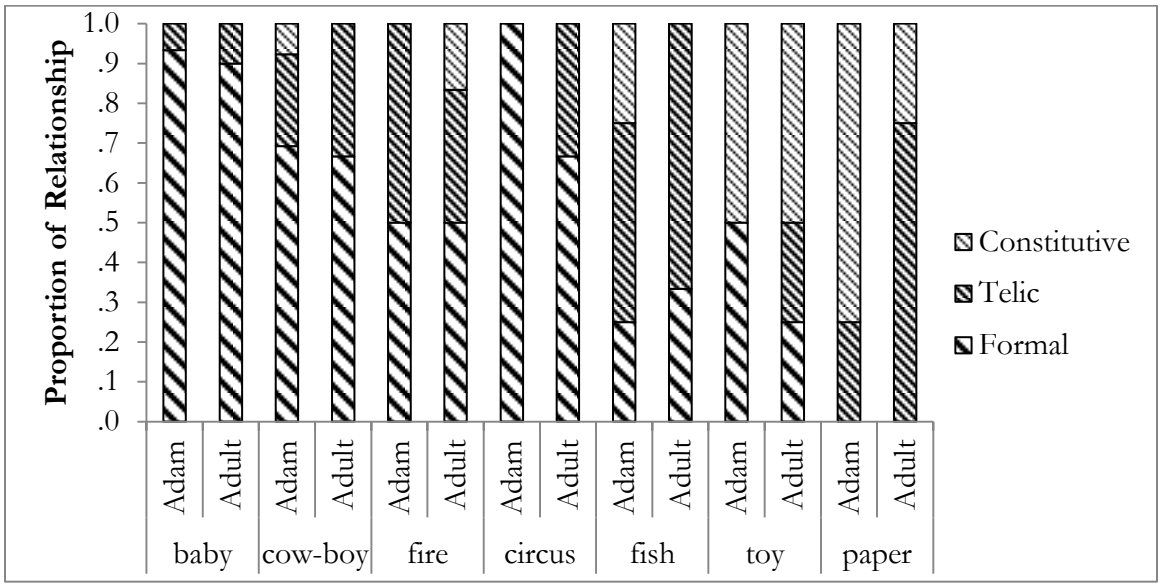
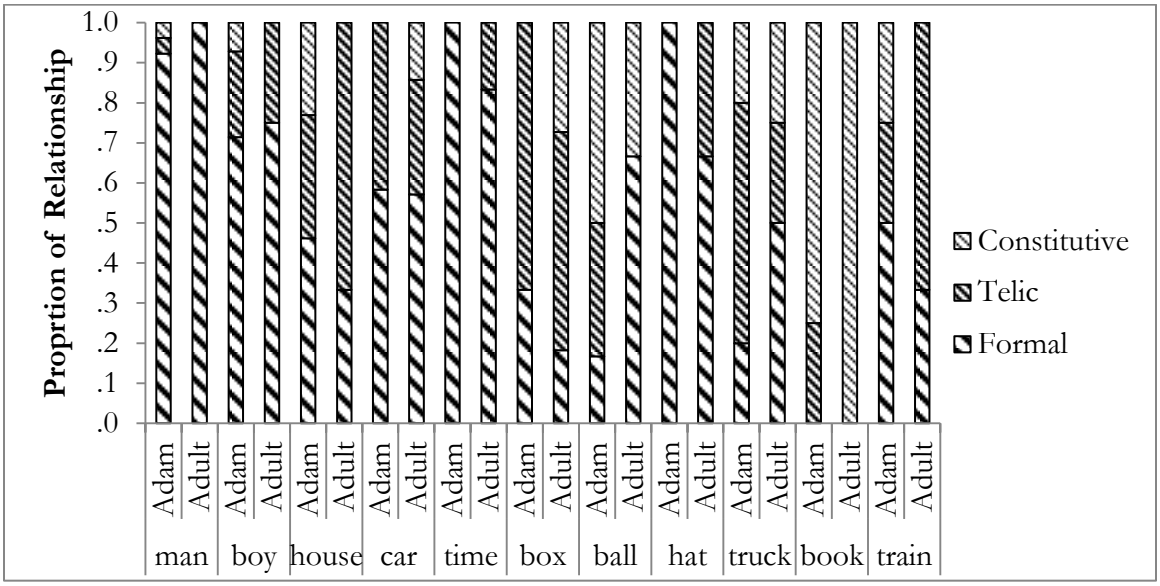


Figure 20. Distribution of Relationships by Head Noun and Speaker for Adam Files



Additionally, Adam and Sarah used many nouns in both head and modifier position that were not used in the input at all (see Table 19). Excluding those also used by the adults, Adam used 89 nouns as heads and 112 nouns as modifiers while Sarah used 75 nouns as heads and 64 nouns as modifiers. For these nouns in these positions, children have no prior word-specific input on which they can base their compound productions.

Table 19. Count of Individual Noun Types by Position and Speaker(s)

Noun Position	Adult only	Adam and adult	Adam only	Adult only	Sarah and Adult	Sarah only
Head	169	69	89	116	31	75
Modifier	190	67	112	114	35	64

5.1.2.3 Summary of Results

At the natural class level, both Adam and Sarah were very well-matched to their input in terms of the distribution of relationship used by natural class. Like adults, children's productions followed our expectations of natural classes. For instance, children were more

likely to use compounds with artifact head nouns to denote Telic relationships than compounds with animate head nouns.

At the noun level, however, Adam used head and modifier nouns with a different distribution of relationships than the distribution of relationships used with those same nouns in his input. Moreover, both Adam and Sarah used a large number of nouns in compounds for which the corpus reflected no adult forms in the input.

5.1.3 Discussion

The goal of this study was to provide evidence that children use natural class-level information, rather than item-specific information, to guide their novel noun-noun compound productions. The results of the study supported both of our predictions for children's production of novel noun-noun compounds. First, the results of the natural class analyses showed that children, like adults, systematically produce novel compounds based on natural class information. Children were shown to match their parents, almost completely, in terms of their relationship use for both head and modifier nouns. These patterns reflected the fact that particular natural classes are more likely to lead to particular types of relationships (Downing 1977).

The results also supported the prediction that children do not necessarily match their input in terms of the distribution of relationships used for individual nouns. This prediction was supported by the nouns that Adam and Sarah used in their novel compounds but did not hear in their input. This finding runs counter to a claim that children are forming word-specific compound templates (Krott and Nicoladis 2005, Krott et al. 2009).

In summary, the results suggest that, at least when producing novel noun-noun compounds, children use the same information as adults (natural classes) to guide their

productions. In the next study we use an elicited production task to further test children's ability to produce novel noun-noun compounds across a range of meanings.

5.2 Child Study 2: Elicited Production of Noun-Noun Compounds

This study examines the likelihood of children to produce noun-noun compounds based on the proposed relationship between two nouns. The goal of this study was to provide evidence that children produce noun-noun compounds for the same set of relationships that adults produce noun-noun compounds. In an elicited production task Hiramatsu et al. (2000) found that children were unlikely to use compound forms for descriptions of the appearance of an object. For example, children were unlikely to use *hand-chair* for a chair that looks like a hand. The authors argued that this was due to a subset principle whereby English-speaking children begin by speaking a language like Hungarian, which does not have shape/appearance compounds. Alternatively, a usage-based theory might predict that children do not produce novel compounds with relationships for which they have not been given sufficient evidence in the input. For example, a child may not produce *hand-chair* for a chair shaped like a hand either because they have not previously heard a compound with the head noun *chair* that is defined by its shape or because, in general, a child has not heard a sufficient number of compounds with shape descriptions to have a productive template.

To examine the impact of the relationship on children's production of novel compounds, an elicited production task was conducted that contained items with descriptions from all four Qualia Roles (Agentive, Constitutive, Formal, Telic). Children's productions were compared to adults' productions for the same items to determine if children avoid using compound forms in situations where adults are likely to use them.

The hypothesis put forward here predicted that, given knowledge of the constituents in the target compound and noun-noun compound syntax, children should use noun-noun compounds in the same situations where adults use them.

5.2.1 Method

5.2.1.1 Participants

29 children (17F, 12M) and 15 adults (12F, 3M) participated in the study. 13 children made up the Younger Children group (3;0 – 5;0: Mean 4;2) and 16 children the Older Children group (5;7 – 6;7: Mean 6;2). Children were recruited from local schools in Western Massachusetts and adults from an undergraduate linguistics course at Michigan State University. The adult participants received extra credit in their course for their participation.

5.2.1.2 Procedure

There were a total of 16 test items comprised of four descriptions types: agentive, constitutive, formal, and telic. Each description type represents a different way that the lexical structure of a noun can be modified by another noun. For each description type, two head nouns were selected, and for each head noun, two modifiers were selected, for a total of four items for each description type. See Table 20 for a breakdown of the items by description type.

Table 20. NNC Elicited Production: Items

Description Type	**Head Noun**	**Description**	**Target Compound**
Agentive	puddle	This is a puddle made by rain. This is a puddle made by paint.	rain-puddle paint-puddle
	shadow	This is a shadow made by a house. This is a shadow made by a tree.	house-shadow tree-shadow
Constitutive	book	This is a book about cowboys. This is a book about princesses.	cowboy-book princess-book
	table	This is a table made of books. This is a table made of blocks.	book-table block-table
Formal	chair	This is a chair that is shaped like a flower. This is a chair that is shaped like a hand.	flower-chair hand-chair
	van	This is a van with a bunny on it. This is a van with a monkey on it.	bunny-van monkey-van
Telic	box	This is a box to put jackets in. This is a box to put shirts in.	jacket-box shirt-box
	blanket	This is a blanket for cats to lay on. This is a blanket for dogs to lay on.	cat-blanket dog-blanket

To begin the task, the child was introduced to Monkey, a curious animal who liked to learn things only from children. The following instructions were read to the child:

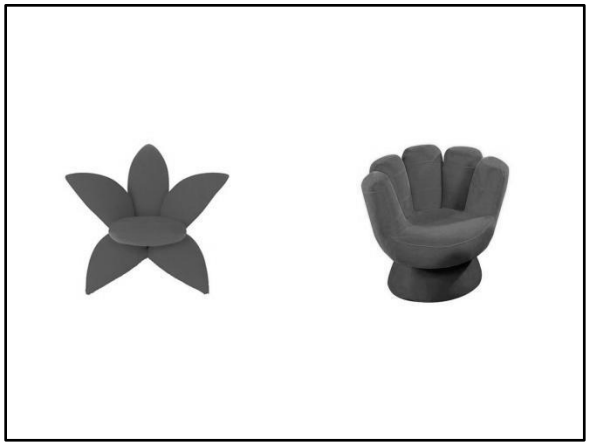
(12) Noun-Noun Compound Elicited Production Instructions

"This is my friend Monkey. There's something that you need to know about this monkey. She's a funny monkey who only likes listening to children. She has a problem, though, because she sees all of these new things, but she's not sure what to call them. Do you think you can help her? I will help with you the first couple of names and then you can help Monkey with the rest, okay?"

Two practice items were introduced by Monkey and named by the experimenter using noun-noun compound forms. For example, one of the images was a cage for birds, a *bird-cage*, and the other was a cage for hamsters, a *hamster-cage*. The names were told to the children, who were then instructed to repeat the names to Monkey. After the child succeeded in doing this, the experimenter moved on to the test items.

Test items were presented in pairs, with each slide showing the two items a common head noun (e.g., *book-table* and *block-tab*le). The contrast created by introducing the set of items together was intended to encourage participants to used compounds. See Figure 21 for a sample item. Children were given two chances to come up with a noun-noun compound form for each item. If they did not give a noun-noun compound by their second form, the experimenter moved on to the next item.

Figure 21. NNC Elicited Production: Sample Item



"Look! This is a chair that's shaped like a flower, and this is a chair that's shaped like a hand! What could we call a chair that's shaped like a flower? (Child responds.) And what could we call a chair that's shaped like a chair? (Child responds.)"

Children were tested individually either in a quiet room or in a quiet part of their classroom. Each child was seated in front of a 12" laptop, approximately 24 inches from the screen. All sessions were audio-recorded. The stimuli were displayed using Microsoft Powerpoint. All images were on a white background and the audio was recorded by the author, with a minor pitch and formant manipulation to create the Monkey's voice.

Generally the stimuli were played over the laptop speakers, but in cases where sound from the laptop speakers was not sufficient, the children wore headphones. The adults were tested in a group, with the visual stimuli displayed on an overhead projector and the audio stimuli played over classroom speakers.

5.2.1.3 Coding

Production forms were coded based on the target compound. If participants produced the target compound in modifier-head order the response was coded as Target. If participants produced the target words in head-modifier order the response was coded as Reversal. If participants produced a full phrase, for example, "a box for shirts" for *shirt-box* the response was coded as Phrasal. If participants produced any other form, for example just a noun (a box) or a possessive (shirt's box), the response was coded as Other.

5.2.1.4 Analysis

The items were recoded to isolate each major production type (Target, Reversal, Phrasal) as the dependent variable for four separate ANOVAs. For example, for the Target ANOVA, items with Target productions (modifier-head) were coded as "1" and all other items (Reversal, Phrasal, Other) were coded as "0". For each of the four analyses, the proportion of the production type in question (Target for the Target ANOVA) served as the dependent measure for a 3 Age Group (Younger Children, Older Children, Adults) X 4 Relationship (Agentive, Constitutive, Formal, Telic) ANOVA. A Bonferroni correction was used for all post-hoc tests to adjust for multiple comparisons.

5.2.2 Results

Table 21 shows the proportion (and count) of forms produced by Item Type and Age Group. Figures 22, 23, and 24 show the proportion of forms used by Description Type for Younger Children, Older Children, and Adults, respectively.

Table 21. Proportion (and Count) of Forms by Item Type and Age Group

		Younger Children		Older Children		Adults		**Overall**	
Target	Agentive	.42	(22)	.70	(39)	.88	(53)	.68	(114)
	Constitutive	.71	(37)	.70	(39)	.90	(54)	.77	(130)
	Formal	.69	(36)	.73	(41)	.90	(54)	.78	(131)
	Telic	.63	(33)	.82	(46)	.97	(58)	.82	(137)
	Target Overall	.62	(128)	.74	(165)	.91	(219)	.76	(512)
Reversal	Agentive	.17	(9)	.09	(5)	.00	(0)	.08	(14)
	Constitutive	.00	(0)	.07	(4)	.00	(0)	.02	(4)
	Formal	.08	(4)	.09	(5)	.00	(0)	.05	(9)
	Telic	.04	(2)	.04	(2)	.00	(0)	.02	(4)
	Reversal Overall	.07	(15)	.07	(16)	.00	(0)	.05	(31)
Phrasal	Agentive	.13	(7)	.14	(8)	.03	(2)	.10	(17)
	Constitutive	.15	(8)	.16	(9)	.07	(4)	.13	(21)
	Formal	.12	(6)	.14	(8)	.10	(6)	.12	(20)
	Telic	.13	(7)	.11	(6)	.03	(2)	.09	(15)
	Phrasal Overall	.13	(28)	.14	(31)	.05	(14)	.11	(73)
Other	Agentive	.27	(14)	.07	(4)	.08	(5)	.14	(23)
	Constitutive	.13	(7)	.07	(4)	.03	(2)	.08	(13)
	Formal	.12	(6)	.04	(2)	.00	(0)	.05	(8)
	Telic	.19	(10)	.04	(2)	.00	(0)	.07	(12)
	Other Overall	.18	(37)	.05	(12)	.04	(7)	.08	(56)

Figure 22. NNC Production: Proportion of Production Types by Younger Children

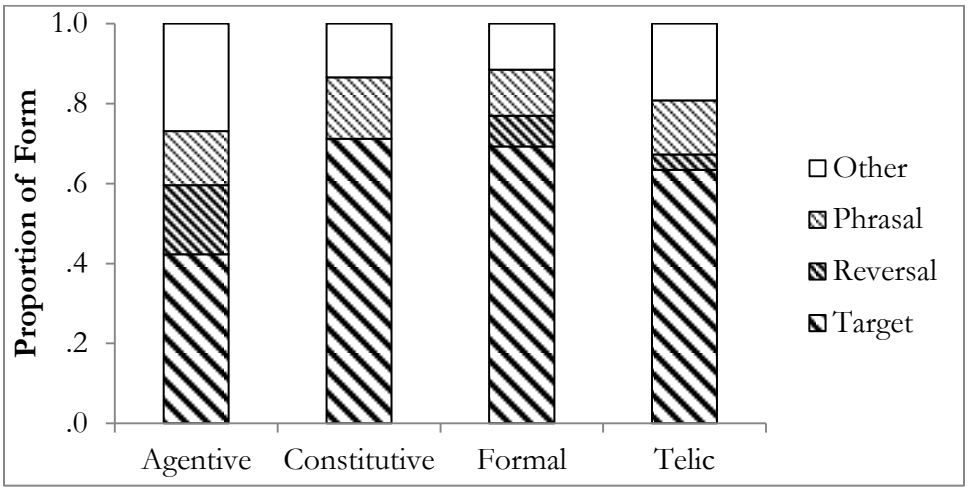


Figure 23. NNC Production: Proportion of Production Types by Older Children

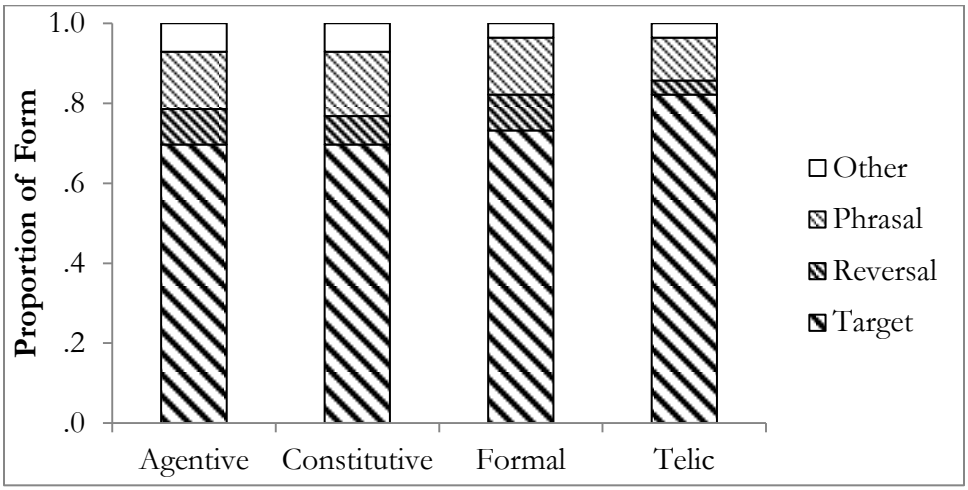
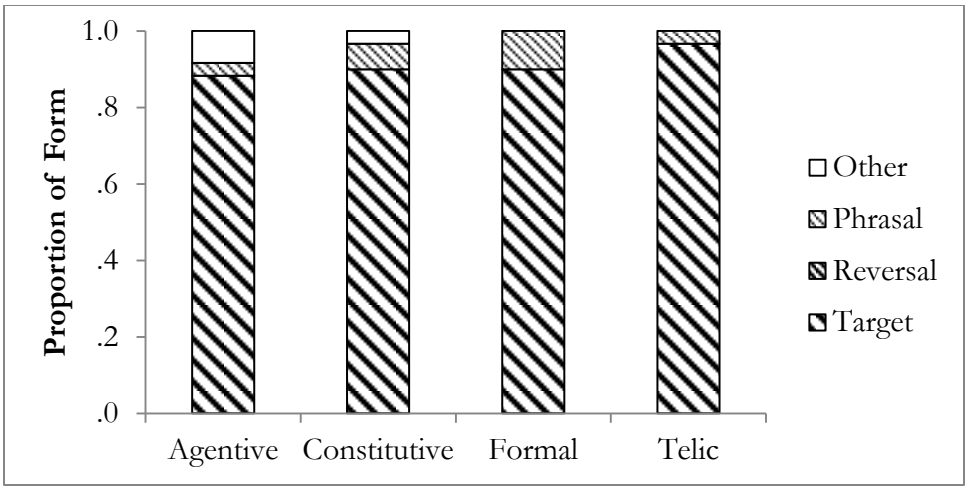


Figure 24. NNC Production: Proportion of Production Types by Adults



5.2.2.1 Target Form Analysis

A 4 Description Type (Agentive, Constitutive, Formal, Telic) X 3 Age Group (Younger Children, Older Children, Adults) ANOVA was carried out on the proportion of Target forms. The main effect of Description Type was significant ($F(1, 39) = 6.009$, $p = .019$). Post-hoc comparisons revealed that, overall, participants produced target forms with Agentive Description Types marginally less often than Telic Description Types ($p = .088$). There were no other differences in proportion of target productions by Description Type.

The main effect of Age Group was also significant ($F(2, 39) = 3.648$, $p = .035$). Post-hoc comparisons revealed that Adults produced significantly more target forms than Younger Children ($p = .033$) There was no difference in the degree of target productions between Younger Children and Older Children ($p = .870$) or between Older Children and Adults ($p = .344$).

The interaction between Description Type and Age Group was not significant ($p = .137$).

5.2.2.2 Reversal Form Analysis

A 4 Description Type (Agentive, Constitutive, Formal, Telic) X 3 Age Group (Younger Children, Older Children, Adults) ANOVA was carried out on the proportion of Reversal forms. The main effect of Age Group was significant ($F(2, 39) = 3.572$, $p = .038$). Post-hoc comparisons revealed that Adults produced marginally less reversal forms than Younger Children ($p = .080$) and Older Children ($p = .084$). There was no difference in the degree of reversal forms between Younger Children and Older Children ($p = 1.000$).

The main effect of Description Type was marginally significant ($F(3, 117) = 2.316$, $p = .079$) and the interaction between Description Type and Age Group was not significant ($p = .216$).

5.2.2.3 Phrasal Form Analysis

A 4 Description Type (Agentive, Constitutive, Formal, Telic) X 3 Age Group (Younger Children, Older Children, Adults) ANOVA was carried out on the proportion of Phrasal forms. The main effects of Description Type (p = .696) and Age Group (p = .533) were not significant. The interaction between Description Type and Age Group was also not significant (p = .922).

5.2.2.4 Summary of Results

The likelihood of a participant producing a target form increased over developmental time, while the likelihood of a participant producing any other type of form decreased. Importantly, however, there were no significant interactions between Description Type and Age Group, suggesting that children and adults produce noun-noun compounds in a similar manner for each Description Type. Younger Children, Older Children, and Adults were all likely to produce target forms for Constitutive, Formal, and Telic descriptions, but less likely for Agentive descriptions.

5.2.3 Discussion

The goal of this study was to provide evidence that children production noun-noun compounds for the same set of relationships that adults do. The results of the study support the prediction made by this dissertation. While it was true that children were less likely to produce target forms for certain description types (agentive, telic), adults were also less likely to produce target forms for these same description types. The results of the study fail to support the claim by Hiramatsu et al. (2000) that children avoid shape/appearance compounds. In fact, the shape/appearance formal descriptions received the most target forms overall of the four description types.

Taken together, the results of the first two studies suggest that children are quite adult-like in their production of noun-noun compounds. The corpus study showed that (i) children are adult-like in their use of natural classes and (ii) children are not dependent on word-specific items in the input to produce novel compounds. The current study provides evidence that children use the full range of relationships made available by the Qualia Structure of words when producing novel compounds. In the final study for this chapter we examine how children use this same lexical semantic information when interpreting noun-noun compounds.

5.3 Child Study 3: Preferred Interpretations of Noun-Noun Compounds

This study examined children's preferred interpretations of noun-noun compounds. The first goal of this study was to provide evidence that children use natural class information, and not individual noun information, to generate interpretations for novel compounds. The second goal of this study was to provide evidence that, given familiar lexical information, children interpret compounds as having intrinsic relationships, rather than accidental/temporary relationships, as was found by Krott et al. 2010.

5.3.1 The Role of Lexical Semantics in Children's Interpretation of Compounds

The first goal of this study was to provide evidence that children use natural class information, and not individual noun information, to generate interpretations for novel compounds. More specifically, the goal was to provide evidence that children are using a generative mechanism, like that proposed in the first half or this dissertation, rather than a usage-based mechanism to interpret compounds. Krott et al. (2009) found in an interpretation task that children interpret novel compounds by analogy to known compounds with the same head noun. For instance, if a *blueberry-spoon* was known to be a spoon for eating blueberries, then a *cake-spoon* was interpreted as a spoon for eating cake.

They suggest that this ease of interpretation is due to word-specific templates that supply the head noun and the relationship for the compound with a slot for the modifier noun. Their findings, however, can also be explained by a different mechanism. *Spoon* is an artifact, and as we have shown in both an adult and a child study now, artifacts are most likely to be interpreted with a functional reading (a spoon that scoops up X). Therefore, the findings by Krott et al. may actually point to the same bias that we are suggesting is in the adult system: depending on the natural classes of the constituents in a compound, speakers are inclined to interpret compounds using particular parts of their lexical structure (Downing 1977).

To examine if children use word-specific or natural class knowledge in their interpretation of compounds, the study was designed such that participants interpreted a number of compounds that all share the same artifact head noun. For example, the head noun *bowl* was used in three items: *orange-bowl, cake-bowl,* and *beach-bowl*. For each item a functional, telic interpretation was available (a bowl that oranges go in, a bowl that cake goes in, a bowl that beach goes in) in addition to a second, possible interpretation (a bowl that is next to an orange, a bowl that is shaped like a cake, a bowl that is used on the beach). This design allowed us to pit the expectations of a generative compound interpretation system, like that proposed in the first half of this dissertation, against a item-based interpretation system, like that proposed in Krott et al. (2009). Given that *bowl* is an artifact, a functional, telic relationship is the preferred relationship based on the behavior of natural classes. Given that *bowl* is likely usually defined in a functional way, a template with ___-*bowl* with a functional relationship is also the most likely template for children to develop. Where these two theories make different predictions is when the normal tendency of artifacts as functional is overruled by the behavior of the modifier noun.

The hypothesis put forward here predicted that children would change the relationship in their interpretation of a compound based both on its head lexical information and modifier lexical information, in the same way that adults do. In other words, even in the absence of examples in their input of a particular artifact head noun behaving in a non-functional way, children should be able to choose a non-functional interpretation.

5.3.2 The Role of Intrinsic/Accident Information in Children's Use of Compounds

The second goal of this study was to provide evidence that, given familiar lexical information, children interpret compounds as having intrinsic relationships, rather than accidental/temporary relationships, as was found by Krott et al. 2010. In a production study, Clark et al. showed that children, like adults, were more likely to produce noun-noun compounds for intrinsic properties than accidental or temporary properties. For instance, both children and adults were more likely to use *pumpkin-house* for a house made of pumpkin (intrinsic) than for a house with a pumpkin near it (accidental). Krott et al. (2010), however, found that children were more likely to interpret novel objects with accidental or temporary relationships. For instance, children, unlike adults, were more likely to interpret a *wug-moop* as a moop that has a wug on it than a moop that has a functional relationship to wugs. Critically, a major difference between these two study designs was the familiarity of the words used. In Clark et al.'s study, where children were adult-like in their preference to use noun-noun compounds to name constituents related by an intrinsic property, all items were known words. For these words, children had access to all of the information that they had learned up to that point about these words. In Krott et al.'s study, where children were non-adult-like in their preference to interpret noun-noun compounds as representing accidental or temporary relationships, all items were nonce words. For these words, children had access to only the information that they could ascertain from the study. While Krott et al. claim that

this shows a bias that young children have for physically apparent relationships (Smith et al. 1996), the system proposed in this dissertation presents a simpler solution: children preferred physically apparent relationships for nonce word compounds because their system for interpreting compounds relies on lexical knowledge to determine a likely relationship, and no lexical information was present, leaving physical information as the strongest information source.

This study was designed to examine this claim in three ways. First, the head and modifier nouns used in the study were well-known by children in the tested age group (3- to 6-year-olds) according to the MacArthur's CDI (Fenson et al. 2006). Therefore, any bias towards a physically apparent interpretation could not be due to a lack of lexical information to provide any other possible interpretation. Second, one type of item was specifically included that pinned a telic reading of a compound against a physically apparent reading of a compound. For example, children had to decide if the better interpretation of an *orange-bowl* was "a bowl that is used to put oranges in" (telic) or "a bowl that is next to an orange" (physically apparent). Finally, while the head nouns and modifier nouns were introduced using pictures, the two interpretations of the compound that those nouns form were not pictured. By not presenting pictures of the two options, children could not be biased by the pictures towards a referent where both the head noun and modifier noun were physically present.

The hypothesis put forward here predicted that, given sufficient lexical information, children should have preferred telic interpretations of compounds to physically apparent interpretations. That is, in the *orange-bowl* example above, children should have preferred the telic reading (a bowl that is used to put oranges in) to the location reading (a bowl that is next to an orange).

5.3.3 Method

5.3.3.1 Participants

31 children (19F, 12M) and 15 adults (12F, 3M) participated in the study. 15 children made up the Younger Children group (3;0 – 5;0: Mean 4;2) and 16 children the Older Children group (5;7 – 6;7: Mean 6;2). Children were recruited from local schools in Western Massachusetts and adults from an undergraduate linguistics course at Michigan State University. The adult participants received extra credit in their course for their participation.

5.3.3.2 Materials and Procedure

The noun-noun compound interpretation task was a 3 Item Type (Location of Use, Appearance, Temporary Position) X 3 Age Group (Younger Children, Older Children, Adults) design where Item Type was a within-subjects variable. Six artifact nouns were chosen as head nouns for this task. Each head noun was then paired with three different nouns, one for each of the different Item Types, for a total of 18 items. See Table 22 for the full list of items.

Table 22. NNC Interpretation: Items

Head Noun	Compound	Item Type	Telic Description	Other Description
bed	mountain-bed	Location	Bed that mountains sleep in	Bed that is used in the mountains
	lion-bed	Appearance	Bed that lions sleep in	Bed that is decorated with lions
	girl-bed	Temporary	Bed that girls sleep in	Bed that a girl is laying on
bowl	beach-bowl	Location	Bowl that beach goes in	Bowl that is used on the beach
	cake-bowl	Appearance	Bowl that cake goes in	Bowl that is shaped like a cake
	orange-bowl	Temporary	Bowl that oranges go in	Bowl that is next to an orange
oven	forest-oven	Location	Oven that bakes forests	Oven that is used in the forest
	apple-oven	Appearance	Oven that bakes apples	Oven that is decorated with apples
	muffin-oven	Temporary	Oven that bakes muffins	Oven that is next to a muffin
pillow	playground-pillow	Location	Pillow that playgrounds lay on	Pillow that is used on the playground
	monkey-pillow	Appearance	Pillow that monkeys lay on	Pillow that is decorated with monkeys
	boy-pillow	Temporary	Pillow that boys lay on	Pillow that a boy is laying on
soap	hospital-soap	Location	Soap that cleans hospitals	Soap that is used at a hospital
	penguin-soap	Appearance	Soap that cleans penguins	Soap that is shaped like a penguin
	foot-soap	Temporary	Soap that cleans feet	Soap that is next to a foot
spoon	school-spoon	Location	Spoon that scoops up schools	Spoon that is used at school
	strawberry-spoon	Appearance	Spoon that scoops up strawberries	spoon that is shaped like a strawberry
	peanut-spoon	Temporary	Spoon that scoops up peanuts	Spoon that is next to peanuts

The Item Types manipulated the likelihood of a functional, telic interpretation, the type of interpretation that is most likely for a compound with an artifact head noun. The first type of item, Location of Use, used a locative noun as a modifier. The descriptions that were given either used the modifier noun as the location of use (likely interpretation, formal) or as that which the artifact acted upon (unlikely interpretation, telic). For example, a *mountain-bed* is more likely to be a bed that is used in the mountains, rather than a bed that is used by mountains. The Location of Use item was designed to as a low-telic interpretation item type.

The second type of item, Temporary Position, used an artifact or a natural kind as a modifier. The descriptions given either used the modifier as an object that the head noun was temporarily positioned next to (unlikely interpretation, formal) or as that which the artifact acted upon (likely interpretation, telic). For example, a *boy-bed* is more likely to be a bed that is used by boys, than a bed that is a boy is laying on. The Temporary Position item was designed as a high-telic interpretation item type.

The final type of item, Appearance, used an artifact or natural kind as a modifier. The descriptions given either used the modifier as something that modified the head noun's appearance (likely interpretation, formal) or as that which the artifact acted upon (likely interpretation, telic). For example, a *lion-bed* is equally likely to be a bed for lions to sleep on a bed that is decorated with lions. The Appearance item was a designed as a neural item type.

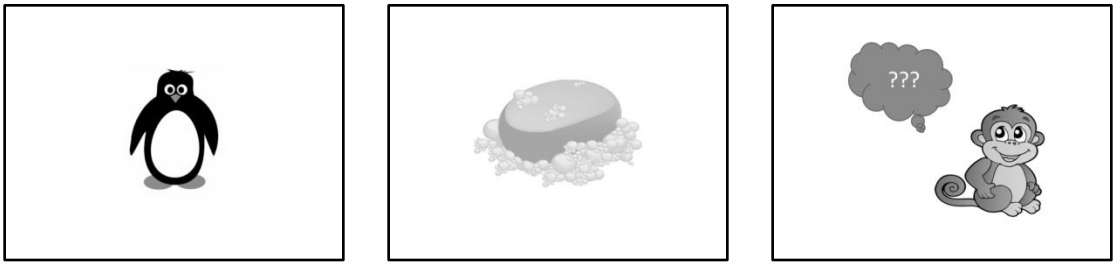
To begin the task, the child was introduced to Monkey, a curious animal who liked to learn things only from children. The following instructions were read to the child:

(13) Noun-Noun Compound Interpretation Instructions

"This is my friend Monkey. There's something that you need to know about this monkey. She's a funny monkey who only likes listening to children. She has a problem, though, because she knows some names for things, but she's not quite sure what the names belong to. Do you think you can help her? She is going to start by telling us about a couple of things that we already know about, and then she's going to ask us to figure out what a third thing is. She is going to give us a name and then two possible descriptions and we have to pick which one it is. Does that sound okay?"

On each trial the modifier and head nouns were introduced in that order, one at a time with an image and an audio recording naming the object. On the third slide, Monkey appeared and the children heard the two possible descriptions. No images were given to match the two descriptions. See Figure 25 for a sample item. Children responded by choosing the description that best fit the name under question.

Figure 25. NNC Interpretation: Sample Item



Slide 1	Slide 2	Slide 3
"This is a penguin."	"And this is soap."	"But what is penguin soap? Is it soap that is used to clean penguins or soap that is shaped like a penguin?"

The general procedure for this task is the same as for the noun-noun compound elicited production task. If children participated in both the noun-noun compound elicited production task and the noun-noun compound interpretation task, the interpretation task was administered on a second day of testing. All adults participated in both the elicited production task and the interpretation task in the same testing session.

5.3.3.3 Analysis

The data were analyzed in two ways. The purpose of the first analysis was to determine if participants' response patterns changed based on the item type and their age. For the first analysis, a 3 Item Type (Location of Use, Appearance, Temporary Position) X 3 Age Group (Younger Children, Older Children, Adults) ANOVA was computed on the proportion of Telic responses.

The purpose of the second analysis was to determine if any of the age groups were more likely to use only Telic interpretations across the board for a given head noun, as they might if they had formed word-specific templates for these nouns. To determine if this was the case, each of the six head nouns were considered for each participant to see if it was ever the case that a participant used telic interpretations for all three instances of that head noun. If a participant did use telic interpretations across the board, that head noun was coded as a "1" and if not, that head noun was coded as a "0". For the second analysis, a 3 Age Group (Younger Children, Older Children, Adults) ANOVA was computed on the proportion of head nouns with consistently telic head nouns.

A Bonferroni correction was used for all post-hoc tests to adjust for multiple comparisons.

5.3.4 Results

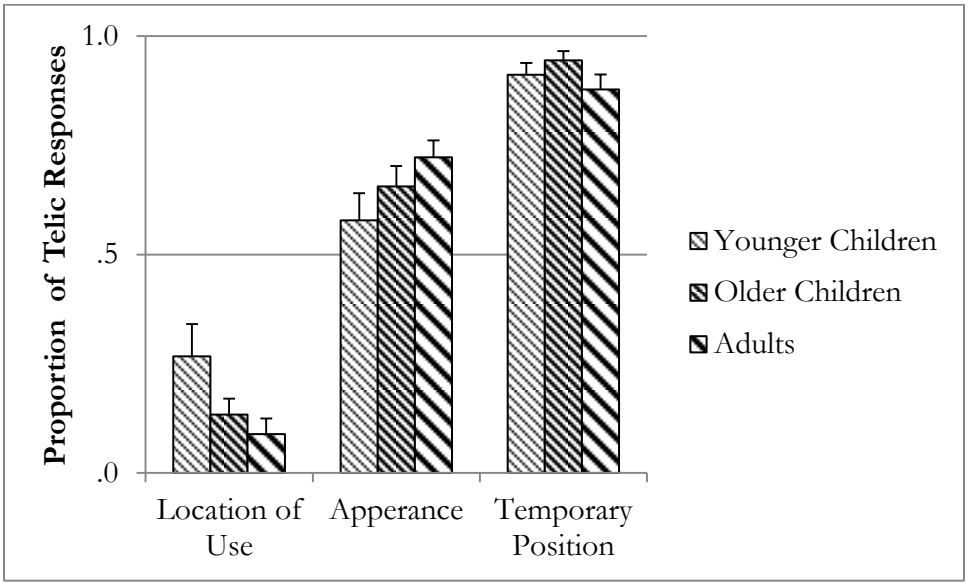
5.3.4.1 Overall Analysis

Figure 26 shows the proportion of Telic responses by Age Group and Item Type. The results of the 3 Item Type X 3 Age Group ANOVA revealed a significant main effect of Item Type ($F(2, 84) = 210.327$, $p < .001$). To unpack the significant main effect of Item Type, pairwise comparisons were carried out on all Item Types, collapsing the data by Age Group. Telic responses were reported significantly more often for Temporary items than for Appearance items ($p < .001$), significantly more often for Temporary items than for Location of Use items ($p < .001$), and significantly more often for Appearance items than Location of Use items ($p < .001$).

The interaction between Item Type and Age Group was also significant ($F(4, 84) = 3.525$, $p = .010$) were not significant. This interaction was likely driven by the tendency for Younger Children to have more Telic responses than Adults for Location of Use items, but Adults to have more Telic responses than children for Appearance items.

The main effect of Age Group was not significant ($p = .822$).

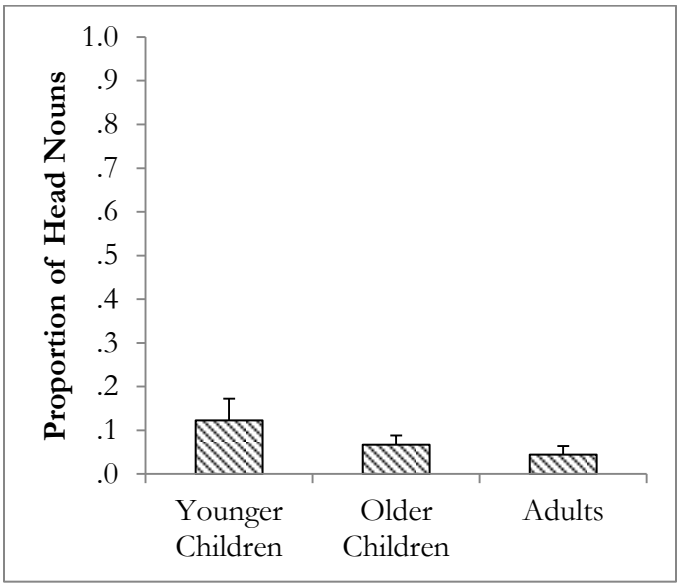
Figure 26. Proportion of Telic Responses By Item Type and Age Group



5.3.4.2 Analysis of Consistency by Head Noun

Figure 27 shows the average proportion of compounds with head nouns that received consistently Telic responses. The 3 Age Group ANOVA on the proportion of compounds with consistently telic head nouns revealed that Age Group was not significant (p = .251). This finding suggests that both younger children and older children were no more likely than adults to assign only Telic interpretations to any given head noun.

Figure 27. Proportion of Head Nouns with Consistent Telic Interpretation by Age



5.3.4.3 Summary of Results

Children behaved very adult-like in their interpretation of novel compounds. Like adults, children in both age groups strongly preferred Telic interpretations for the Temporary Position Items and strongly dispreferred Telic interpretations in the Location of Use items. Moreover, children were no more likely than adults to prefer Telic interpretations across the board for a given head noun.

5.3.5 Discussion

The goal of this study was to provide evidence that children, like adults, use lexical semantic information to interpret noun-noun compounds. The results of the study supported the two predictions made by this dissertation. First, children were adult-like in their ability to change their interpretation of compounds with the same head noun based on the lexical semantics of the modifier noun. For example, both children and adults preferred telic interpretations of compounds with an inanimate or artifact modifier noun, but dispreferred telic interpretations of compounds with a locative modifier noun. The children in the study were no more likely than adults to interpret compounds with the same head noun consistently with the same telic interpretation, suggesting that children rely on more than a template with head noun and relationship information to interpret novel compounds, contra Krott et al. (2009).

The results of the study also support the second prediction, that children do not have a general preference for temporary/accidental interpretation compounds. Rather, when children have sufficient lexical information they prefer intrinsic relationships, suggesting that the findings of Krott et al. (2010) were an artifact of the nonce word study design.

5.4 General Discussion

The goal of the studies in this chapter was to provide evidence that children use the same system as adults to produce and interpret noun-noun compounds. In the first half of this dissertation we showed that adults use the tendencies of natural classes in conjunction with the parts of the lexical structure available on the head noun to determine the meaning of a noun-noun compound. From all three studies, we found results that support the hypothesis that children interpret compounds using the same mechanism as adults.

The first study, a corpus study, compared children's production of novel noun-noun compounds to the noun-noun compounds in the children's input. The results showed that children were sensitive to the behavior of natural classes, but were not sensitive to behavior of particular words. For instance, children matched adults in their high production of compounds with artifact heads and telic relationships. On the other hand, children did not necessarily match adults in the relationships used with individual head nouns. These findings are the first piece of evidence that runs contrary to a template-based noun-noun compound system for children (Krott and Nicoladis 2005, Krott et al. 2009).

The second study, an elicited production study, compared children's production of novel noun-noun compounds to adults' production of novel noun-noun compounds across the full span of relationships. While previous research had suggested that young children do not use compounds for particular types of relationships (Hiramatsu et al. 2000), the results of this study found no evidence for that claim. Across the four relationships, including the specific examples used in the Hiramatsu study, children's preference to use a noun-noun compound form closely matched adults' preference to use a noun-noun compound form. For example, both adults and children were very likely to use noun-noun compounds for formal relationships (a chair shaped like a hand is a *hand-chair*). Both adults and children were less likely to use noun-noun compounds for agentive relationships (a shadow caused by a tree is a *tree-shadow*). This study provides evidence that children, like adults, are able to use all parts of a word's lexical structure to produce compounds.

The last study, a forced-choice interpretation task, compared children's interpretation of noun-noun compounds to adults' interpretation of noun-noun compounds. The results showed that children were adult-like in two manners in terms of their interpretations. First, children used the lexical information coming from both the head and modifier nouns to

determine the compounds meaning. On the items where a functional, telic interpretation was available and plausible, children and adults chose this interpretation. On the items where a functional interpretation was available, but not plausible, children and adults chose a different interpretation. For example, both children and adults interpreted *lion-bed* as a bed that lions sleep in, but did not interpret *mountain-bed* as a bed that mountains sleep in. Rather, children and adults preferred a location of use interpretation for mountain bed, a bed that is used in the mountains.

Taken together, the results of these studies suggest that children use the same generative mechanism as adults in their production and interpretation of compounds. Rather than relying on templates, children are able to weigh multiple sources of lexical information at once to determine which interpretation is most likely for noun-noun compounds. In the next chapter we explore the syntactic side of the proposed interpretation system to determine if children are adult-like in their interpretation when syntax, rather than lexical semantics, determines the relationship in a compound.

CHAPTER 6: CHILD VERBAL COMPOUND TASKS

6.0 Introduction

In Chapter 5 I showed that children adhere to the adult system to interpret noun-noun compounds, using lexical information from the head and modifier in noun-noun compounds to determine the appropriate interpretation. The goal of this chapter is to provide evidence that children use their knowledge of verbal compound syntax to constrain their interpretation of verbal compounds in the same way that adults do.

This chapter presents the results of two studies examining children's acquisition of verbal compounds. The aim of these studies is to address the questions in (14).

(14) Questions addressed in Chapter 6 Studies

a. How do children learn verbal compound syntax?

b. Does children's knowledge of verbal compound syntax restrict their interpretation of verbal compounds in an adult-like way?

The first study, which addressed the question in (14a), examined the set of non-adult verbal compound forms that children produce, in order to determine how children acquire verbal compound syntax and what type of syntactic knowledge children should have as they progress through the acquisition process. The second study, which addressed the question in (14b), examined the way in which children interpret verbal compounds, given their syntactic knowledge as measured by their verbal compound productions in the first study.

Taken together, the ultimate goal of this chapter was to provide evidence that children use the same mechanism as adults to produce and interpret verbal compounds, and any deviations from adult-like interpretations can be explained by lacking syntactic knowledge.

6.1 Child Study 4: Elicited Production of Verbal Compounds

This study examined how children acquire verbal compound syntax. It is well-attested that children produce a particular set of forms, verb-internal argument *catch-mouse* and verb-*er*-internal argument *catcher-mouse* for the target *mouse-catcher* (Clark et al. 1986, Nagpal and Nicoladis 2009, Gamache and Schmitt to appear). The goals of this study were (i) to replicate previous findings that children produce this set of non-adult forms (*catch-mouse* and *catcher-mouse,* but not *mouse-catch* for *mouse-catcher*) and (ii) to determine a baseline for individual children's syntactic knowledge. In the second study in this chapter, we used this baseline to determine if children's interpretation of verbal compounds is predicted by their knowledge of verbal compound syntax.

The hypothesis put forward in this dissertation predicted that children would produce the same pattern of forms that have been found in previous studies, namely *catch-mouse* and *catcher-mouse*, but not *mouse-catch*, as the non-adult forms are intermediate steps in the adult derivation.

6.1.1 Method

6.1.1.1 Participants

31 children (19F, 12M) and 15 adults (12F, 3M) participated in the study. 15 children made up the Younger Children group (3;0 – 5;0: Mean 4;2) and 16 children the Older Children group (5;7 – 6;7: Mean 6;2). Children were recruited from local schools in Western Massachusetts and adults from an undergraduate linguistics course at Michigan State University. The adult participants received extra credit in their course for their participation.

6.1.1.2 Materials and Procedure

Four verbs were chosen for each of three verb types (atelic, telic, particle) for a total of 12 items. See Table 23 for the full list of items. Note that three verb types were used in

this study (atelic, telic, particle) to mirror the verb types used in the second study in this chapter, but for the purposes of determining a baseline for children's syntactic knowledge, these verb types have been collapsed.

Table 23. VC Elicited Production: Items

Verb Type	**Verb**	**Prompt**	**Target Form**
Atelic	*wipe*	This is a woman who wipes tables.	*table-wiper*
	burn	This is a man who burns candles.	*candle-burner*
	push	This is a man who pushes carts.	*cart-pusher*
	fight	This is a boy who fights robots.	*robot-fighter*
Telic	*fix*	This is a man who fixes chairs.	*chair-fixer*
	cut	This is a man who cuts onions.	*onion-cutter*
	buy	This is a man who buys food.	*food-buyer*
	wash	This is a woman who washes plates.	*plate-washer*
Particle	*set up*	This is a man who sets up ladders.	*ladder-setter-upper*
	drop off	This is a woman who drops off kids.	*kid-dropper-offer*
	take away	This is a man who takes away cars.	*car-taker-awayer*
	check out	This is a man who checks out computers.	*computer-checker-outter*

To begin the task, the child was introduced to Monkey, a curious animal who liked to learn things only from children. The following instructions were read to the child:

(15) Verbal Compound Elicited Production Instructions

"This is my friend Monkey. There's something that you need to know about this monkey. She's a funny monkey who only likes listening to children. She has a problem, though, because she meets all of these new people, but she's not sure what to call them. Do you think you can help her? I will help with you the first couple of names and then you can help Monkey with the rest, okay?"

Two practice items were introduced by Monkey and named by the experimenter using verbal compound forms in full sentences. For example, children were shown a picture of a girl reading a book and were told "This is a girl who reads books. We could call a girl who reads books a book-reader. Can you tell Monkey that she is a book-reader?" After the child

repeated the compounds from the practice items to Monkey, the experimenter moved on to the test items.

On each trial an image was presented along with an audio recording that described the person in the picture. See Figure 28 for a sample item. Children were given two chances to come up with a verbal compound form for each item. If they did not give a verbal compound by their second attempt, the experimenter moved on to the next item. For each response, children were prompted to respond in a full sentence ("He is a X."/"She is a X.") to ensure that the forms that children were producing were in fact nominal forms and not simply repetitions of the final words of the prompts.

Figure 28. VC Elicited Production: Sample Item

"Look! This is a man who cuts onions. What could we call a man who cuts onions?"

Children were tested individually either in a quiet room or in a quiet part of their classroom. Each child was seated in front of a laptop with a 12 inch screen approximately 24 inches from the computer. All sessions were audio-recorded. The stimuli were displayed using Microsoft Powerpoint. All images were on a white background and the audio was recorded by the author, with a minor pitch and formant manipulation to create the Monkey's voice. Generally the stimuli were played over the laptop speakers, but in cases where the

speakers were not sufficiently loud, the children wore headphones. The adults were tested in a group, with the visual stimuli displayed on an overhead projector and the audio stimuli played over classroom speakers.

6.1.1.3 Coding and Analysis

Production forms were coded by according to the position of each morpheme. Verbs were coded as V, internal arguments as O (object), agents as A, particles as P, and morphemes as reflected in their English orthography (e.g., *er*, *ing*). Simple nouns (N) and noun-noun compounds (NNC) were coded accordingly. Phrasal responses, for example "a man who drives trucks", were coded as Phrasal. A sample of this coding scheme is shown in Table 24.

Table 24. VC Elicited Production: Coding Scheme

Production Form	**Code**
truck-driver	OV*er*
driver-man	V*er*A
pick-up-car	VPO
chauffeur	N
car-man	NNC

For analysis, coding was simplified in a few ways. First, while they were coded separately, any form that included both the agent (A) and *–er* morphology, for example, *driver-man*, was collapsed with those forms that included only the *–er* morphology. Second, forms that included a particle were coded with the particle, for example OV*er*P*er* for *car-picker-upper*, but were collapsed with non-particle forms for the purposes of the general analyses. That is, a form of OV*er*P*er* and OV*er* were both coded as OV*er*. Finally, any forms that did not meet a threshold of appearing more than 5% of the time for any age group were collapsed into an Other category. Note that the Other category made up less than 6% of forms for each age group. See Appendix C for the full set of forms produced in the study.

The results were analyzed in three ways. First, the forms that children and adults did produce were examined in light of the full range of possible forms that the children and adults could have produced. That is, of all of the possible permutations of the morphemes in a verbal compound, which permutations were produced and which failed to be produced? For a form to be considered reliably produced, it had to be produced by more than one child and by each child more than one time.

Second, the distribution of the forms that were deemed representative of children's learning path by the first analysis (OV*er*, V*er*O, VO) were examined to determine if the forms proceed in a way that is reflective of steps, as they are proposed to be reflective of the steps in the adult derivation. A series of one-way Age Group (Younger Children, Older Children, Adults) were carried out on the proportion of each form.

Finally, the overall distribution of production forms was examined to determine if children and adults use verbal compound forms to the same degree. For this analysis, forms were collapsed into four groups: verbal compound forms (OV*er*, V*er*O, and VO), other nominal forms (nouns, noun-noun compounds, and V*er*), phrasal forms, and other forms. A series of one-way Age Group (Younger Children, Older Children, Adults) ANOVAs were carried out on the proportion of verbal compound forms, the proportion of other nominal forms, and the number of phrasal forms.

A Bonferroni correction was used for all post-hoc tests to adjust for multiple comparisons.

6.1.2 Results

6.1.2.1 Analysis of Verbal Compound Permutations

Table 25 shows the proportion and counts of possible permutations of verbal compounds. Only four permutations reached the reliability threshold: OV*er* (the target),

V*er*O, VO, and V*er*. Of these permutations, OV*er* and V*er*, were used by both child and adult participants and are attested in the adult grammar. V*er*O and VO were not used by adult participants, but V*er*O was used by nine children, and VO by ten children.

Table 25. Proportion (and Count) of Verbal Compound Permutations

Form	Example	Younger Children		Older Children		Adults	
OV*er*	***truck-driver***	**.22**	**(35)**	**.47**	**(91)**	**.85**	**(153)**
V*er*O	***driver-truck***	**.06**	**(10)**	**.04**	**(8)**	**.00**	**(0)**
VO*er*	*drive-trucker*	.01	(1)	.00	(0)	.00	(0)
O*er*V	*trucker-drive*	.00	(0)	.00	(0)	.00	(0)
VO	***drive-truck***	**.17**	**(26)**	**.04**	**(7)**	**.00**	**(0)**
OV	*truck-drive*	.01	(1)	.01	(1)	.00	(0)
V*er*	***driver***	**.15**	**(24)**	**.20**	**(38)**	**.02**	**(3)**
O*er*	*trucker*	.00	(0)	.00	(0)	.00	(0)
O	*truck*	.01	(1)	.01	(1)	.00	(0)
V	*drive*	.01	(1)	.00	(0)	.00	(0)
Other		.37	(57)	.24	(46)	.13	(24)

Grey = attested adult forms.
Bolded = forms that surpassed reliability threshold.

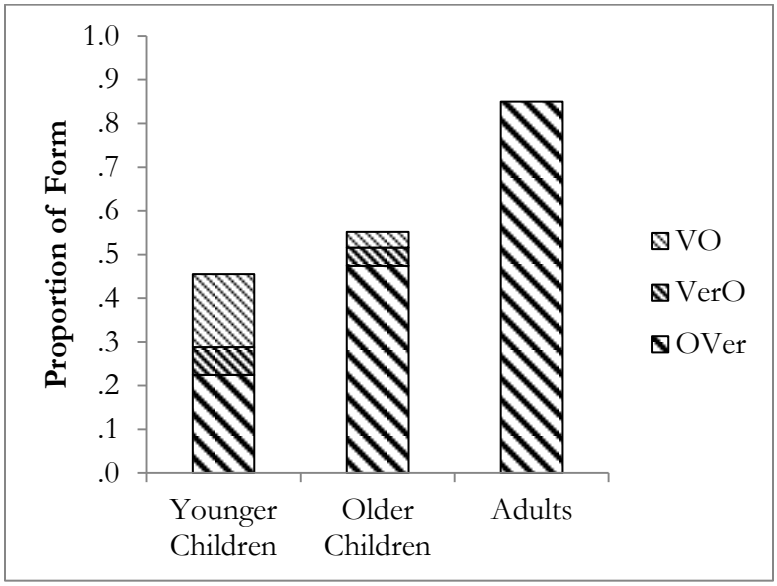
Six permutations of the verbal compound morphemes were not reliably produced: VO*er*, O*er*V, OV, O*er*, O, and V. The absence of three of these forms, VO*er*, O*er*V, and O*er*, suggests that children understand that *–er* merges with verbs, not nouns. The absence of just O or just V forms suggests that children are minimally able to merge the verb and internal argument when they begin to produce verbal compound forms. Finally, what does the absence of OV suggest about children's knowledge of verbal compound syntax? Or, more to the point, what does the presence of VO and V*er*O and the absence of OV suggest? As I have proposed in previous research (Gamache and Schmitt to appear), this pattern reflects the steps in the adult verbal compound derivation, which children are learning step-by-step. In other words, VO and V*er*O are partial steps in the verbal compound derivation, while OV is an impossible set in the derivation, since *–er* must merge into the structure prior to the

internal argument (O) moving to the left of the verb. For the next two analyses VO and V*er*O, in addition to the target OV*er*, are all considered verbal compound forms.

6.1.2.3 Analysis of Distribution of Verbal Compound Forms

Figure 29 shows the proportion of verbal compound forms by age group. A series of one-way 3 Age Group (Younger Children, Older Children, Adults) ANOVAs were performed on the proportion of each form type (VO, V*er*O, OV*er*).

Figure 29. VC Elicited Production: Proportion of Verbal Compound Forms



The ANOVA performed on the proportion of OV*er* forms revealed a main effect of Age Group ($F(2, 41) = 19.022$, $p < .001$). Post-hoc comparisons revealed that both Adults ($p < .001$) and Older Children ($p = .001$) were more likely than Younger Children to use target OV*er* forms. Older Children were marginally more likely than Younger Children to use target forms ($p = .054$).

The ANOVA performed on the proportion of V*er*O forms revealed no main effect of Age Group ($p < .136$).

Finally, the ANOVA performed on the proportion of VO forms revealed a significant main effect of Age Group ($F(2, 41) = 4.037$, $p = .025$). Post-hoc comparisons

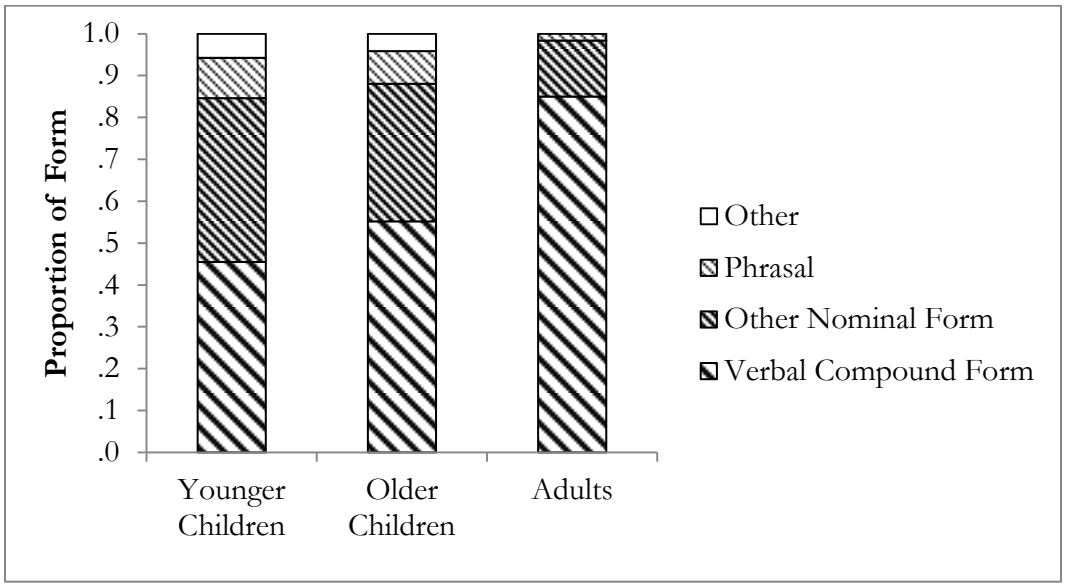
revealed that Younger Children were significantly more likely than Adults to use VO forms (p = .028). There were no differences between Younger Children and Older Children (p = .110) or Older Children and Adults (p = 1.000).

In summary, the proportion of VO and V*er*O forms decreased over time, while the proportion of OV*er* increased.

6.1.2.4 Analysis of Distribution of Overall Forms

Figure 30 shows the distribution of form types by age group. A series of one-way 3 Age Group (Younger Children, Older Children, Adults) ANOVAs were performed on the proportion of each form type (VO, V*er*O, OV*er*).

Figure 30. VC Elicited Production: Proportion of Overall Forms by Age Group



The ANOVA performed on the proportion of Verbal Compound Forms revealed a main effect of Age Group ($F(2, 41) = 7.634$, p = .002). Post-hoc comparisons showed that Adults used significantly more Other Forms than Younger Children (p = .002) and Older Children (p = .016). There was no difference between Younger Children and Older Children in the use of Verbal Compound Forms (p = 1.000).

The ANOVA performed on the proportion of Other Nominal Forms revealed a main effect of Age Group ($F(2, 41) = 3.940$, $p = .027$). Post-hoc comparisons showed that Younger Children used significantly more Other Nominal Forms than Adults ($p = .035$). There were no differences between Younger Children and Older Children ($p = 1.000$) or Older Children and Adults ($p = .188$) in the use of Other Nominal Forms.

The ANOVA performed on the proportion of Phrasal Forms revealed a main effect of Age Group ($F(2, 41) = 5.841$, $p = .020$). However, post-hoc comparisons showed no significant between-group differences after Bonferroni's correction.

Finally, the ANOVA performed on the proportion of Other Forms revealed a main effect of Age Group ($F(2, 41) = 5.139$, $p = .010$). Post-hoc comparisons showed that Adults used significantly more Other Forms than Younger Children ($p = .011$) and marginally more Other Forms that Older Children ($p = .077$). There was no difference between Younger Children and Older Children in the use of Other Forms ($p = 1.000$).

In summary, children used less verbal compound forms than adults, and instead frequently produced other adult-like, but non-OV*er* nominal and phrasal forms.

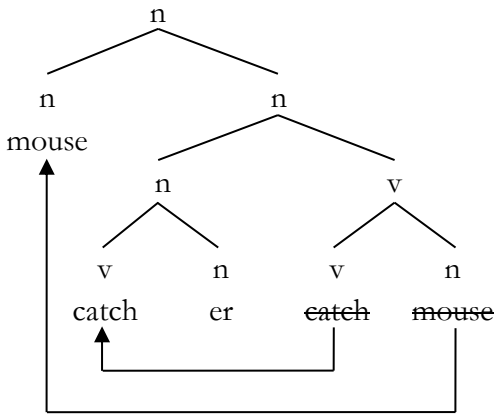
6.1.2.5 Summary of Results

Children produced only four possible permutations of the morphemes in verbal compounds: OV*er*, V*er*O, V*er*, and VO. V*er* represents a different adult target form. The other three forms were shown to progress as expected in development: V*er*O and VO were more prevalent in the children's productions and decreased with age, while OV*er* was more prevalent in adults' productions and increased in children's productions with age. Moreover, in the overall distribution of forms produced, adults used predominantly target verbal compound forms, while children, who produced less target verbal compound forms, tended to use a wider range of other adult forms, such as V*er* or noun-noun compounds.

6.1.3 Discussion

The results of this study replicated the findings of previous studies: children produce *catch-mouse* and *catcher-mouse* but not *mouse-catch* for *mouse-catcher* (Clark et al. 1986, Nagpal and Nicoladis 2009, Gamache and Schmitt to appear). As I have argued in previous research, this pattern of forms reflects children building a particular derivation of verbal compounds, repeated from (3a) in (16) below.

(16)



According to this derivation, children should, and do, first produce *catch-mouse* then *catcher-mouse* before producing the adult-like *mouse-catcher*. Because *catch* can only move after *–er* has merged into the structure, children should not, and are not attested to, produce *mouse-catch*.

The claim that children's non-adult forms are a reflection of their building of the adult structure makes a particular prediction for how these children should interpret compounds. The first step in the derivation merges the verb with the internal argument, which means that as soon as children have acquired this step in the derivation, they should only allow for verb-internal argument interpretations of verbal compounds. This prediction was tested in the next study.

6.2 Child Study 5: Preferred Interpretations of Verbal Compounds

The final study examined how children interpret verbal compounds. The ultimate goal of this study, in conjunction with the previous study, was to determine if children's interpretation of verbal compounds is dependent on their knowledge of verbal compound syntax. An immediate goal of this study was to provide evidence that children do not start off with a bias towards the adult interpretation of verbal compounds. That is, the goal was to show that, at some point in a child's language development, a *towel-cleaner* is equally likely to be a person who cleans towels (internal argument reading of *towel*) or a person who cleans things using a towel (adjunct reading of *towel*).

This study was designed to examine these claims by pairing nouns and verbs together where the noun could easily serve as either the internal argument of the verb or an adjunct to the verb. For example, *clean* and *towel* were paired since a towel is both something that can be cleaned and can be used to clean. In the task the child had to choose which of two people was a *towel-cleaner,* a person who cleans towels (internal argument) or a person who cleans things using a towel (adjunct). Additionally, as in Adult Study 2, telicity was manipulated in the items to determine if children were sensitive to the differences in argument structure of atelic and telic verbs.

The hypotheses put forth in this dissertation made particular predictions about children's behavior on this task. Children who had not yet learned that the modifier noun in a verbal compound is the internal argument of the verb should have had no preference between an internal argument interpretation and an adjunct reading for verbal compounds. In other words, these children should have been equally likely to choose an internal argument reading or an adjunct reading of *towel-cleaner*. Children who had already learned that the modifier noun in a verbal compound is the internal argument of the verb should have

only preferred internal argument readings of verbal compounds. With respect to telicity, children were predicted, like adults (Borer 1994), to allow more adjunct interpretations for atelic verbs and less adjunct interpretations for telic and particle verbs.

6.2.1 Method

6.2.1.1 Participants

31 children (18F, 13M) and 10 adults (8F, 2M) participated in the study. 15 children made up the Younger Children group (3;0 – 5;0, Mean 4;2) and 16 children the Older Children group (5;7 – 6;7, Mean 6;2). Children were recruited from local schools in Western Massachusetts and adults from an undergraduate linguistics course at Michigan State University. The adult participants received extra credit in their course for their participation.

6.2.1.2 Materials and Procedure

Four verbs were chosen for each of three verb types (atelic, telic, and particle). Each verb was then paired with two different nouns, for a total of 24 items. Nouns were chosen for each verb that could reasonably serve as either the internal argument of the verb or an adjunct, usually an instrument, to the verb. See Table 26 for the full list of items.

Table 26. VC Interpretation: Items

Verb Type	**Verb**	**Compound**	**Argument Description**	**Adjunct Description**
Atelic	carry	*helicopter-carrier* *airplane-carrier*	carries helicopters carries airplanes	carries things using a helicopter carries things using an airplane
	tickle	*bird-tickler* *penguin-tickler*	tickles birds tickles penguins	tickles things using a bird tickles things using a penguin
	protect	*sword-protector* *shield-protector*	protects swords protects shields	protects things using a sword protects things using a shield
	pull	*truck-puller* *tractor-puller*	pulls trucks pulls tractors	pulls things using a truck pulls things using a tractor
Telic	draw	*pencil-drawer* *crayon-drawer*	draws pencils draws crayons	draws things using a pencil draws things using a crayon
	paint	*mouth-painter* *foot-painter*	paints mouths paints feet	paints things using their mouth paints things using their foot
	make	*block-maker* *box-maker*	makes blocks makes boxes	makes things using blocks makes things using boxes
	clean	*sponge-cleaner* *towel-cleaner*	cleans sponges cleans towels	cleans things using a sponge cleans things using a towel
Particle	pick up	*stick-picker-upper* *fork-picker-upper*	picks up sticks picks up forks	picks up things using a stick picks up things using a fork
	pass out	*spoon-passer-outter* *cup-passer-outter*	passes out spoons passes out cups	passes out things using a spoon passes out things using a cup
	fill up	*bowl-filler-upper* *bucket-filler-upper*	fills up bowls fills up buckets	fills up things using a bowl fills up things using a bucket
	put away	*basket-putter-awayer* *bag-putter-awayer*	puts away baskets puts away bags	puts away things using a basket puts away things using a bag

To begin the task, the child was introduced to Monkey, a curious animal who liked to learn things only from children. The following instructions were read to the child:

(17) Verbal Compound Interpretation Instructions
"This is my friend Monkey. There's something that you need to know about this monkey. She's a funny monkey who only likes listening to children. She has a problem, though, because she knows some names for people, but she's not quite sure who the names belong to. Do you think you can help her? She is going to tell us about two people and then give us a name and we have to figure out which person it goes with. Does that sound okay?"

On each trial two people were introduced, one at a time, with an image and an audio recording describing the person in the pictures. On the third slide, both images appeared side by side and the child was asked to determine which person should have a particular name. See Figure 31 for a sample item. Children responded by pointing to the person on the screen that they believed should have the name under question.

Figure 31. VC Interpretation: Sample Item

Slide 1	Slide 2	Slide 3
"This is a person who protects swords."	"And this is a person who protects things using a sword."	"Which one is the sword-protector?"

The general procedure for this task was the same as for the verbal compound elicited production task. If children participated in both the verbal compound elicited production task and the verbal compound preference task, the preference task was administered on a

second day of testing. All adults participated in both the elicited production task and the preference task in the same testing session.

6.2.1.3 Analysis

The data were analyzed in two ways. First, a 3 Verb Type (Atelic, Telic, Particle) X 3 Age Group (Younger Children, Older Children, Adults) ANOVAs was carried out with proportion of argument responses as the dependent measure to determine if there are age- or verb type-related differences in response patterns.

Next, the results of the elicited production study were compared to the results of the preference task for those children were participated in both. Children were divided into groups based on the types of forms that they were producing in the elicited production task. A 5 Production Group ANOVA was carried out on the proportion of consistent head nouns with post-hoc comparisons to examine the differences in the productions groups. A Bonferroni correction was used on the post-hoc comparisons. Finally, one-sample *t*-tests were used to examine each group's performance on the preference task against chance.

6.2.2 Results

6.2.2.1 Preference Task Analysis

Figure 32 shows the proportion of argument responses for each participant in the study by age group, sorted within each group by the age of the participants. The horizontal grey bar shows the range from .4 to .6 argument responses, which is the chance range for this forced-choice task. There are a few patterns to take note of. First, no adult participants fell in this region; all adult participants were well above chance for selecting argument interpretations of verbal compounds. Second, both of the child groups had participants in this range, eight in the Younger Children group and three in the Older Children group. Finally, no participants fell below the chance region.

Figure 32. VC Interpretation: Proportion of Argument Responses by Participant

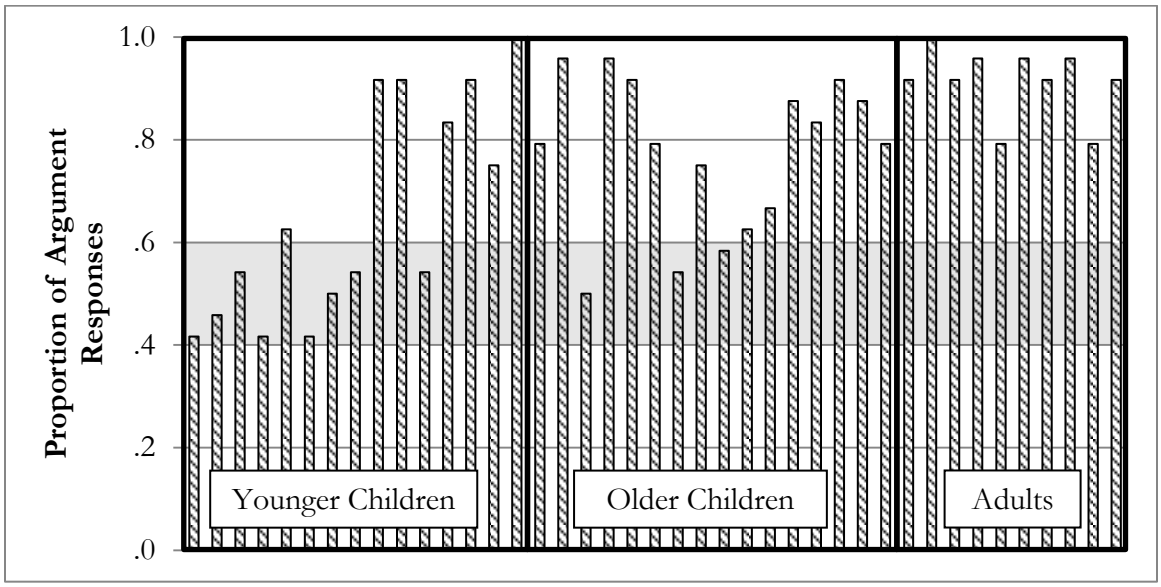
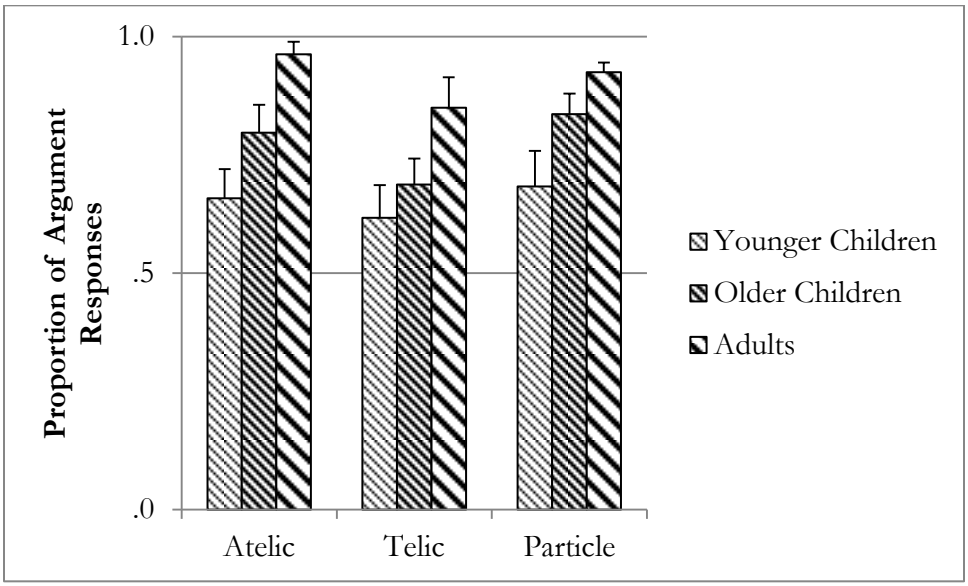


Figure 33 shows the proportion of argument responses by each age group in the verbal compound interpretation task.

Figure 33. VC Interpretation: Proportion of Argument Responses



The results of the 3 Verb Type X 3 Age Group ANOVA revealed a significant main effect of Verb Type ($F(2, 76) = 3.496$, $p = .035$). Post-hoc comparisons revealed that Particle Verbs received marginally more Argument responses than Telic Verbs ($p = .086$). There was

no difference between Atelic Verbs and Telic Verbs (p = .158) or between Atelic Verbs and Particle Verbs (p = 1.000).

The main effect of Age Group was also significant ($F(2, 38) = 7.634$, p = .002). Post-hoc comparisons revealed that Adults used significantly more argument responses than Younger Children (p = .001). There were no differences between Younger Children and Older Children (p = .140) or Older Children and Adults (p = .124).

The interaction between Verb Type and Age Group was not significant (p = .827).

6.2.2.2 Summary of Results

The results provide evidence that children do not start out with a preference for verb-internal argument readings of verbal compounds, which suggests that children do not have a bias towards argument readings in advance of their syntactic knowledge constraining their interpretation. By age five or six, however, this preference for verb-internal argument readings has clearly developed. Replicating the findings from Adult Study 2, adults in the current study had a strong preference for verb-internal argument readings only. The effect of telicity, however, failed to replicate in this study. The lower number of nouns per verb type group (four, as opposed to eight in Adult Study 2) could have contributed to the lack of this finding, in addition to changes to the methodology to make the study child-appropriate (picturable verb-internal argument/adjunct combinations). See Appendix D for results by individual verb.

6.2.3 The Interaction of Syntax and Interpretation

To examine the predicted interaction between children's acquisition of verbal compound syntax and its effect on children's interpretation of verbal compounds, the children who participated in both the verbal compound elicited production task and the

verbal compound preference task (N = 28) were divided into groups based on their elicited production task performance.

Categorizing children was difficult for two reasons. First, children did not necessarily use the same verbal compound form across all of the items when they used verbal compound forms. For example, a child may have produced both VO and V*er*O forms. Only one child produced all three forms (VO, VerO, and OVer), while the others who produced more than one form produced either VO and VerO or VerO and OVer, suggesting that these children were still learning the features in the next step of the derivation. The second issue was that children, like adults, did not always use verbal compound forms. For example, a child may have used a mix of verbal compound forms and noun-noun compound forms. For these reasons, children had to reach a threshold of 50% of the form under consideration and any more advanced form in the derivation. For example, a child who produced 25% V*er*O and 25% OV*er* would be considered to be a V*er*O-producer, since at least 50% of their trials showed them to have knowledge of at least the V*er*O step. Similarly, a child who produced 25% VO and 25% V*er*O was considered to be a VO-producer.

The resulting grouping was the following. Children who produced more than 50% OV*er* forms were in the OV*er*-producer group. Children who produced more than 50% combined OV*er* and V*er*O forms were in the V*er*O-producer group. Children who produced more than 50% combined OV*er,* V*er*O, and VO were in the VO-producer group. Children who failed to produce these forms on a total of 50% of the trials were in the non-verbal compound-producer group. Table 27 shows the distribution of children by group.

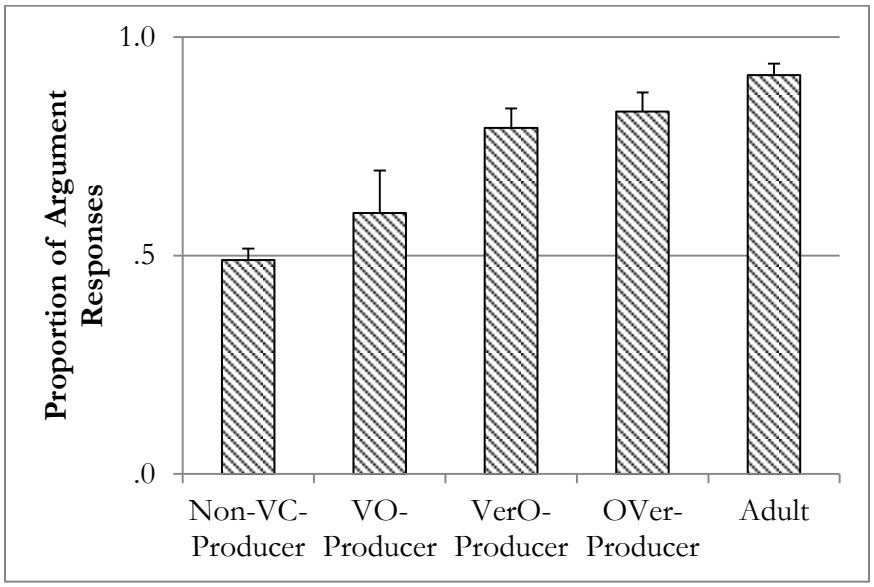
Table 27. Groups based on Elicited Production Task Performance

Group	**N**	**Mean Age**	**Production Performance**
Non-VC-producer	4	4;5	< 50% combined VO, VerO, OVer forms
VO-producer	3	4;8	≥ 50% combined VO, VerO, OVer forms
VerO-produce	11	5;4	≥ 50% combined VerO and OVer forms
OVer-produce	10	5;11	≥ 50% combined OVer forms
Adult	10	---	---

To assess how children's knowledge of verbal compound syntax affected their interpretation of verbal compounds, two analyses were performed. First, a one-way Production Group (Non-VC-producer, VO-producer, VerO-producer, OVer-producer, Adult) ANOVA was performed on the proportion of argument responses for each production group to determine at which stage in development children's preference increased towards only argument interpretations. Second, one-sample *t*-tests were performed on the proportion of argument responses for each production group against chance (.5) to determine at which stage children reliably chose above chance argument interpretations.

See Figure 34 for the average proportion of argument responses by elicited production group.

Figure 34. VC Interpretation: Proportion of Argument Responses by Production Group



The one-way Age Group ANOVA on the proportion of argument responses revealed a main effect of Production Group ($F(4, 33) = 10.472$, $p < .001$). Post-hoc comparisons revealed that Adults responded with significantly more argument responses than VO-producers ($p = .005$) and Non-VC-producers ($p < .001$). OV*er*-producers responded with significantly more argument responses than Non-VC-producers ($p = .001$) and marginally more argument responses than VO-producers ($p = .074$). V*er*O-producers responded with significantly more argument responses than Non-VC-producers ($p = .002$). There were no other significant differences between groups.

The results of the second analysis, comparing the groups to chance, reflected the findings of the first analysis. While V*er*O-Producers ($t(10) = 6.540$, $p < .001$), OV*er*-Producers ($t(9) = 7.461$, $p < .001$), and Adults ($t(10) = 18.822$, $p < .001$) were all significantly above chance, Non-VC-Producers ($p = .718$) and VO-Producers ($p = .423$) were at chance.

In summary, children's performance on the preference task, matched their predicted performance based on the production task. Children who reliably produced 50% or more OV*er* and V*er*O forms performed adult-like on the preference task, while children who

produced 50% or more non-verbal compound forms did not. The VO-producers, while not significantly above chance, do trend in the predicted direction and would be expected to differ from chance given a large sample size within this group.

6.3 General Discussion

The goals of the studies in this chapter were (i) to replicate previous elicited verbal compound production studies and (ii) to determine if children's syntactic knowledge predicts their interpretation of verbal compounds. In the first half of this dissertation we showed that the syntax of verbal compounds alone restricts their interpretations for adults. The burden of the studies in this chapter was to show there was a correlation between the way that children produce and interpret verbal compounds. Namely the correlation that we were looking for was between children's knowledge of steps in the derivation and the reflection of those steps in how children constrain the interpretation of verbal compounds.

The results of the two studies supported both guiding hypotheses of this dissertation. First, the verbal compound forms that children produced were the same as those that have been attested in previous production studies (Clark et al. 1986, Nagpal and Nicoladis 2009, Gamache and Schmitt to appear). Children produced VO *catch-mouse,* V*er*O *catcher-mouse,* and OV*er mouse-catcher,* but, again, failed to produce OV *mouse-catch.* As in previous work, I argue that these forms reflect steps in the adult derivation (Gamache and Schmitt to appear).

The fact that children are building the adult structure led to the prediction that children who have sufficient verbal compound syntax knowledge should have adult-like interpretations of verbal compounds. Sufficient verbal compound syntax knowledge is defined as having learned the step in the derivation where the modifier noun merges as the internal argument of the verb, which is the first step in the derivation. The results of the

comparison between children's syntactic knowledge and their interpretation of verbal compound showed that children with little or no knowledge of verbal compound syntax allowed adjunct interpretations that are not allowed by adult verbal compound syntax, while children with adult-like or near-adult-like knowledge of verbal compound syntax only allowed internal argument readings of verbal compounds. The overall finding lends support to the hypothesis that children are building steps in the adult derivation, since their syntactic knowledge bore directly on their interpretation knowledge, and also to the hypothesis that children use the same compositional system as adults to interpret compounds.

CHAPTER 7: SUMMARY AND CONCLUSIONS

7.1 Goal of Dissertation

This dissertation had two main goals: (i) to define the system that adults use to interpret compounds and (ii) to understand how child come to use this system.

The first half of this dissertation presented the results of two studies examining adults' interpretation of noun-noun compounds and verbal compounds. Adults' interpretation of compounds was predicted to be guided by (i) the syntactic structures of compounds and (ii) the lexical structure of the words in the compounds and tendencies of different natural classes to behave in particular ways. With respect to syntax, verbal compound syntax was predicted to constrain adults' interpretation of noun-verb-*er* strings to a reading where the noun is interpreted as the internal argument of the verb (Roeper and Siegel 1978, Selkirk 1982, Lieber 1983, Di Sciullo and Williams 1987, Bobaljik 2003). For example, a *cucumber-holder* was predicted to be interpreted as only a person who holds cucumbers and not a person who holds things using a cucumber. Noun-noun compound syntax was predicted to not constrain adults' interpretations in any particular way, except by determining which of the two elements is the head. Therefore, *cucumber-basket* was predicted to lead to many interpretations. With respect to lexical structure, adults were predicted to interpret compounds in line with the tendencies of the natural classes of their constituents (Downing 1977, Leonard 1985, Štekauer 2005). For example, a *cucumber-basket* would most likely to lead to a reading of "a basket that cucumbers are put in" because *basket* is an artifact and artifacts are most often defined in terms of their function (to hold/carry).

The first study explored how syntactic structure (verbal compound, noun-noun compound) and natural classes (animate natural kinds, inanimate natural kinds, locative/temporal nouns, humans, artifacts) interacted in adults interpretation of

compounds. The findings supported a theory of compound interpretation that requires syntax and structured lexical entries. First, there were striking differences between noun-noun strings, which were presumably parsed with noun-noun compound syntax, and noun-verb-*er* strings, which were presumably parsed with verbal compound syntax. Noun-noun strings were interpreted using the full range of available relationships (agentive, constitutive, formal, telic), while noun-verb-*er* strings were mainly interpreted with telic, verb-internal argument relationships. This pattern held for known and nonce head nouns in noun-noun strings and for known and nonce verbs in noun-verb-*er* strings, suggesting that this pattern was arising from the syntax, not lexical-item specific knowledge. Second, there were systematic differences in the way that noun-noun strings were interpreted based on their natural classes. Noun-noun strings with an artifact as the head noun were often interpreted as telic, while noun-noun strings with animate natural kind head nouns were almost never interpreted as telic. For example, *paper-scissors* was likely to be interpreted as scissors used to cut paper, while *paper-salamander* was unlikely to be interpreted with a functional connection between *paper* and *salamander*. These findings reflect previous findings by Downing (1977), Leonard (1985), and Štekauer (2005).

The second adult study examined adults' ability to assign either licit (internal argument) or illicit (adjunct) interpretations to verbal compounds. The results showed that adults overwhelmingly prefer internal argument readings of verbal compounds. Participants only allowed non-verb-internal argument readings when the verb did not require an object. Atelic verbs, which may lack lexically-realized internal arguments (Borer 1994), were more likely to lead to adjunct interpretations, such as a person who cleans using towels for *towel-cleaner*, than telic verbs and particle verbs, which both require lexically-realized internal arguments. For example, a *basket-carrier* (atelic) was more likely than a *towel-cleaner* (telic) to

allow an adjunct reading where *basket* was the instrument that did the carrying, rather than was the object that was carried.

Taken together, the results of the adult studies provide evidence that the compositional system that adults use to interpret compounds includes: (i) the syntax of compounds, (ii) the relationships made available by the lexical structure of the head noun, and (iii) the most salient lexical properties of particular nouns associated to particular natural classes.

The second half of this dissertation presented the results of five studies that examined children's production and interpretation of noun-noun compounds and verbal compounds. Children were predicted to behave exactly like adults, except in cases where systematic differences in syntactic or lexical semantic representations caused children to have different interpretations. The first series of studies, exploring children's production and interpretation of noun-noun compounds, examined how children use lexical semantic information in compounds. The second series of studies, exploring children's production and comprehension of verbal compounds, examined how children use syntactic information in compounds.

The first noun-noun compound study, a corpus study, compared children's production of novel noun-noun compounds to these compounds in their input based on the natural classes of the modifiers and heads and the relationship between them. The goal of this study was to provide evidence that children use the tendencies of natural classes, rather than specific items in the input, to produce novel compounds. The results showed just that. Children were matched to the input in terms of the distribution of relationships used at the natural class level, but not at the individual items level. Children also produced compounds composed of nouns that were not in their compound input, suggesting that templates are

not necessary for productive compound production. The findings of this study run counter to a claim that children use head-relationship templates for novel compounds (Krott et al. 2009).

The second noun-noun compound study, an elicited production task, examined children's production of novel compounds based on the relationships between the head and modifier. The goal of this study was to provide evidence that children produce noun-noun compounds for the same range of meanings as adults. The results showed that there were some relationships that children were more likely to produce noun-noun compounds for than others. For example, children were very likely to produce noun-noun compounds for shape, formal relationships, such as a *hand-chair* for a chair that is shaped like a hand, but much less likely to produce noun-noun compounds for creation, agentive compounds, such as a *rain-puddle* for a puddle created by rain. However, this pattern also held for adults. While adults produced more noun-noun compounds overall than children, the relationships for which they were less likely to produce noun-noun compounds patterned with the children.

The third, and final, noun-noun compound study, a forced-choice interpretation task, examined children's interpretation of noun-noun compounds given (i) the natural classes of the head and modifier and (ii) the permanence of the relationship between the head and modifier. The goal of this study was to provide evidence that children interpret compounds according to the tendencies of the natural classes of their constituents in the same way that adults do. The results showed that children had the same the interpretation as adults for each of the item types. Children were able to taking into account both natural class information and permanence information to arrive at different types of relationships for compounds that shared the same head noun. The findings ran counter to Krott et al.'s (2009) findings that children base their interpretations on previous head-relationship pairings

from the input; given that children were able to give adult-like interpretations for compounds with the same head noun, but different relationships, they must be using a more complex system than templates for interpretation.

To summarize the findings of the noun-noun compound studies, children were adult-like by all measures. Unlike proposals from previous authors (Krott et al. 2009), children did not rely on item-specific information to either produce or interpret novel noun-noun compounds. Moreover, children produced novel noun-noun compounds for the same range of relationships as adults, contra Hiramatsu et al. (2000).

Turning to the verbal compound studies, the first study, an elicited production task, examined children's knowledge of the verbal compound syntactic structure. The goal of this study was to create a baseline of syntactic knowledge for each child. The results replicated previous findings showing that children only produce a particular set of non-adult forms, *clean-towel* and *cleaner-towel*, but not *towel-clean* for *towel-cleaner*. As in previous research (Gamache and Schmitt to appear), I argued that these forms are reflective of steps in the adult derivation, and therefore carry with them all of the same syntactic constraints as the adult derivation.

The second verbal compound study, a forced-choice interpretation task, examined children interpretation of verbal compounds. The goal of the study was to provide evidence that children's interpretation of verbal compounds is determined by their knowledge of verbal compound syntax, as measured by their productions in the previous study. The results showed a coupling between syntactic knowledge and interpretation; children who were not able to produce any of the verbal compound structure freely allowed either internal argument or adjunct readings of the modifier in a verbal compound. On the other hand, children who showed knowledge of the verb and internal argument merging in their verbal

compound productions only allowed adult, internal argument interpretations of verbal compounds.

To summarize the findings of the verbal compound studies, children interpreted verbal compounds in an adult-like way insofar as their syntactic representations were adult-like. If children's production data showed that they had learned a particular step in the syntactic derivation, their interpretation reflected the constraints that had been built up to the step.

7.2 Conclusions

The findings of this dissertation have implications for both theoretical linguistics and language acquisition research. First, to speak to the theoretical implications, one finding of this dissertation is that speakers can arrive on common interpretations of compounds, even those that lack constraint from the syntax, in the absence of context. This runs counter to the claim that compound meanings are constructed completely based on context (e.g., Marchand 1966). This dissertation has demonstrated that there is sufficient information in the linguistic signal to find the most likely meaning of a compound, and sufficient flexibility in the structure of lexical items to account for the fact that a single compound can have multiple meanings.

Another finding relevant to both theoretical and child language research is the evidence from the child production data for the structure of verbal compounds. Contra previous proposals (Harley 2009, Borer 2012), the children's productions suggest that the verbal compound derivation proceeds as (i) merge verb and internal argument, (ii) merge *–er* in the structure, (iii) incorporate the verb into *–er* and (iv) move the internal argument to a specifier position above verb-*er*. This finding has implications for the field that go beyond the structure of verbal compounds. Children were shown to adhere to the principles of the

adult compound structures both in production and in interpretation, even before they have acquired the full derivation. This finding suggests that the strong continuity hypothesis in correct, at least in the domain of compounds, and data of this type can be treated more seriously as evidence for features of adult structures.

Finally, the finding that children use the same source of information for both their production and interpretation of compounds throughout development without recourse to item-specific information suggests that we need to reconsider theories built on the notion that children are completely dependent on the input. The finding that children are not dependent on the input, even in the interpretation of noun-noun compounds, which are extremely impoverished syntactically, suggests that in cases of rich syntactic structure, children do not rely on item-specific information.

APPENDICES

APPENDIX A. Full Compound List for Adult Study 1

Table 28. Full Compound List for Adult Study 1 by Head and Modifier Category

	Animate Head	Artifact Head	Human Head	Inanimate Head	Temporal Head	Nonce Head	Nonce-er Head	Verb-er Head
Animate Modifer	bunny-dolphin	bird-spoon	bee-criminal	camel-mud	camel-month	camel-dort	dog-bemainer	fish-builder
	dolphin-bunny	bird-telephone	bee-man	cat-lettuce	cat-mountain	cow-quait	dog-jender	fish-reader
	dolphin-lobster	bird-vacuum	bee-woman	chicken-banana	cow-mountain	frog-bretch	dog-lorcer	fish-tickler
	dolphin-mouse	bunny-bowl	bunny-lady	chicken-cherry	giraffe-beach	frog-hade	goat-fisser	horse-toucher
	horse-shark	deer-bowl	cat-author	chicken-milk	giraffe-bedroom	frog-zimit	lobster-lalker	lobster-eater
	lobster-dolphin	elephant-chair	deer-lady	cow-lettuce	giraffe-zoo	goat-quait	monkey-cheamer	mouse-eater
	mouse-dolphin	horse-chair	elephant-author	deer-mud	goat-mountain	lion-dresh	monkey-fleacher	owl-toucher
	pig-shark	mouse-bowl	hippo-lady	eagle-lava	hippo-month	lion-garve	monkey-ploser	sheep-toucher
	shark-horse	panda-box	pig-author	eagle-sand	puppy-breakfast	lion-gick	owl-fisser	snail-cleaner
	shark-pig	panda-coat	tiger-dentist	eagle-snow	puppy-dinner	owl-quait	sheep-fisser	snail-opener
	shark-sheep	panda-oven	tiger-musician	elephant-lettuce	puppy-year	snake-dort	snake-lalker	snail-thrower
	sheep-shark	pig-chair	tiger-toddler	hippo-mud	snake-month	turtle-dort	turtle-lalker	turtle-eater
Artifact Modifier	bowl-bunny	box-key	couch-criminal	airplane-rain	airplane-evening	airplane-dunt	blanket-mielder	box-driver
	bowl-deer	bus-cup	couch-mother	bed-lava	bicycle-castle	bicycle-glesh	broom-mielder	broom-driver
	bowl-mouse	bus-spoon	couch-woman	bed-lemon	blanket-castle	blanket-glesh	clock-cherver	car-baker
	box-panda	bus-vacuum	crib-boy	bed-snow	bottle-beach	broom-glesh	coat-mielder	car-builder
	chair-elephant	cup-bus	cup-pilot	bicycle-peach	bottle-lunch	clock-dunt	door-cherver	car-reader
	chair-horse	desk-key	desk-boy	crib-peach	bottle-zoo	comb-garve	shirt-jender	coat-driver
	chair-pig	key-box	oven-boy	cup-rain	clock-evening	comb-gick	shirt-lorcer	door-lover
	coat-panda	key-desk	radio-dentist	desk-peach	crib-castle	comb-mook	shirt-malker	refrigerator-cleaner
	oven-panda	key-oven	radio-lawyer	shoe-milk	soap-evening	diaper-bretch	table-cheamer	refrigerator-feeder
	spoon-bird	oven-key	radio-musician	shoe-water	truck-breakfast	diaper-hade	table-ploser	refrigerator-thrower
	telephone-bird	spoon-bus	soap-pilot	shoe-banana	truck-planet	diaper-masp	table-praster	telephone-lover
	vacuum-bird	vacuum-bus	spoon-pilot	soap-rain	truck-year	door-dunt	telephone-cherver	vacuum-lover

Table 28 (con't)

	Animate Head	Artifact Head	Human Head	Inanimate Head	Temporal Head	Nonce Head	Nonce-er Head	Verb-er Head
Human Modifier	author-cat author-elephant author-pig criminal-bee dentist-tiger lady-bunny lady-deer lady-hippo man-bee musician-tiger toddler-tiger woman-bee	boy-crib boy-desk boy-oven criminal-couch dentist-radio lawyer-radio mother-couch musician-radio pilot-cup pilot-soap pilot-spoon woman-couch	athlete-butcher athlete-criminal athlete-mother butcher-athlete criminal-athlete judge-poet lawyer-poet mother-athlete musician-poet poet-judge poet-lawyer poet-musician	butcher-apple coach-apple doctor-banana doctor-sun doctor-water judge-wind lawyer-wind mother-apple teacher-broccoli teacher-lemon teacher-snow uncle-wind	aunt-day butcher-forest child-beach child-circus child-lunch coach-forest judge-day nurse-breakfast nurse-planet nurse-school sister-forest uncle-day	accountant-bley aunt-bley coach-blump girl-cload girl-garve girl-mook politician-bretch politician-masp politician-zill sister-blump teenager-blump uncle-bley	accountant-pliver aunt-pliver baby-jender baby-malker baby-youcher chef-cheamer chef-ninker chef-praster man-heigner sister-heigner teenager-heigner toddler-pliver	accountant-biter dentist-biter man-finder soldier-baker soldier-reader soldier-rinser son-cleaner son-feeder son-puller teenager-finder toddler-biter woman-finder
Inanimate Modifier	banana-chicken cherry-chicken lava-eagle lettuce-cat lettuce-cow lettuce-elephant milk-chicken mud-camel mud-deer mud-hippo sand-eagle snow-eagle	banana-shoe lava-bed lemon-bed milk-shoe peach-bicycle peach-crib peach-desk rain-airplane rain-cup rain-soap snow-bed water-shoe	apple-butcher apple-coach apple-mother banana-doctor broccoli-teacher lemon-teacher snow-teacher sun-doctor water-doctor wind-judge wind-lawyer wind-uncle	broccoli-dirt carrot-rock carrot-sun carrot-water dirt-broccoli dirt-lemon dirt-raisin lemon-dirt raisin-dirt rock-carrot sun-carrot water-carrot	broccoli-party cucumber-house egg-planet egg-school egg-store fire-circus fire-lunch fire-morning grape-party raisin-party rock-house sun-house	cloud-cload cloud-mook cloud-zesh cucumber-blosh grape-hink mist-hink pea-brist pea-masp pea-zill raisin-hink rock-blosh stone-blosh	cherry-zainer cucumber-zainer flower-mainter flower-malker flower-youcher grape-shrapper mist-shrapper sand-shrapper stone-zainer tomato-ninker tomato-praster tomato-yolder	cherry-juggler lava-kicker milk-juggler mist-kicker potato-baker potato-drinker potato-rinser sand-kicker stone-juggler tree-feeder tree-puller tree-pusher

Table 28 (con't)

	Animate Head	Artifact Head	Human Head	Inanimate Head	Temporal Head	Nonce Head	Nonce-er Head	Verb-er Head
Locative/Temporal Modifer	beach-giraffe bedroom-giraffe breakfast-puppy dinner-puppy month-camel month-hippo month-snake mountain-cat mountain-cow mountain-goat year-puppy zoo-giraffe	beach-bottle breakfast-truck castle-bicycle castle-blanket castle-crib evening-airplane evening-clock evening-soap lunch-bottle planet-truck year-truck zoo-bottle	beach-child breakfast-nurse circus-child day-aunt day-judge day-uncle forest-butcher forest-coach forest-sister lunch-child planet-nurse school-nurse	circus-fire house-cucumber house-rock house-sun lunch-fire morning-fire party-broccoli party-grape party-raisin planet-egg school-egg store-egg	bathroom-winter circus-winter cottage-sky morning-winter school-sky sky-cottage sky-school sky-store store-sky winter-bathroom winter-circus winter-morning	afternoon-brind autumn-drign bathroom-drign city-brist city-drunt city-zill cottage-brind morning-drign store-brind weekend-cload weekend-hote weekend-zesh	afternoon-fanker autumn-mouter bathroom-mouter bedroom-mouter cottage-fanker dinner-fanker kitchen-ninker kitchen-troker kitchen-yolder summer-larter summer-mainter summer-youcher	autumn-hugger afternoon-helper bedroom-hugger dinner-helper night-hitter night-puller night-pusher ocean-drinker ocean-kisser ocean-rinser year-helper zoo-hugger
Nonce Modifier	bretch-frog dort-camel dort-snake dort-turtle dresh-lion garve-lion gick-lion hade-frog quait-cow quait-goat quait-owl zimit-frog	bretch-diaper dunt-airplane dunt-clock dunt-door garve-comb gick-comb glesh-bicycle glesh-blanket glesh-broom hade-diaper masp-diaper mook-comb	bley-accountant bley-aunt bley-uncle blump-coach blump-sister blump-teenager bretch-politician cload-girl garve-girl masp-politician mook-girl zill-politician	blosh-cucumber blosh-rock blosh-stone brist-pea cload-cloud hink-grape hink-mist hink-raisin masp-pea mook-cloud zesh-cloud zill-pea	brind-afternoon brind-cottage brind-store brist-city cload-weekend drign-autumn drign-bathroom drign-morning drunt-city hote-weekend zesh-weekend zill-city	brist-rond drunt-rond hote-pame pame-hote pame-quelt pame-zesh quelt-pame rond-brist rond-drunt rond-weach weach-rond zesh-pame	dresh-trider drunt-flader hote-trider klend-jeeder klend-larter klend-mainter luse-drosher luse-troker luse-yolder quelt-trider weach-flader zimit-flader	dresh-catcher faise-hitter faise-pusher faise-watcher gick-catcher hade-rider quelt-catcher weach-rider zimit-rider zove-climber zove-drinker zove-kisser

Table 28 (con't)

	Animate Head	**Artifact Head**	**Human Head**	**Inanimate Head**	**Temporal Head**	**Nonce Head**	**Nonce-er Head**	**Verb-er Head**
Nonce-er Modifier	bemainer-dog cheamer-monkey fisser-goat fisser-owl fisser-sheep fleacher-monkey jender-dog lalker-lobster lalker-snake lalker-turtle lorcer-dog ploser-monkey	cheamer-table cherver-clock cherver-door cherver-telephone jender-shirt lorcer-shirt malker-shirt mielder-blanket mielder-broom mielder-coat ploser-table praster-table	cheamer-chef heigner-man heigner-sister heigner-teenager jender-baby malker-baby ninker-chef pliver-accountant pliver-aunt pliver-toddler praster-chef youcher-baby	mainter-flower malker-flower ninker-tomato praster-tomato shrapper-grape shrapper-mist shrapper-sand yolder-tomato youcher-flower zainer-cherry zainer-cucumber zainer-stone	fanker-afternoon fanker-cottage fanker-dinner larter-summer mainter-summer mouter-autumn mouter-bathroom mouter-bedroom ninker-kitchen troker-kitchen yolder-kitchen youcher-summer	drosher-luse flader-drunt flader-weach flader-zimit jeeder-klend larter-klend mainter-klend trider-dresh trider-hote trider-quelt troker-luse yolder-luse	bemainer-shraller drosher-farker farker-drosher farker-fleacher farker-troker fleacher-farker jeeder-shraller larter-shraller shraller-bemainer shraller-jeeder shraller-larter troker-farker	bemainer-painter brenser-climber brenser-kisser brenser-tickler drosher-player fesker-hitter fesker-opener fesker-watcher fleacher-player jeeder-painter lorcer-painter ploser-player
Verb-er Modifier	builder-fish cleaner-snail eater-lobster eater-mouse eater-turtle opener-snail reader-fish thrower-snail tickler-fish toucher-horse toucher-owl toucher-sheep	baker-car builder-car cleaner-refrigerator driver-box driver-broom driver-coat feeder-refrigerator lover-door lover-telephone lover-vacuum reader-car thrower-refrigerator	baker-soldier biter-accountant biter-dentist biter-toddler cleaner-son feeder-son finder-man finder-teenager finder-woman puller-son reader-soldier rinser-soldier	baker-potato drinker-potato feeder-tree juggler-cherry juggler-milk juggler-stone kicker-lava kicker-mist kicker-sand puller-tree pusher-tree rinser-potato	drinker-ocean helper-afternoon helper-dinner helper-year hitter-night hugger-autumn hugger-bedroom hugger-zoo kisser-ocean puller-night pusher-night rinser-ocean	catcher-dresh catcher-gick catcher-quelt climber-zove drinker-zove hitter-faise kisser-zove pusher-faise rider-hade rider-weach rider-zimit watcher-faise	climber-brenser hitter-fesker kisser-brenser opener-fesker painter-bemainer painter-jeeder painter-lorcer player-drosher player-fleacher player-ploser tickler-brenser watcher-fesker	builder-washer climber-washer opener-wiper thrower-wiper tickler-washer washer-builder washer-climber washer-tickler watcher-wiper wiper-opener wiper-thrower wiper-watcher

APPENDIX B. Full Compound List for Corpus Study

Table 29. Compound List for Corpus Study by Speaker

Adam

air-man
air-plane-man
air-plane-part
air-plane-port
alphabet-box
animal-book
animal-car
animal-duck
apartment-house
apple-juice
apple-snake
army-gun
automobile-car
baby-chicken
baby-dog
baby-dragon-fly
baby-horse
baby-jesus
baby-mail-bag
baby-soup
baby-tulip
baby-whale-fish
barn-tree
barrel-man
base-ball-ball
base-ball-hat
base-ball-statue
base-man
beach-ball
bee-count
bird-dinner
birdie-house
bird-nest
bird-pie
bird-seed
boot-snow
bowel-movement
box-thing
boy-bath
boy-bath-tub
boy-bed
boy-bird
boy-fish
bunny-day
bus-man
butter-birdie
butter-fly-bug
butter-fly-program
button-hole
cage-house
cake-fork
camera-movie
car-mosquito
car-swing
car-truck
cat-cage
cat-car
cat-name
cereal-baby-soup
cheek-kiss
chick-egg
chicken-pox
children-shout
chocolate-syrup
choo-choo-train
choo-choo-train-cow-boy-hat
christmas-tree
church-party
circus-animal
circus-dan
circus-elephant
circus-ring
clown-thing
cocker-shell
color-egg
comb-hair
cotton-ball
country-box
cow-boy-coffee
cow-boy-fire-engine
cow-boy-holster
cow-boy-hoot
cow-boy-kangaroo
cow-boy-shirt
cow-boy-sock
cow-boy-train
crown-number
cry-baby
daddy-chicken
daddy-dragon
daddy-tiger
dance-time
Dan-circus
day-time-light
diesel-motor
dinosaur-baby
dirt-shovel
doctor-board
doctor-nothing
doctor-thing
dodge-thing
dog-baby
doggie-baby
doggie-house
dog-horse
dollar-book
door-apartment-house
dough-nut-pail
drain-hole
egg-noodle
egg-robin
elephant-foot
elephant-monkey
engineer-man
engine-truck
farm-house
fashion-car
fire-car
fire-chief
fire-chief-hat
fire-engine-boy
fire-hat
fish-flies
fish-fork
fluffer-nutter-day
freight-fire
gas-thing
gentle-man
giraffe-mosquito
glove-hand
graham-cracker
grocery-store-man
guitar-drum
gun-pen
halloween-church-party
head-ache
high-school
horse-dress
house-circus
ice-cone
ice-cream-horn
ice-cube
ink-finger
jeep-man
jello-pie
jet-air-plane
juice-cranberry
key-lock
king-hat
kitty-box
kitty-cat
koala-bear
lady-bug
lady-dinosaur
lady-elephant
library-school
locomotive-caboose
log-car
macaroni-cheese
magic-boy
mail-paper
man-texaco-star
mantle-shelf
marble-gun
marble-race
medicine-box
middle-shoe
milk-box
milk-glass
milk-pond
milk-tire
Mommy-dinosaur
mommy-tiger
morning-time
mountain-sea
mouse-house
neck-lace
news-paper
numbers-bet
nurse-hat
office-train
pan-cake
paper-ball
paper-thing
parking-place
peanut_butter-pickle
peanut-bug
peanut-butter-man
peanut-butter-peanut
peanut-butter-pickle-man
pencil-pen
pickle-pie
pie-boy
pie-turkey
pilot-thing
pin-cushion
pine-juice-apple
pirate-costume
play-check
play-ticket

Table 29 (con't)

police-gun	sand-shovel	steam-trailer	tennis-racket	trapeze-lion
police-song	santa-claus	stick-boy	tennis-thing	truck-game
polish-shoe	santa-claus-boy	stick-whale	time-lunch	truck-man
punch-man	school-church	stone-bug	tire-clock	truck-track
puppy-dog	sea-gull	stone-fence	toe-finger	truck-wheel
razor-toy	ship-hat	stream-line	tomato-juice	tuna-fish
record-box	snack-pop-corn	sugar-snack	tommy-spider	tv-camera
record-folder	snow-boot	sweep-broom	tooth-brush	vanilla-pie
rifle-gun	space-man	tail-bird	totem-pole	water-fountain-boy
rubber-band-band-aid	spices-cake	tail-part	toy-rhinoceros	water-queen
rubber-band-man	spider-book	tattoo-man	toy-train	whale-fish
sailor-man	spider-web	taxi-cab	tractor-puzzle	wind-mill-house
salad-meat	star-fish-animal	telephone-number	train-car	wind-shield-man
	station-wagon-wheel	telephone-pole	train-man	wood-friend
			trapeze-elephant	

Adam Input				
air-plane	back-yard	birth-day-time	car-train	cookie-dough
air-plane-movie	bag-car	boat-car	cave-man	cottage-cheese
air-port	baggage-car	boat-pie	center-pole	cough-drop
alphabet-basket	ball-player	boat-ship	chair-trick	country-doctor
animal-doctor	banana-song	Bob-fish	chimney-house	country-doctor-box
animal-man	band-aid	book-shelf	chocolate-hair	cow-boy
animal-skin	band-box	boston-university	chocolate-spray	cow-boy-bill
apple-cider	bar-bell	box-car	Christmas-present	cow-boy-book
army-man	bar-bell-set	boy-baby	Christmas-vacation	cow-boy-boot
art-gallery	barber-shop	boy-chair	church-hat	cow-boy-bunny
arts-festival	barn-yard	boy-house	church-music	cow-boy-hat
baby-barn	base-ball	boy-scout	cigarette-smoke	cow-boy-lady
baby-bear	base-ball-bat	bread-box	circus-man	cow-boy-rope
baby-boy	base-ball-player	breakfast-time	circus-parade	cow-boy-shale
baby-carriage	basket-ball	brief-case	circus-people	cow-girl
baby-chick	bath-room	brother-dinosaur	circus-train	cow-horse
baby-cow	bath-tub	bubble-gum	clothes-line	cracker-crumb
baby-doggie	bean-bag	buddy-cake	clothes-pin	cranberry-juice
baby-doll	bean-bean	bull-dozer-song	coal-bin	crayon-box
baby-dragon	bean-stalk	bullet-gun	cocoa-bean	cream-pitcher
baby-duck	beauty-salon	bunk-house	cocoa-marsh	cub-scout
baby-elephant	bee-hive	bunny-rabbit	coffee-can	cup-cake
baby-food	bird-carriage	butter-fly	coffee-cup	curtain-rod
baby-giraffe	bird-house	cake-knife	coffee-pot	dairy-farm
baby-lamb	birth-day	candle-stick	control-panel	dairy-products
baby-sitter	birth-day-cake	candy-cane		day-time
baby-whale	birth-day-party			

Table 29 (con't)

diaper-man
dick-tracy-car
diesel-locomotive
dinner-bell
dinner-time
doctor*dan
doctor-box
doctor-dan
doctor-kit
dodge-car
dog-cake
doggie-horse
dog-house
door-bell
dough-nut
dragon-fly
drum-stick
ear-ache
ear-phone
ear-phone-plug
easter-egg
egg-apple
egg-plant
egg-shape
extension-cord
eye-brow
face-cloth
farm-animal
farm-puzzle
farm-yard
farm-yard-truck
feather-brain
ferris-wheel
film-viewer
finger-fish
finger-nail
finger-paint
finger-print
fire-alarm
fire-department
fire-engine
fire-father
fire-hoop
fire-hydrant
fire-man
fire-place
fire-station
fire-truck
fish-cart
fish-fly
fish-house
fish-net
fish-school
flash-light
flower-pot
fluffer-nutter
fly-paper
foot-ball
foot-ball-game
footie-ballie
foot-print
fruit-basket
gas-station
gas-tank
ginger-ale
god-mother
grape-fruit
green-light
grocery-store
hair-pin
Halloween-parade
Halloween-party
Halloween-time
hand-kerchief
hard-ware
hard-ware-store
Harvard-shirt
Harvard-Square-bus
head-shake
heart-beat
house-bird
ice-berg
ice-cream
ice-cream-cake
ice-cream-cone
ice-cream-dessert
ice-vanilla
ice-vanilla-food
ink-pad
iron-fish
jelly-bean
jesus-knot
jingle-pole
kangaroo-house
key-case
key-chain
key-hole
kitchen-door
knight-book
license-number
light-time
lion-fish
lion-heart
lion-tamer
lip-stick
liquid-medicine
log-truck
lumber-company
lunch-time
magic-word
mail-bag
mail-box
mail-car
mail-man
marble-bag
marble-basket
marble-box
matching-game
meadow-pond
microphone-cord
milk-man
milk-truck
mommy-chicken
money-gravy
monkey-train
morning-supper
mother-kangaroo
motor-boat
motor-scooter
movie-camera
mud-pie
muffin-man
nail-file
neck-tie
news-cast
night-stick
night-time
note-book
numbers-bit
nursery-school
oat-meal
oat-meal-box
orange-juice
orange-seed
palm-tree
papa-bear
papa-dragon
paper-clip
paper-cup
paper-plunge
paper-punch
paper-sponge
paper-towel
peach-jam
peanut-butter
pet-shop
pickle-man
picnic-cake
pill-box
pillow-station
pine-apple
pine-apple-juice
pin-game
pin-wheel
plastic-bag
plastic-flower
pocket-book
police-car
police-man
police-thing
police-whistle
popeye-film
popeye-movie
popsicle-stick
post-man
post-office
power-shovel
president-kennedy
pumpkin-bird
pumpkin-candle
pumpkin-seed
puppet-show
question-mark
rail-road
rail-road-train
rail-road-truck
rain-coat
rain-hat
raisin-bran
rattle-snake
razor-blade
red-light
rein-deer
ring-master
roast-beef-chicken-flower
rocket-ship
rope-trick
rubber-band
rubber-tip
safety-book
safety-rule
sail-boat
sales-man
school-bus
school-children
school-room
science-museum
scissors-finger
scotch-tape
sea-amoeba
sea-creature
sea-green
sea-green-monster
sea-shell
sea-shore
seat-belt
see-saw
service-station
ship-air-plane
ship-boat

Table 29 (con't)

shoe-ball	station-wagon	sword-fish	toy-car	valentine-cookie
shoe-lace	steam-shovel	tagalong-man	toy-clock	vanilla-ice
shoe-polish	stocking-cap	tail-light	toy-company	vegetable-part
shoe-store	stone-fly	tank-car	toy-house	water-bug
side-walk	story-book	tank-truck	toy-snake	water-color
silver-ware	straw-berry	taxi-car	track-train	water-fountain
sky-dart	street-broom	tea-cake	train-track	water-hydrant
smoke-stack	street-car	tea-cup	train-whistle	water-juice
snow-ball	street-light	telegraph-key	trash-can	water-scorpion
snow-man	street-lights	telephone-company	trash-truck	water-show
snow-plow	sugar-dish	television-program	treasure-chest	water-tea
snow-suit	sugar-ice-cream	television-set	treasure-horse	week-end
snow-time	sugar-spoon	texaco-star	treasure-house	wheaties-box
soda-water	suit-case	tinkey-toy	tree-barn	wheel-barrow
space-boat	summer-time	toilet-seat	tree-top	wheel-barrow-horse
space-chart	sun-glasses	tomato-soup	tricycle-stick	white-wash
space-ship	sun-shine	tooth-paste	t-square	wind-mill
spice-cake	sun-suit	top-floor	tummy-ache	wind-shield
stamp-basket	supper-time	toy-box	turkey-pie	winter-time
stamp-pad	surprise-game		turtle-pie	x-ray
star-fish	swan-boat		tv-set	

Sarah

animal-book	diamond-ring	halloween-something	mommy-girl	sugar-plum
apple-ear	doll-blanket	hand-cream	monkey-ear	sugar-snap
apple-sun	donkey-face	hand-kerchief	motor-cycle	sugar-wheat
baby-bath	duck-house	hand-kerchief-clothes	mountain-rock	tea-cup
baby-feet	duck-sponge	home-work	night-night-pillow	teddy-bear-bear
baby-kangaroo	easter-bow	house-tree-top	note-book	telephone-book
baby-rattle	eye-glasses	indian-thing	peanut-lollipop-door	thumb-nail
baby-swing	eye-lash	iron-board	phone-book	tiger-hair
ball-game	fairy-god-mother	jelly-bean	piano-chord	tooth-ache
beauty-parlor	finger-polish	lady-leg	poodle-swing	toy-bike
bubble-game	fire-man-department	lollipop-door	powder-thing	toy-boat
bunny-rabbit	fishie-water	magazine-beach	puppet-show	tree-top
cart-wheel	flower-house	mary-poppins-record	root-beer	valentine-doll
cat-monster	god-mother	meat-ball	rope-thing	valentine-watch
chocolate-kind	hair-pin	mike-shake	school-pencil	wall-paper
clothes-line	halloween-candy		soap-powder	water-sled
cuckoo-clock	halloween-hat			water-thing
dance-school				

Sarah Input

abc-book	after-noon	air-plane	alarm-clock	animal-cracker

Table 29 (con't)

animal-farm
anirmal-farm-house
apple-eye
apple-juice
apple-pie
apple-teeth
ash-tray
automobile-accident
baby-book
baby-brother
baby-butter-cup
baby-carriage
baby-chair
baby-clothes
baby-doll
baby-monkey
baby-pillow
baby-powder
baby-rabbit
baby-talk
baby-toy
back-yard
ball-pole
ballet-shoe
bamboo-plate
banana-finger
band-aid
barber-shop
base-ball
basket-ball
bath-robe
bath-room
bath-room-kitchen
beach-ball
beach-chair
beach-house
bed-room
bed-time
bed-time-story
belly-ache
belly-button
belt-buckle
bermuda-shorts
bible-song
bird-house
bird-party
birdie-house
birth-day-cake
birth-day-party
birth-day-present
birth-day-record
birth-day-shorts
Bobby-doll
bogey-man
book-department
boy-chickie
bubble-bath
bubble-gum
bulk-head
bunny-bee
bunny-sticker
butter-cup
butter-finger
butter-fly
cake-pan
candy-bar
candy-cane
candy-desk
card-board
carriage-robe
carrot-candle
cash-register
child-thought
china-children
china-man
chocolate-candy
chocolate-chip
chocolate-cookie
chocolate-chip-cookie
chrismas-tree
christmas-bell
christmas-card
christmas-dress
christmas-egg
christmas-eve
christmas-play
christmas-present
christmas-song
christmas-time
christmas-tree
city-child
cocoa-crispies
cocoa-pop
cocoa-puff
coffee-cake
coffee-pot
collection-box
comic-book
comic-strip
conversation-piece
corn-flake
cotton-tail
cow-boy
cow-girl
cow-boy-Bill
cream-soda
cross-bone
crown-princess
cub-scout
cub-scout-party
cuckoo-nut
cup-board
cup-cake
dance-costume
dance-recital
day-light
day-time
dish-pan
dish-towel
dog-baby
dog-food
dog-house
dog-pretzel
doggie-bank
doll-carriage
doll-house
donald-duck-soup
door-bell
door-prize
door-prize-cake
dough-nut
dust-pan
ear-drum
ear-muff
ear-muffs
ear-plug
ear-ring
easter-basket
easter-bunny
easter-card
easter-egg
easter-time
eater-card
egg-shell
emergency-button
extension-cord
eye-brow
face-cloth
fan-club
farm-animal
farm-house
ferris-wheel
field-trip
finger-nail
fink-test
fire-department
fire-engine
fire-house
fire-man
fire-truck
fish-bowl
fish-head
foot-stool
fruit-loop
garden-set
gas-station
gilligan's-island-tree
girl-chickie
girl-friend
globe-santa
grape-tonic
halloween-party
hand-ball
hand-grenade
hand-lotion
hand-lotion-powder
hat-box
head-band
heart-attack
heart-failure
heir-loom
honey-bee
honey-comb
honey-moon
house-key
house-wife
house-work
human-being
ice-box
ice-cream
ice-cube
ice-skate
ice-cream-jimmies
indian-tent
jelly-jar
jewelry-box
jingle-bell
kitchen-table
kitty-cat
lady-bug
lamp-shade
light-house
lip-stick
liver-pill
lunch-bag
macaroni-salad
mail-box
mail-man
man-meal
mary-poppins-doll
mass-noun
mayonnaise-sandwich
medicine-cabinet
milk-man
mink-stole

Table 29 (con't)

mirror-image
monster-apple
monster-picture
movie-picture
nail-polish
nick-name
noon-time
nose-powder
nurse-baby
nursery-rhyme
nursery-school
oat-meal
orange-cake
orange-juice
pan-cake
paper-boy
paper-doll
peanut-butter
peanut-door
peanut-lollipop
peanut-butter-sandwich
peg-board
peg-game
penny-bank
pepper-mint
pet-department
pet-shop
phone-call
picture-book
pie-plate
pig-farm
pig-sty
pig-tail
pigeon-coop
piggie-back
piggie-bank
piggie-box
pine-apple
play-dough
play-ground-apple
pocket-book
police-man
pony-express
pony-tail
poodle-dress
post-office
pot-luck
potato-chip
potato-salad
poultry-farm
powder-puff
preschool-kid
princess-telephone
pussy-cat
pussy-dog
rabbit-people
raisin-bran
rein-deer
roof-thing
sail-boat
salad-roll
sand-box
sand-man
sand-shark
santa-claus-puzzle
savings-bond
scooter-doll
Scooter-suit-case
septic-tank
shower-curtain
snow-man
space-ship
sport-jacket
sticker-bur
sticker-bur-bush
straw-berry
street-corner
sugar-baby
sugar-bear
sugar-bowl
sugar-daddy
sugar-pop
suit-case
summer-squash
summer-time
sun-apple
sun-burn
sun-glasses
sun-suit
sweet-heart
table-cloth
table-cover
tea-bag
tea-party
tea-pot
tea-spoon
teddy-bear
telephone-call
telephone-car
telephone-conversation
telephone-pole
thanksgiving-dinner
toe-nail
toe-shoe
tooth-brush
tooth-paste
tootsie-roll
toy-box
toy-department
toy-party
toy-piano
train-track
tree-light
tummy-ache
tuna-fish
tuna-fish-ice-cream
tv-desk
vanity-table
variety-store
watch-band
week-end

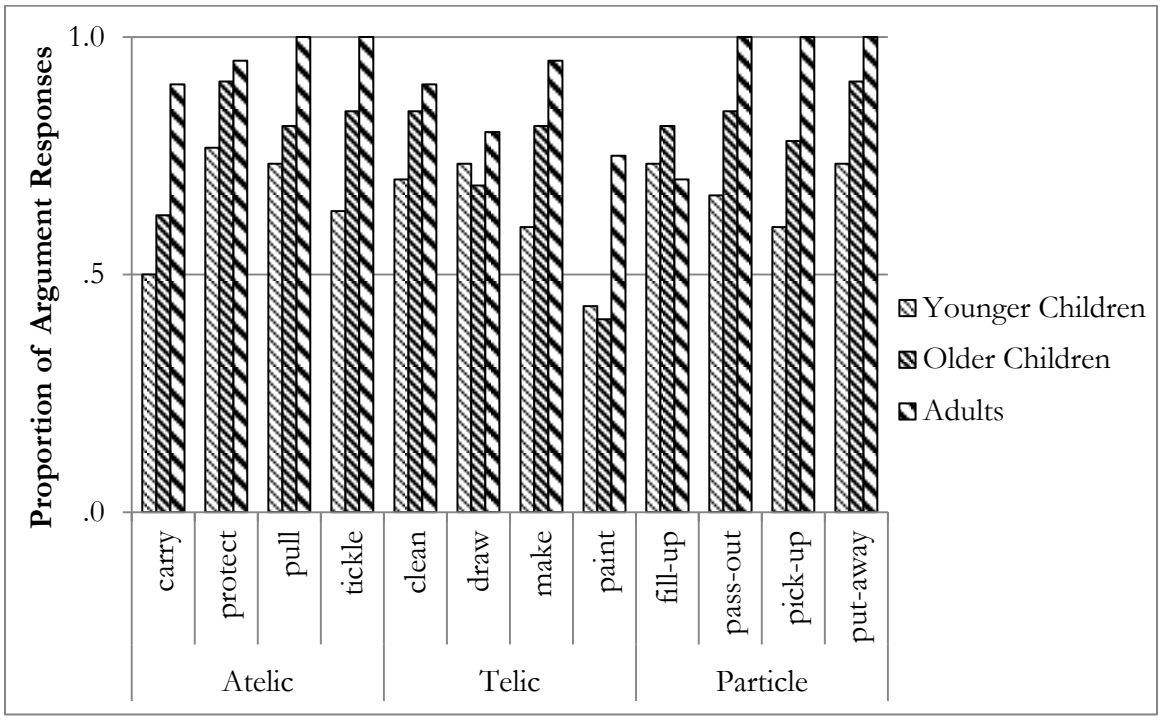
APPENDIX C. Production Forms for VC Elicited Production Task

Table 30. VC Production: Counts for All Production Forms By Age Group

Form	Example	Younger Children	Older Children	Adults	Total
OV*er*	*table-cleaner*	33	86	145	**264**
V*er*	*cleaner*	17	25	3	**45**
NN	*table-girl*	13	19	12	**44**
Noun	*girl*	24	6	9	**39**
Phrasal	*a girl who cleans tables*	15	15	3	**33**
No Response	---	10	9	0	**19**
VO	*clean-table*	15	0	0	**15**
MV*er*	*girl-cleaner*	2	9	0	**11**
VPO	*clean-up-table*	8	2	0	**10**
OV*er*P*er*	*table-cleaner-upper*	1	0	6	**7**
V*er*O	*cleaner-table*	2	5	0	**7**
V*er*O*er*	*cleaner-tabler*	4	2	0	**6**
OVP*er*	*table-clean-upper*	0	4	1	**5**
VOM	*clean-table-girl*	1	3	0	**4**
VPOM	*clean-up-table-girl*	2	2	0	**4**
V*er*M	*cleaner-girl*	2	2	0	**4**
V*er*OM	*cleaner-table-girl*	3	0	0	**3**
VP*er*	*clean-upper*	3	0	0	**3**
V*ing*M	*cleaning-girl*	2	1	0	**3**
MOV*er*	*girl-table-cleaner*	1	0	1	**2**
VPM	*clean-up-girl*	0	2	0	**2**
OV	*table-clean*	1	1	0	**2**
OV*er*M	*table-cleaner-girl*	0	1	0	**1**
VO*er*	*clean-tabler*	1	0	0	**1**
MV*er*O	*girl-cleaner-table*	0	1	0	**1**
V*er*P*er*	*cleaner-upper*	0	1	0	**1**
V*er*P	*cleaner-up*	0	1	0	**1**
VM	*clean-girl*	1	0	0	**1**
V*ing*OM	*cleaning-table-girl*	0	1	0	**1**
V*ing*O	*cleaning-table*	1	0	0	**1**

APPENDIX D. Responses by Verb for Child Verbal Compound Interpretation Study

Figure 35. VC Interpretation: Proportion of Argument Responses by Individual Verb



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