WHERE LINGUISTICS MEETS PSYCHOLOGY: CAN TALMY'S CATEGORIES OF MOTION EVENTS EXPLAIN HOW CHILDREN LEARN VERBS?

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ABSTRACT

This dissertation uses Talmy's linguistic analysis to evaluate the Typological Prevalence Hypothesis – the idea that concepts that are consistently lexicalized across languages are *easier to learn* than less-consistently-lexicalized concepts, especially for young language learners (Gentner & Bowerman, 2009). We predicted that, for 2-year-olds, who have just begun verb acquisition, mapping a novel verb onto its referent should be easiest for categories that are consistently represented in the world's verb systems (PATH of motion), followed by less consistently-represented concepts (MANNER of motion), and then concepts that are never represented (COLOR of an actor) (Research Question 1). We also evaluated whether this mapping pattern was predicted by age (Research Question 2) or individual differences in vocabulary levels (Research Question 3).

Largely confirming our prediction, 2-year-olds were better at mapping verbs for PATH and MANNER than COLOR. Thus, at the early stage of verb acquisition, children are already equipped with basic knowledge of what verbs should encode. Later into development, 4-year-olds showed the language-specific verb-to-MANNER bias. Further, adults were most likely to associate a novel verb with MANNER, followed by PATH, and then COLOR, exactly mirroring the way the English verb system encodes motion events. Individual differences in language skills predicted the verb learning patterns in adults but not in children. Taken together, this dissertation provides an important step towards

understanding how the semantic organization of language may relate to the process of verb acquisition.

TABLE OF CONTENTS

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LIST OF TABLES

Table Page

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Language plays a powerful and critical role in how humans think, remember, and communicate (Hirsh-Pasek & Golinkoff, 2003). The world's languages share considerable similarities and hence are mutually translatable (e.g., Jakobson, 1959). Thus, any language allows its speakers to discuss a variety of topics ranging from tonight's dinner to quantum physics. Despite universal commonalities, however, languages are not "neutral coding systems of an objective reality" (Slobin, 1996, p. 91). Each language uniquely segments a spatially and temporally continuous flow of thoughts and events into discrete units in order to label them (e.g., Fisher & Gleitman, 2002; Gleitman & Papafragou, 2013, in press; Golinkoff & Hirsh-Pasek, 2008; Papafragou, 2007).

If language does not encode everything we process, it is imperative that we understand how language carves up the world, and how young language learners figure out the specific ways in which their native language imposes categories. At birth, an infant presumably has no knowledge about the semantic organization of the particular language she is going to learn. For every word she hears, there are infinite possible meanings. How can she start learning words? Young word learners are faced with the same dilemma as was the foreign linguist who was desperately trying to figure out the meaning of the unknown word "*gavagai*" in Quine's famous thought problem (Quine, 1960, 1969). This problem of the "word-to-world mapping" has been one of the central questions in our understanding of early language development (Bloom, 2000; Gentner, 1982; Gleitman, 1990; Gleitman, Cassidy, Papafragou, Nappa, & Trueswell, 2005; Golinkoff & Hirsh-Pasek, 2008; Graham & Vukatana, 2014; Smith, 2000; Tomasello, 1995).

Historically, the investigation of the word-to-world mapping problem has primarily focused on how children learn nouns, or names for objects. However, language conveys much more than object names. Language expresses a wide range of phenomena, including how and where dynamic actions and events occur. Further, words are bound together in sentences, constrained by verbs which lie at the fulcrum of the sentence. Thus, in the past few decades, verb acquisition has become a window for understanding the word mapping process (Hirsh-Pasek & Golinkoff, 2006). This dissertation examines the role of language in the word-to-world mapping problem by focusing on verb learning. More specifically, we evaluate the possibility that young children can learn verbs partially because the semantic organization of language reflects the natural ways in which humans perceive the world. This work also adopts a developmental approach, asking whether the ways in which children map word to world varies with exposure to their native tongue. As such, this dissertation offers unique insights into the relation between the organization of language and the human mind.

Why Verbs?

Verbs are the architectural centerpieces of sentences or the "building blocks of grammar" (Roseberry, Hirsh-Pasek, & Golinkoff, 2014, p.958). It is the verb (e.g., chase) that connects arguments (e.g., Peter, dog) to create propositions through sentences (e.g., Peter chases a dog). Without verbs, relations among arguments – be they objects or participants – cannot be specified (Fisher, Hall, Rakowitz, & Gleitman, 1994; Göksun, Hirsh-Pasek, & Golinkoff, 2010).

This functional significance of verbs alone makes research on verb acquisition critical and fascinating, but the main reason verbs are the best example for studying the word-to-world mapping is that the lexicalization patterns of verbs are *not* transparent and vary widely across languages, and thus verbs are “hard words” (Gleitman et al., 2005). Whereas nouns predominantly label discrete objects, verbs highlight one or more features within a *continuous* stream of motion (e.g., Gentner, 1982; Hirsh-Pasek & Golinkoff, 2006; Talmy, 1985). Theoretically, the labeling patterns of relational terms, such as verbs and prepositions, should vary more across languages than those of nouns because relational terms are constructed by language whereas nouns are more likely to be “given by the world” (Gentner & Boroditsky, 2001, p. 217; see also Gentner, 1981, 1982; Gleitman et al., 2005; Snedeker & Gleitman, 2004). Confirming this theoretical perspective, recent empirical studies demonstrate large cross-linguistic variability in what relational terms label (Majid, Jordan, & Dunn, 2015; Malt, Ameel, Imai, Gennari, Saji, & Majid, 2014; see also Malt, Gennari, Imai, Ameel, Saji, & Majid, 2015). Making verb learning even more challenging, the referent of a verb, such as an action or motion, is often transient and changes dynamically (Golinkoff, Jacquet, Hirsh-Pasek, & Nandakumar, 1996; Hirsh-Pasek & Golinkoff, 2006).

The cognitive linguist Leonard Talmy (2000) recognized the complexity in the verb system and offered a descriptive analysis of how motion is expressed across the world’s languages. Talmy compiled a list of individual though related semantic components and illustrated how those components are conflated into verbs and other relational lexical items across languages. Talmy never discussed the psychological reality of these semantic components nor claimed that they constitute an exhaustive list. Nevertheless, his list can and has provided an anchor point for the investigation of the word-to-world mapping in verbs and, as such, early language development (Golinkoff & Hirsh-Pasek, 2008; Göksun, et al., 2010; Hirsh-Pasek & Golinkoff, 2006).

Talmy's Typology

In an attempt to better understand the inherent structure of motion verbs and their relationship to events, Talmy conducted an extensive typological analysis, which later became the gold standard for language research in the field of developmental psychology and many other disciplines (Talmy, 1972, 1985, 1991, 2000; see also Jackendoff, 1983, 1990; Lakoff, 1987; Langacker, 1987; Pinker, 1989). Talmy (2000) suggested that all languages contain semantic elements such as PATH, i.e., the trajectory of motion in relation to a ground object, and MANNER, i.e., how motion is carried out, that are mapped onto surface lexical elements like verbs and prepositions, based on language-specific rules. For example, when describing a scene with a bottle floating in the ocean and moving into a cave, English speakers may say "the bottle floated into the cave," marking the PATH in the preposition "into" and the MANNER in the verb "float." In contrast, as in example (1) below, speakers of Spanish mark the PATH in the verb ("entró") and leave the MANNER in the optional constituent ("flotando").

(1)	*La botella*	*entró*	*a*	*la*	*cueva*	(*flotando*)
	the bottle	entered	to	the	cave	(floating)
	"The bottle entered the cave"					

This difference in motion encoding patterns appears because English and Spanish are two different types of language according to Talmy's classification. This classification is based on how PATH, or the "core schema" of motion, is linked to lexical items. Languages such as Spanish, for example, are dubbed verb-framed languages or V-languages because their main verbs typically encode PATH. In contrast, languages like English fall into what Talmy called the satellite-framed languages or S-languages because they encode PATH in satellites of the main verbs, such as particles and prepositional phrases. In S-languages, verbs are more likely to encode MANNER than PATH.

Interestingly, though PATH and MANNER are both essential semantic elements in motion, the relative prominence of PATH over MANNER has been suggested. Not only are PATH verbs (e.g., enter) abundant across languages, but PATH is marked in satellites, even when it is not encoded in the verb itself (e.g., "The bottle floated *into* the cave"; see also Slobin, 2006). When we consider all syntactic elements in a verb complex (i.e., verbs and satellites), speakers of an S-language actually express PATH with greater frequency than MANNER (Emerson, Özçalışkan, & Frishkoff, 2015; Emerson, Özçalışkan, Frishkoff, & Romay-Fernández, 2012; see also Gennari, Sloman, Malt, & Fitch, 2002). Thus, regardless of the language one speaks, PATH of motion is encoded in the verb complex. Most importantly, although speakers of S-languages tend to use fewer PATH verbs than do speakers of V-languages, S-languages still have expressions that correspond to PATH verbs in V-languages. For example, in English there are PATH verbs such as "enter," "exit," "ascend," and "descend." In other words, PATHs of motion are consistently and similarly represented across the world's languages.

Table 1.
Estimated number of V- and S-languages.

Name of language/language family	Estimated number of languages
V-languages	
Romance languages	44
Semitic languages	79
Polynesian languages	37
Nez Perce	1
Caddo	1
Japanese	1
Korean	1
Turkic languages	41
Tamil	1
Bantu languages	537
Mayan[1]	31
Basque	1
Greek	1
American and Netherlands signed languages + other signed languages	> 2
S-languages	
Indo-European languages except Romance languages[2]	401
Finno-Ugric languages	32
Chinese	14
Ojibwa	1
Warlpiri	1

Note. This list was compiled based on research by Talmy and others (Slobin, 2003; Slobin, 2013; Slobin & Hoiting, 1994; Talmy, 2000; Trueswell & Papafragou, 2010) whereas the number of languages in each language family was estimated based on Ethnologue Languages of the World (Lewis, Simons, & Fennig, 2016, https://www.ethnologue.com/).

MANNER of motion, on the other hand, may be more auxiliary and is often unmarked in languages (Emerson et al., 2015). Many MANNER verbs in S-languages seem to have no parallel expressions in V-languages. For example, English has many different verbs to describe the act of jumping, including hop, skip, jump, leap, bound, bounce, pop, bob, vault, and spring, whereas Spanish has only three words, *brincar* "jump/hop," *saltar*

[1] "Most Mayan" (Talmy, 1991, p. 486) or "Some branches of Mayan" (Talmy, 2000, p. 222)
[2] "All branches of Indo-European languages except (post-Latin) Romance" (Talmy, 1985, p. 62) or "most Indo-European minus Romance" (Talmy, 2000, p. 222)

"jump/skip/leap," and *botar* "bounce," to express variations in jumping (Emerson et al., 2015; see also Malt et al., 2014). Further, even when MANNER can be expressed with the use of adverbial and subordinate clauses, MANNER information is often omitted in V-languages as in the case of "flotando" (see example (1) above; Gennari et al., 2002, Naigles, Eisenberg, Kako, Highter, & McGraw, 1998; Özçalışkan, 2004, 2005; Özçalışkan & Slobin, 2003; Slobin, 2004).

The saliency of PATH over MANNER can also be discussed at a broader level, with regards to the number of V-languages and S-languages that exist in the world. According to research by Talmy (2000) and others, there appear to be more V-languages than S-languages (see Slobin, 2003 for Turkic languages; Trueswell & Papafragou, 2010 for Greek; Slobin, 2003 for Basque; and Slobin, 2003, Slobin & Hoiting, 1994, and Slobin, 2013 for American Sign Language (ASL) and other sign languages), in terms of both the number of individual languages and the number of language families[3] (see Table 1). Thus, at both the level of expressions within each language as well as the level of languages and language families, PATH appears to be marked more consistently and frequently than MANNER.

A bounty of psycholinguistic research has examined the linguistic encoding of PATH and MANNER (e.g., Berman & Slobin, 1994; Maguire et al., 2010; Naigles et al.,

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[3] However, these estimates must be interpreted with caution because (1) there is a possibility that fewer attempts have been made to discover S-languages compared to V-languages as most psycholinguistic studies use English as an example of an S-language; (2) there has been disagreement about whether some of the languages listed as V-languages here are truly V-languages (see Brown, 2004 for the case of Tzeltal, Soroli, 2011, 2012 for the case of Greek, and Ibarretxe-Antuñano, 2015 for the case of Basque); and (3) the distinction between V-languages and S-languages is no longer seen as clear-cut as was originally theorized (Beavers, 2008, Croft, Barðdal, Hollmann, Sotirova, & Taoka, 2010; Maguire et al., 2010; Matsumoto, 1996; Naigles & Terrazas, 1998; Pavlenko & Volynsky, 2015; Slobin, 2006).

1998; Naigles & Terrazas, 1998; Ozyurek & Kita, 1999; Papafragou, Massey, & Gleitman, 2002; Slobin, 2003); however, another important aspect of Talmy's analysis has been largely ignored: semantic components of motion that are *not* marked in any language. His examples include color of an actor, symmetry of an actor, relation to comparable events (i.e., whether an action has occurred alone, or in addition to/in place of another comparable event; e.g., the distinction between the sentences "he only danced," "he also danced," and "he danced instead"), and site deixis (i.e., the location of an event's occurrence with respect to the speaker or hearer; e.g., the distinction between the adverbs "here" and "there"). For example, COLOR of an actor is not marked in verbs or satellites of verbs in the world's languages *despite* its perceptual salience (e.g., Pitchford & Mullen, 2001). Most languages have color names (e.g., red) and even verbs that mark colors (e.g., redden); however, in describing motion events, COLOR information never appears in the verb complex.

In this dissertation, we use a partial list of Talmy's semantic categories – PATH, MANNER, and COLOR – to drive our understanding of how the organization of language may or may not reflect the organization of the language-learning mind. Talmy's typology offers a potential window into how children learn mappings from word to world and how this mapping process might become attuned to their native language over time. This dissertation addresses the following three questions. The first concerns the psychological reality of Talmy's semantic categories in young children who have just started to learn verbs. In particular, we examined whether it is easier for 2-year-olds to learn verbs for semantic constructs that are prevalent in the world (PATH) than verbs for constructs that are represented less consistently (MANNER) or not represented at all (COLOR). The second question focuses on developmental changes in verb learning biases. As Bowerman and Levinson (2001) so eloquently put it, one of the central questions for developmental psychologists is how “children from an initially equivalent base, end up controlling often very differently structured languages” (p. 10). To this end, we assessed developmental changes in how individuals map a novel verb onto PATH, MANNER, and COLOR, by testing 2-year-olds, 4-year-olds, and adults. Finally, our last question asks whether individual differences in language skills predict how children and adults learn the mappings between verbs and PATH, MANNER, or COLOR. Below, we discuss the motivation behind each of the research questions, the gaps between the current state of the literature and the research objectives, and how this dissertation fills these gaps.

Research Question 1: Talmy’s Categories in 2-year-olds

Talmy provides an extensive and informative discussion of how the world’s languages conflate concepts into verbs. However, his analysis is a descriptive linguistic analysis, and does not address how children and adults *learn* the mappings between verbs and their meanings. The Typological Prevalence Hypothesis by Gentner and Bowerman (2009), on the other hand, moves the theory into the psychological space and guides an examination of verb learning using Talmy’s semantic categories.

Typological Prevalence Hypothesis

The Typological Prevalence Hypothesis suggests that young children are able to learn words because semantic categories found across languages are largely constrained by *how we naturally perceive and think of the world* (Gentner & Bowerman, 2009; see also Slobin, 1985). Patterns of semantic categorization and conflation found consistently across the world's languages are hypothesized to be more “natural” or easily recognizable for us.

Gentner and Bowerman further argued that *the naturalness of concepts determines the ease of learning corresponding labels* (see also George, Konishi, Hirsh-Pasek, & Golinkoff, 2014).

Gentner and Bowerman (2009) empirically evaluated the Typological Prevalence Hypothesis by studying static spatial relational prepositions. English and Dutch both distinguish between support/ON relations (e.g., cup on table) and containment/IN relations (e.g., apple in bowl). However, the two languages differ in how they treat different kinds of ON relations. In English, cup on table, picture on wall, and ribbon on candle are all described using the preposition "on" whereas in Dutch the three spatial relations are denoted by the different prepositions, "op," "aan," and "om," respectively. In this study, English- and Dutch-speaking children saw various spatial relations between two objects (e.g., mirror and wall) that can be explained using prepositional phrases in both English and Dutch (e.g., mirror on wall). Children were prompted to state the location of a specified object. As the English style of partitioning – one overarching category for all ON relations – is more common across languages, Gentner and Bowerman predicted that the English term "on" is easier to learn than the Dutch counterparts, "op," "om," and "aan" (see Figure 1 for examples of how different languages partition the ON-IN continuum).

Confirming the prediction, English learners correctly used the term "on" at a much younger age than Dutch learners correctly used their three terms (op, om, and aan). The conclusion, therefore, was that more widely lexicalized relations are acquired sooner than less frequent relations, as the Typological Prevalence Hypothesis predicted (see also Beekhuizen, Fazly, & Stevenson, 2014).

Limitations of the Previous Research

Though Gentner and Bowerman's findings are interesting, several concerns and limitations must be addressed to critically evaluate the generalizability of their claim. Below, we list three of these concerns and argue that extending and expanding Gentner and Bowerman's (2009) preposition study to test Talmy's semantic elements in dynamic motion might eliminate these concerns while also deepening our understanding of word learning.

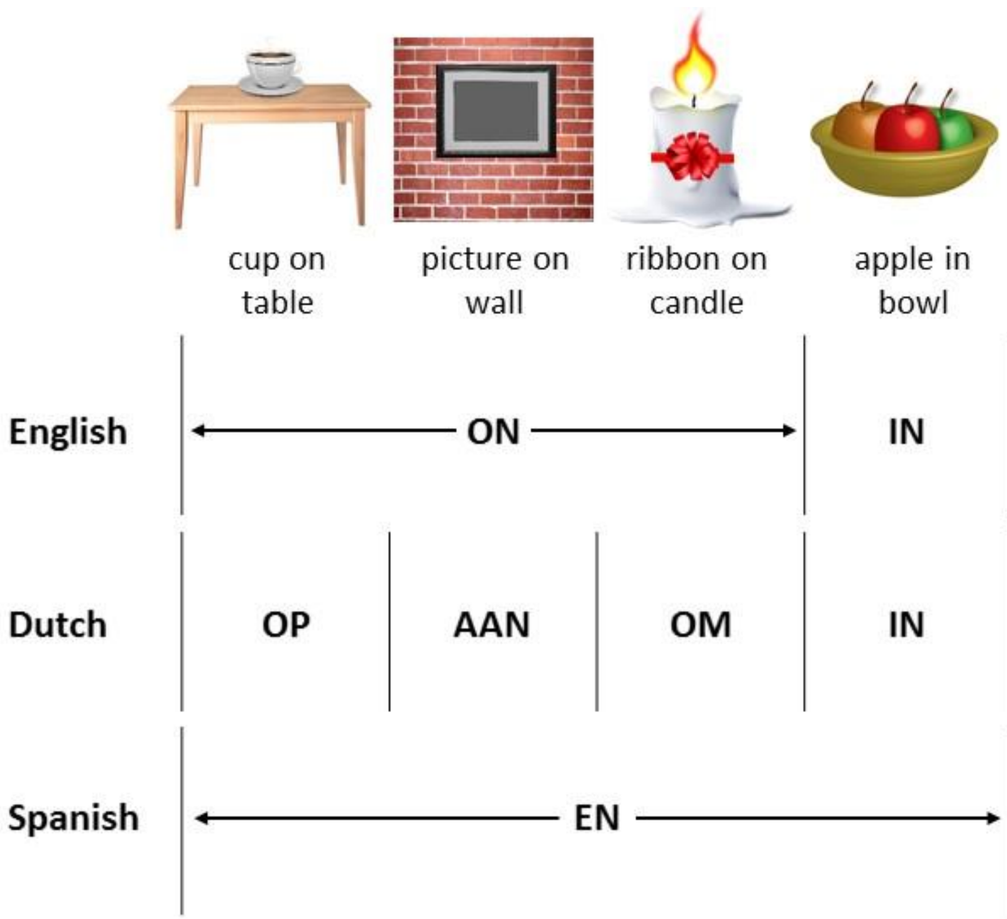


Figure 1. Schematic image of cross-linguistic differences in how spatial relations containment and support are lexicalized across languages (created based on Gentner & Bowerman, 2009).

First, Gentner and Bowerman (2009) only tested static relations represented with a limited number of closed-class words (i.e., prepositions). Talmy's semantic categories allow us to evaluate the Typological Prevalence Hypothesis at a broader level of generalizability. Whereas Gentner and Bowerman examined an individual word, Talmy's classification allows us to test the hypothesis at the level of the *category*, or cluster of words (e.g., PATH, MANNER). This dissertation thus asks whether the Typological Prevalence Hypothesis explains the acquisition of individual closed-class words only or can be applied to categories of open-class words like motion verbs. Recent research on language and thought also seems to suggest that the category-level analysis is a better approach because conceptual categories (as measured through a non-linguistic sorting task) align better with categories or clusters of words than with individual words (Holmes & Wolff, 2013; Malt et al., 2014; see also Malt, Sloman, Gennari, Shi, & Wang, 1999; Munnich, Landau, & Dosher, 2001). For example, Malt et al. (2014) asked speakers of English, Dutch, Spanish, and Japanese to either label a variety of human locomotive actions (e.g., jogging, walking, and skipping) or sort them based on physical similarity. Labeling patterns largely aligned with sorting patterns at the level of cluster, with all languages respecting the similarity clusters determined by the sorting task. At the level of individual words, however, cross-linguistic variability in labeling patterns was apparent, most notably in the number of labels used to describe the actions.

Second, Gentner and Bowerman's (2009) Dutch prepositions "op," "om," and "aan" are subcategories of the English preposition "on." Their results favoring the English categorization over the Dutch categorization may simply be a reflection of children's general preference for semantically broader categories. It is possible that children learned "on" better than "op," "om," or "aan" because more inclusive concepts are easier to learn than narrower concepts. Relatedly, Gentner and Bowerman's study is essentially a *correlational* study that tested the vocabulary children learned in natural settings, outside of the lab. English-speaking children may have heard “on” more frequently than Dutch-speaking children heard any one of “op,” “aan,” and “om.” Perhaps the young Dutch-speaking children in their study did not know the three ON categories because they did not hear those prepositions frequently enough. The present study eliminates the possible confounds caused by the broad vs. narrow distinction by testing semantic categories (PATH, MANNER, and COLOR) that are independent of each other. We also avoid the possible confound of the difference in frequency of exposure by teaching novel words.

Finally and importantly, Gentner and Bowerman (2009) never tested concepts that are *not* marked in any language. This dissertation evaluates the Typological Prevalence Hypothesis as well as the psychological reality of Talmy’s categories to a fuller extent, as it tests not only the concepts that are lexicalized frequently across languages (PATH and MANNER) but also a concept that is not lexicalized in the verb system of any language (COLOR).

The Case of Path, Manner, and Color

We hypothesized that, as suggested by the Typological Prevalence Hypothesis, the lexicalization patterns found across languages reflect the natural ways in which humans conceptualize dynamic events. As such, young children who have just started to learn verbs are expected to have an easier time associating a verb with PATH of motion than MANNER of motion because PATH is more consistently represented across languages than MANNER.

The saliency of PATH over MANNER has been suggested in the infant literature. Data from Mandler (1991, 1992, 2004, 2012) argues that the saliency of PATH in young infants reflects its privileged status as a *conceptual primitive,* serving as a foundation for the conceptual development of motion (see also Pruden & Hirsh-Pasek, 2006; Pruden, Göksun, Roseberry, Hirsh-Pasek, & Golinkoff, 2012). This argument also appears rational from an evolutionary perspective. For example, when encountering a predator, noting the predator's PATH of motion (e.g., moving towards s vs. away) may increase the survival rate more than noting its MANNER (e.g., walking vs. jumping).

Research by Maguire et al. (2010) also supports this prediction. In their study, English-, Japanese-, and Spanish-reared 2-year-olds were first familiarized to an animated clip of the starfish "Starry" performing an action in a particular MANNER (e.g., jumping jacks) and along a particular PATH (e.g., around a reference object) paired with a nonsense verb (e.g., *hirshing*). They were then presented with a PATH-match option (familiarized PATH + novel MANNER) and a MANNER-match option (familiarized MANNER + novel PATH). The study found that 2-year-olds in all language groups had a PATH bias, uniformly assuming that a novel verb referred to the PATH of motion.

The adult literature also suggests that PATH may be more prevalent than MANNER in word learning contexts. Emerson and colleagues explored how English- and Spanish-speaking adults learned an association between a novel word and PATH or MANNER of motion by studying how well adults remember meanings of action verbs (Emerson, 2013; Emerson et al., 2015; Emerson, Özçalışkan, Frishkoff, & Romay-Fernández, 2012). Emerson et al. found that, regardless of which language participants spoke, it was easier for them to learn and retain PATH verbs than MANNER verbs (Emerson, 2013; Emerson et al., 2012; Emerson et al., 2015).

In sum, previous research seems to suggest that learning labels is easier for PATH than MANNER of motion. With regards to a feature that is not marked in any verb, COLOR, predictions are harder to make. Infants as young as 4 months of age are able to perceive basic color categories such as red and blue (Bornstein, Kessen, & Weiskopf, 1976). Though infants and children are very aware of basic colors tested in the study, they may not pay much attention to color or other characteristics of actors or objects in general when they are nested in dynamic events. Perhaps when language learners are watching a dynamic event and learning a novel verb, their attention is allocated differently, such that the actor in the scene becomes schematized as what Landau and Jackendoff (1993) referred to as a simple "lump" or "blob." In fact, Xu and Carey (1996) found that 10-month-olds ignored the characteristics of objects in motion and regarded them as "general objects." However, it has also been reported that young children may be sensitive to characteristics of an actor, and they seemed to experience difficulty extending a verb to the same action carried out by a different actor (see Forbes & Poulin-Dubois, 1997 for an example of a live action study using human actors; and Kersten & Smith, 2002 for an example of a study with animated characters in different shapes; but see Imai, Haryu, & Okada, 2005 for the case of 3-year-olds). Nevertheless, if Talmy's analysis of semantic categories reflects how children naturally perceive the world, 2-year-olds should struggle to associate a verb with COLOR.

Research Question 2: Developmental Changes in Verb Learning Biases

Once we establish how 2-year-olds, who have just started learning verbs, associate a verb with its referent, the next question is: How do the patterns of verb learning change across development? Though prior research on this question is limited, some studies have investigated developmental changes in how children and adults generalize the meaning of a novel verb.

Maguire et al. (2010) examined not only 2-year-olds but also preschoolers and adults to capture developmental change. The study found that, by age 3 and beyond, children's way of mapping words onto meanings reflected language-specific patterns of verb lexicalization such that English-speaking children were more likely to map a novel verb onto the MANNER of the motion than Japanese- and Spanish-speaking children. Spanish-speaking preschoolers showed a MANNER bias, which was unexpected for speakers of a V-language; nevertheless, adult Spanish speakers showed a PATH bias as predicted by the patterns found in their native language.

A study by Hohenstein (2005), however, suggests that the language-specific bias may still be developing at age 3. English- and Spanish-speaking children at 3.5 and 7 years of age learned a novel verb (e.g., *kradding* in English and *mecando* in Spanish) embedded in either a PATH frame sentence (e.g., "She's *kradding* the tree" in English or "Ella está *mecando* al árbol" in Spanish) or a MANNER frame sentence (e.g., "She's *kradding* towards the tree" in English or "Ella está *mecando* hacia el árbol" in Spanish) as they viewed a live-action video of a motion event (e.g., a woman skipping toward a tree). When children were asked to choose the referent of the learned verb from two options (one depicting the familiar PATH and the other depicting the familiar MANNER), 3-year-olds preferred videos matching the sentence frame, regardless of the language they spoke. Seven-year-olds, on the other hand, showed sensitivity to the sentence frame as well as the features that verbs typically encode in their native language. As such, Spanish-speaking 7-year-olds chose the familiar PATH option more often than did their English-speaking peers.

Taken together, these studies suggest that before age 3, there may be a universal pattern such that learning verb-referent associations is easier for PATH verbs than for MANNER verbs (Maguire et al., 2010). By age 3, children become more familiar with their native language and show sensitivity to the typological patterns in that language (Maguire et al., 2010) although their sensitivity may still be developing (Hohenstein, 2005; Maguire et al., 2010). Based on these data, we predict that the English-speaking 4-year-olds in the present study will show a MANNER bias and that this bias will be even stronger for adults (but see Emerson et al., 2015). With regards to COLOR, we hypothesize that participants in all age groups will experience difficulty associating novel verbs with COLOR because both the universal and language-specific verb learning biases suggest that COLOR should not be the referent of a verb.

Research Question 3: Individual Differences in Verb Learning Biases

Though most studies cited so far compared children's performance across different chronological ages, some suggest that, even within the same age group, children with high language skills develop language-specific biases more quickly than their less advanced peers (Choi, 2006; Göksun, 2010; Pulverman, Golinkoff, Hirsh-Pasek, & Sootsman Buresh, 2008). Pulverman et al. (2008) found that among 14- to 17-month-old English-reared infants, those with larger vocabularies paid more attention to MANNER changes than to PATH changes, mirroring the typological patterns found in their native language. Spanish-reared infants with low vocabularies attended more to MANNER than their high-vocabulary counterparts, further confirming the link between vocabulary size and language-specific biases. Similarly, Choi (2006) examined the spatial relations containment and support and found that English-reared infants with larger vocabularies, as compared to their less advanced peers, were less likely to notice whether two objects were fitting tightly or loosely – spatial relations that are denoted by two separate verbs in Korean but not English. Thus, the infants' sensitivity to a distinction that was not relevant in their mother tongue appeared to be dampened with language experience (see Göksun, 2010 for similar results).

Based on these data, we predict that language plays an important role in directing children's attention to specific features of motion events that are most relevant in their mother tongues. Children with larger vocabularies must have encountered and processed more language than their less advanced peers, and hence they should be more aware of the lexicalization patterns found in their native language. As stated earlier, all children were expected to show a MANNER bias by age 4. Here, we predict that even 2-year-olds with larger vocabularies may already show a MANNER bias. We further speculate that 4-year-olds may show a stronger MANNER bias when they have large vocabularies.

Hypotheses

If Talmy's semantic categories represent the ways in which children perceive dynamic events in a verb learning context, then concepts that are more consistently realized in the verb systems (PATH) should be relatively easy to grasp and to learn labels for, compared to other concepts that are less consistently (MANNER) or never realized (COLOR) in verbs. Further, language experience, as manifested in chronological age or individual differences in language skills, may predict the verb learning biases such that older individuals or individuals with advanced language skills may have a stronger language-specific bias (i.e., MANNER bias).

CHAPTER 2

METHODOLOGY

This dissertation uses Talmy's semantic categories – PATH, MANNER, and COLOR – to evaluate three questions. The first question asked whether it is easier to learn labels for concepts that are represented consistently across the world's verb systems as compared to less consistently represented concepts. Following the first question, the second and third questions examined whether developmental changes or individual differences in language skills predict changes in the verb learning pattern. As described below, the same Verb Learning Task was conducted across three age groups to capture the developmental trajectory of verb learning biases. Vocabulary tests were included to measure individual differences. All experimental protocols reviewed in the following sections were approved by the Temple University Institutional Review Board.

Participants

Two-year-olds, 4-year-olds, and adults participated in the present study. The sample size for each of the three groups was determined based on power analyses and counterbalancing of stimuli. For 2- and 4-year-olds, the same number of males and females were recruited as young children's language abilities sometimes show gender differences (e.g., Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; but see Hyde & Linn, 1988) although the differences seem to disappear during childhood (Wallentin, 2009). However, adult participants were largely convenience samples and consisted primarily of females (N = 48; 43 females). All child participants were from upper-middle-class households in the suburbs of a northeastern city in the US. The majority of the study sample was White

Caucasian (83.33% of the 2-year-olds were White, 8.75% were multiracial, and the ethnic background of the remaining 4.17% was not provided by their parents. All 4-year-olds were White. 58.33% of the adult participants were White, 35.42% were Black, 2.08% were Asian, and 4.17% were multiracial).

2-year-olds

Forty-eight 2-year-olds participated in the study (*Mean age* = 32.60 months; *SD* = 1.93; 26 females). Participants had no known vision or hearing impairments nor first-degree relatives (parents or siblings) with color blindness. There is no standard measure to diagnose color blindness in young children. Thus, we followed previous research (Kaldy & Blaser, 2009; Kaldy & Blaser, 2013) and used information about first-degree relatives to exclude children at risk of being color blind. Seven additional children were also tested, but were excluded from the analysis as they did not finish the task. All children were full-term and were from monolingual English-speaking households.

4-year-olds

Forty-eight 4-year-olds participated in the study (*Mean age* = 55.33 months; *SD* = 3.28; 21 females). Participants had no known vision or hearing impairments nor first-degree relatives with color blindness. Two additional children were also tested, but were excluded from analysis as they did not finish the task. All children were from monolingual English-speaking households.

Adults

Forty-eight English-speaking adults participated in the study (*Mean age* = 20.50 years; *SD* = 3.85; 43 females). All participants were undergraduate or graduate students at

Temple University, and they were offered research credit for their participation. Participants were monolingual speakers of English with no vision or hearing impairments. There were two participants who had first-degree relatives with color blindness; however, these adult participants were not excluded from the analysis because the participants self-reported that they themselves had no color blindness.

Stimuli

Verb Learning Task

Animations based on those of Maguire et al. (2010) were created using Strata 3Dpro 3.9 (see Pulverman, 2005 for the original installation of the animations; see also Emerson et al., 2015; Pruden et al., 2012; Pruden, Roseberry, Göksun, Hirsh-Pasek, & Golinkoff, 2013; Pulverman, Hirsh-Pasek, Golinkoff, Pruden, & Salkind, 2006; Pulverman et al., 2008 for works using similar stimuli). In these studies, a starfish character named Starry performed

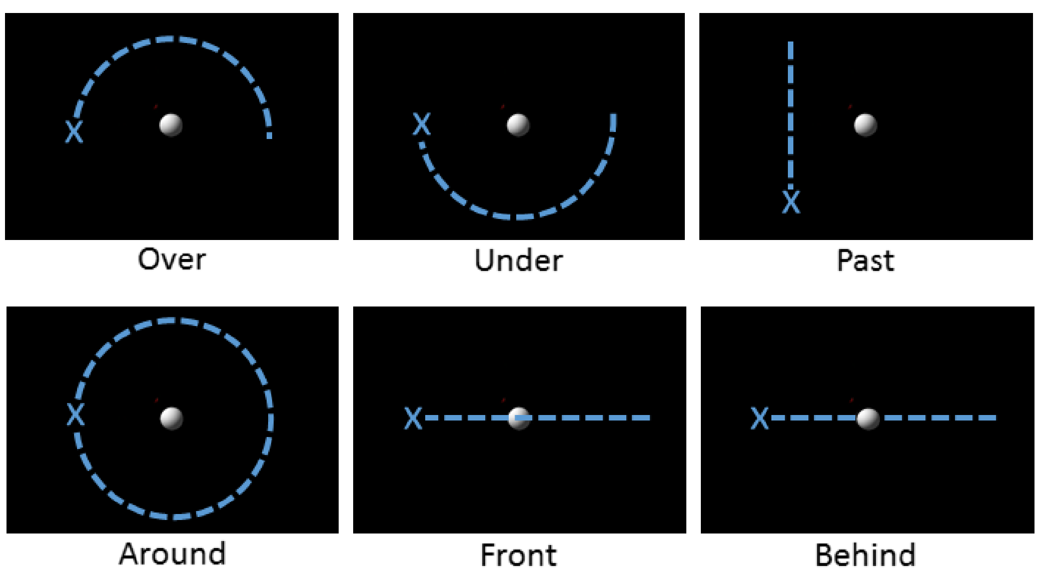


Figure 2. Six PATHs tested in this study. The X depicts the starting and ending point for each of the six PATHS.

various actions (see Figures 2 and 3 for examples). As depicted in Table 2, all animations showed a white sphere in the center as a reference object, and Starry moved around the reference object. Starry was used in the present study to portray PATH, MANNER and COLOR.

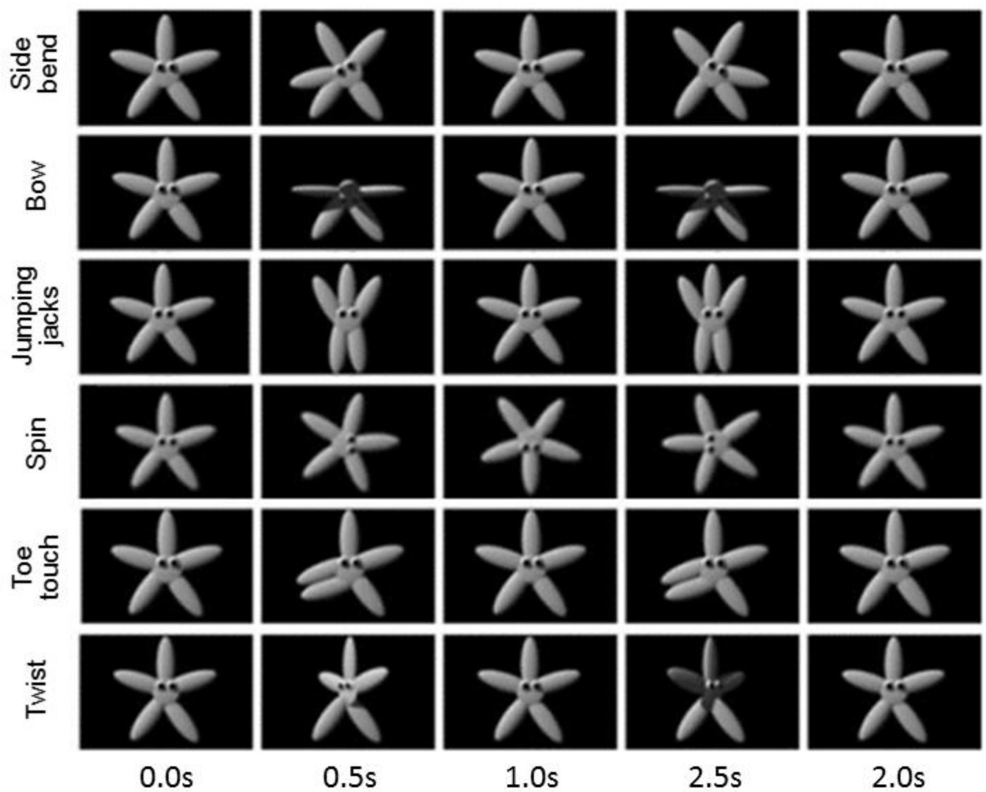


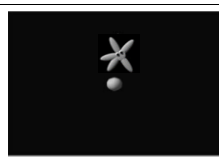
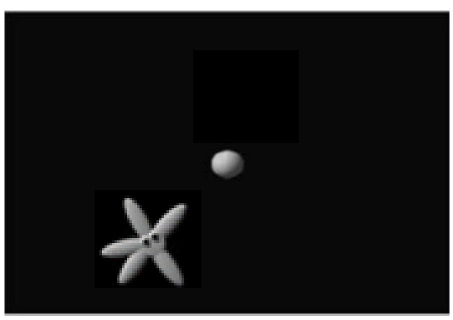
Figure 3. Six MANNERs tested in this study. Each of the six MANNERs are shown here as static pictures on a 2s timescale, though they were presented as dynamic events in the study.

Six PATHs (over, under, past, around, front, and behind), six MANNERs (bow, jumping jacks, spin, toe touch, twist, and side bend), and six COLORs (red, green, blue, yellow, purple, and orange) were selected as potential features to be used in the main studies (see Figure 2 for PATHs and Figure 3 for MANNERs). Whereas all PATHs and MANNERs had been used in previous studies (e.g., Pruden et al., 2012), COLORs were selected based on developmental literature on color names and consultation with an expert

(M. Banks, personal communication, September 24, 2015). Children as young as 2 should be able to distinguish the selected six shades (e.g., Wagner, Dobkins & Barner, 2013; the RGB coordinates of the six colors used in the study were [255, 0, 0] for red, [0, 255, 0] for green, [0, 0, 255] for blue, [255, 255, 0] for yellow, [127, 0, 127] for purple, and [255, 128, 0] for orange).

First, every possible combination of the three referent types (PATH, MANNER, and COLOR) was animated. Then, based on the stimulus selection study described below, we selected a final set of stimuli consisting of 60 animations (36 animations for the training phase and 12 pairs of animations for the test phase; Appendix A).

Table 2.
Experimental design used by Maguire et al. (2010)

Phase	Visual Stimuli	Auditory Stimuli
Salience	 	Look up here! What's Starry doing? What's going on up here?
Training		Look Starry's *blicking*! Do you see Starry *blicking*? Watch Starry *blicking*!
Test	 	Where's Starry *blicking*? Do you see Starry *blicking*? Point to Starry *blicking*!

Saliency of Stimuli

One major concern about testing multiple attributes or dimensions (e.g., PATH, MANNER, and COLOR) in the same experiment is that there is no straightforward way to compare participants' performance across attributes (e.g., Kaldy & Blaser, 2009). For example, if the child learns a verb for one kind of PATH, e.g., *below*, but fails to learn a verb for a kind of MANNER, e.g., *jumping jacks*, does that mean that she is better at learning PATH verbs than MANNER verbs? What if the particular PATH we chose to use was perceptually more salient than the particular MANNER we chose to use? Researchers must ensure that perceptual (or conceptual) saliency of particular items is not driving the observed group-level effect.

Previous studies have used a variety of methods to deal with this issue. Many took a "post-test" approach in which saliency of stimuli was taken into account after the study was conducted. For example, testing infants and young children in a preferential looking paradigm, Maguire et al. (2010) and others included a "salience phase" at the beginning of the experiment (e.g., Pruden et al., 2012; Pruden et al., 2013; Pulverman et al., 2006; Pulverman et al., 2008; Roseberry et al., 2014). In the salience phase, children watched the pair of animated clips that were later used in the test phase of the same experiment, but without a prompt to find the referent of the learned word (see Table 2). The looking time data from the salience phase and the following test phase were compared against each other on the assumption that, if the child looked longer at one of the two animations when prompted to look for the referent of the novel verb (the test phase) than when they simply watched the animations without the prompt (the salience phase), the child must have chosen that option as the referent of the verb (see also Emerson et al., 2015 for another example of the post-test approach). "Pre-test" approaches are also common in these kinds of tasks.

Turning to the object identification literature with infants, Kaldy and Blaser (2009) conducted a separate stimulus selection study prior to their main experiment to ensure that the test items used in the main experiment were similar in saliency across the attributes they compared (color, shape, and luminance).

Both pre- and post-test approaches to evaluating stimulus saliency are valuable for determining whether a child's initial looking in a study can be attributed to the experimental manipulation, or whether saliency cannot be ruled out as an alternative explanation. However, while saliency often influences a child's first look in a preferential looking paradigm, it is unlikely to influence a response in a pointing paradigm because, in a pointing paradigm, children can look at the two options for as long as they like before choosing one option, and it does not matter which option they look at first (Maguire et al., 2010). Importantly, even Maguire et al. (2010) who included a salience phase for young children tested in a preferential looking paradigm, did not evaluate the effects of saliency for older children and adults tested in a pointing paradigm (see Hehenstein, 2005 for another example of a looking time study that did not include a salience phase).

The present study tested young children and adults in a pointing paradigm, as recent research suggests that children as young as 2 years old are able to point (e.g., Bannard & Tomasello, 2012). The pointing paradigm should obviate the need for saliency testing, and previous research has established that infants and children are able to distinguish the particular PATHs, MANNERs, and COLORs used in this study; however, we chose to take extra caution and used both pre- and post-test approaches to ensure that differences in stimulus saliency across attributes (PATH, MANNER, COLOR) or any other item-specific confounds would not drive group-level effects. The pre-test stimulus selection study ensured that no specific trial was easier than any other. The post-test regression analysis including by-item random effects ensured that the effect of referent types (PATH, MANNER, and COLOR) was not driven by specific test items. The details of the pre-test stimulus selection process are described in the following section, and the post-test statistical analysis is described in the Data Analysis section at the end of this chapter.

Stimulus Selection

The stimulus selection study was conducted to compile the 12 pairs of animations (four for each of PATH, MANNER, and COLOR) that would be used in the test phase of the Verb Learning Task. Our main aim here was to ensure that all trials in the Verb Learning Task were comparable with each other in their difficulty. Previous research has established that even young infants can identify the particular exemplars of PATH, MANNER, and COLOR tested here (e.g., Bornstein et al., 1976; Pruden, 2007; Pulverman & Golinkoff, 2004); however, a given trial can also become too easy (or too difficult) if the two options given at the test phase differ drastically in their perceptual saliency. In other words, children may show high accuracy on the trial if the invariant they were trained with in the training phase is much more salient than the incorrect option (i.e., distracter) presented in the test phase. To avoid this issue, we identified pairs of equally-salient exemplars (e.g., *front* and *under*) within each of the three referent types (see Figure 4). Importantly, however, the pairs of animations used in the test phase of the Verb Learning Task differed not only in the target attribute (e.g., PATH) but also in the other two attributes (e.g., MANNER and COLOR; see the Design section for more detail of the task design). Therefore, we selected pairs of animations that contained equally-salient exemplars for each of the three attributes. For example, if *front* and *under* (PATH), *jumping jacks* and *spin* (MANNER), and *red* and *yellow* (COLOR) were identified as equally-salient pairs, they could be combined into a pair of animations for a test trial: one animation containing *front*, *jumping jacks*, *red* and the other containing *under*, *spin*, and *yellow*.

A group of English-reared 2-year-olds participated in the stimulus selection process. The youngest age group, 2-year-olds, was targeted here because young children have a tendency to associate a novel word with a perceptually salient feature in their visual input (Pruden, Hirsh-Pasek, Golinkoff, & Hennon, 2006). The final set of data consisted of 14 2-year-olds (*Mean age* = 28.49 months; *SD* = 3.32; 7 females). An additional 3 children came to the lab for participation but were not tested as they were not willing to sit in front of the screen.

Following Kaldy and Blaser (2009), children were presented with two animations that differed in only one of the three attributes (PATH, MANNER, or COLOR; e.g., a red Starry moving *in front of* the reference object while performing jumping jacks vs. a red Starry moving *under* the reference object while performing jumping jacks). During the presentation of animations, child-friendly instrumental music was played. Before each pair of animations, the fixation point "+" was presented with an attention getter sound (i.e., sound of a baby laughing). In addition, whenever children appeared to stop looking at the screen, an additional attention getter (e.g., picture of Elmo and a laughing sound) was presented on the screen before the fixation point for the next pair of animations was presented.

The six exemplars of each referent type (PATH, MANNER, or COLOR) give 15 possible pairings within each referent type, for a total of 45 exemplar pairs. Each of the 45 pairs of exemplars was to appear multiple times throughout the experiment, each time randomly combined with different exemplars from the two non-targeted attributes. We, however, expected many children to lose attention before watching all animation pairs. Thus, instead of presenting all possible animations in a random order we divided animations into blocks consisting of 36 pairs of animations to ensure that we would at least have saliency data for the 36 pairs of animations in the first block. In fact, most children watched animations from the first block only. On average, each child watched 32.25 animations (*SD* = 5.59). Thus the test animations for the Verb Learning Task were created based on the data from the first block only.

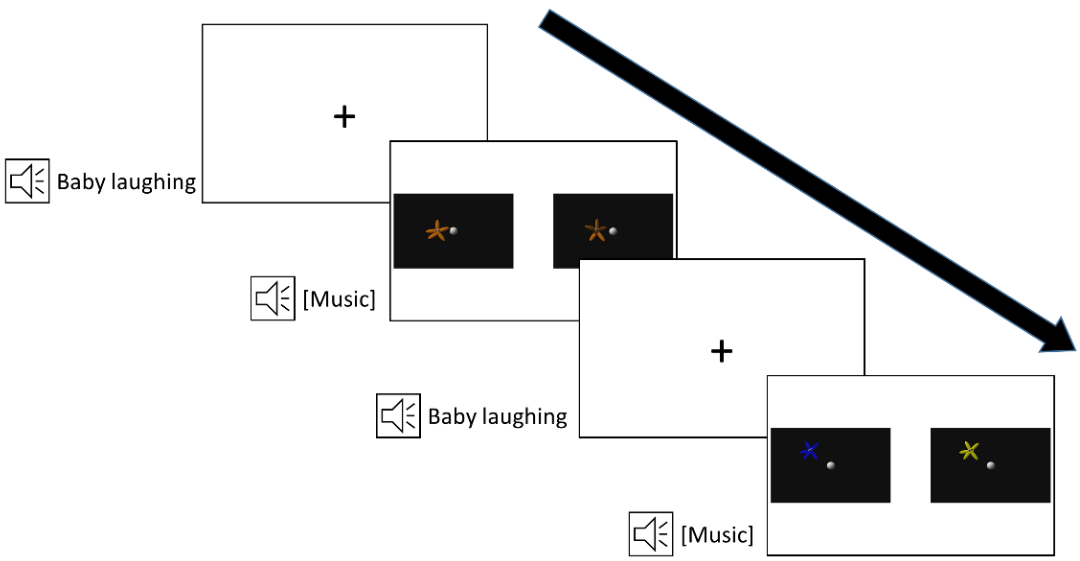


Figure 4. Schematic image of how the stimulus selection study proceeded. This image shows a trial testing MANNER (toe touch vs. bend down) followed by a trial testing COLOR (blue vs. yellow). The fixation point was presented for 3 seconds accompanied by the sound of a baby laughing. Each animation pair was presented with music and lasted for 6 seconds.

A Tobii X60 was used to measure looking time. The eye tracker positioned in front of the computer screen emitted the infrared towards participants' retinas, and sensed the reflection of the infrared to determine the direction of eye gaze. As eye structure varies across individuals, the algorithms to determine the direction of eye gaze were calibrated for each participant at the beginning of the experiment. In the calibration process, participants watched a red dot moving around on the screen. For each pair of animations, the amount of time participants looked at each of the two animations was calculated and compared using independent *t*-tests. As described earlier, the final set of animations used in the test phase of the Verb Learning Task was constructed by combining pairs of items that did not significantly differ in looking time (see Appendix B for statistics for the final set of test animations used in the Verb Learning Task).

Additional Assessments

In addition to the main experiment (Verb Learning Task), two assessments were included in the study. These additional assessments were completed by the parents of the child participants and by the adult participants themselves.

Background Questionnaire

A short background questionnaire was created to collect demographic information including participants' birth date and gender (Appendices C and D). For exclusionary purposes, the questionnaire also asked about vision and hearing impairments, color blindness in first-degree relatives, and experience with languages other than English. No participant had any of these issues, and thus no one was excluded based on their responses on the background questionnaire. Among the adult participants, two reported having a first-degree relative with color blindness; however, they were themselves not colorblind, and therefore were not excluded from the study.

Vocabulary Test

Two different measures were used to assess participants' vocabulary levels. For the adults and 4-year-olds, vocabulary was measured using the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 2007; Figure 5). For the 2-year-olds, the toddler version of the MacArthur Communicative Development Inventory (MCDI; Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994; Appendix E) was used. Although the MCDI and PPVT differ in the words tested and the ways they are administered, the two tests are theorized to be equivalent at the construct level, both reliably measuring vocabulary levels of children.

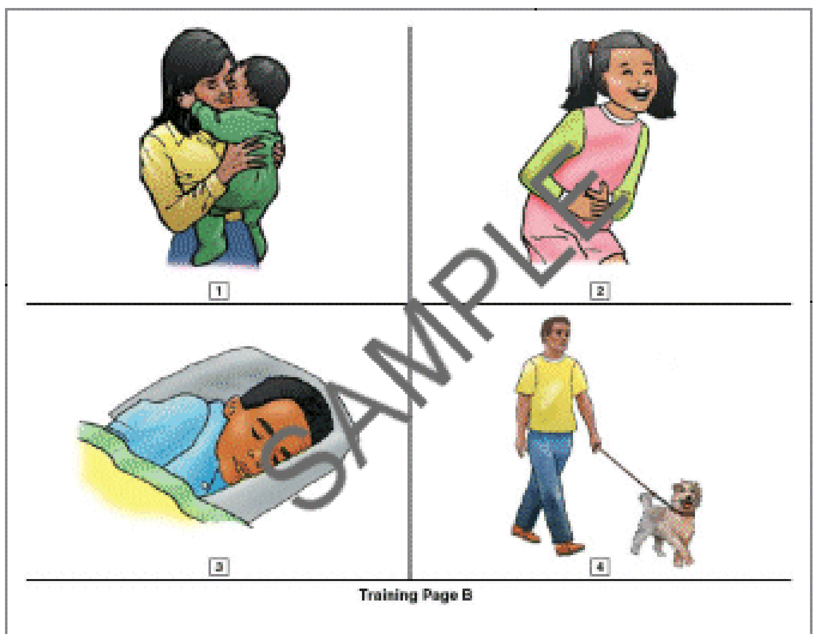


Figure 5. Sample question from the Peabody Picture Vocabulary Test (PPVT). Participants chose the picture that corresponds to a given word (e.g., laughing).

The Peabody Picture Vocabulary Test (PPVT). Vocabulary levels of 4-year-olds and adults were assessed using the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 2007). The PPVT is one of the most commonly used language assessments and has a high average internal consistency reliability (split half) of .94. In the PPVT, participants are asked to identify the meanings of various words, including nouns, verbs, and adjectives, by selecting the representative picture among four possible options (Figure 5). The test consists of a series of 12-word sets. The assessment starts at a set of words specific to the participant's age and continues until the participant makes 8 or more errors within a set. Following the official instructions, testing was started from the second set for 4-year-old participants and the 14th set for adult participants.

The MacArthur Communicative Development Inventory (MCDI). Vocabulary levels of 2-year-olds were assessed with the toddler version of the MacArthur Communicative Development Inventory (MacArthur Short Form Vocabulary Checklist: Level II (Form A); Fenson et al., 1994). This version of the MCDI asks the parents of child participants to indicate words their children are able to produce (productive vocabulary). The MCDI has been widely used in studies of early language development. The toddler form used in the current study has a high internal consistency reliability of .97 (Fenson, Pethick, Renda, Cox, Dale, & Reznick, 2000). In addition to the official set of words, relational terms (verbs and prepositions) were included in this inventory (e.g., jump, kick) because the focus of this study was verb learning (see Appendix E).

Design

Verb Learning Task

In the Verb Learning Task, a novel verb was presented with animations, and participants were prompted to associate the novel verb with one of the three Referent Types – a PATH, MANNER, or COLOR. Importantly, the Verb Learning Task measured how well participants mapped a novel verb to the targeted attribute, as opposed to their mapping preference. Investigating a similar question of how children map verbs onto PATH and

MANNER of motion, Maguire et al. (2010) examined onto which aspect children *preferred* to map the verb. In their study, a novel verb was presented with the same animation multiple times, and participants were asked to choose PATH or MANNER. There was no correct or incorrect answer. The biggest limitation of this preference approach is that children may have chosen one option over the other not because they had a strong bias to associate a verb with the feature depicted in that option, but because they *preferred* to associate a verb with the feature if they *must* choose between the two available options.

The present study is interested in whether the “ease of mapping” differs across PATH, MANNER, and COLOR, and thus we designed a task with correct answers. We presented multiple exemplars of a particular attribute and asked children to find an invariant among the exemplars. Thus, participants’ performance was analyzed for their accuracy on each trial. Based on 2-year-olds’ attention span in pilot testing, the number of trials was set to four trials per Referent Type, resulting in a total of 12 trials.

The study used a block design, in which all trials were grouped together based on Referent Types, and four trials for each Referent Type were presented in succession. The order of the blocks (PATH, MANNER, and COLOR) was counterbalanced across participants, which resulted in six different orders. For example, participants who were assigned to the block order of PATH, MANNER, and COLOR, went through four PATH trials, followed by four MANNER trials, and four COLOR trials. This block design was implemented for two reasons. First, young children are known to have less inhibitory control than adults and thus often struggle to switch their focus between different attributes/dimensions (Kirkham, Cruess, & Diamond, 2003). By using the block design, the degradation of performance caused by insufficient inhibitory control was minimized as the task demanded that participants switch their focus only twice. Second, the block design minimized the concern that earlier trials may influence performance in later trials because the data in the first block of the study reflect the response patterns without any intrusion. This meant the data could be analyzed in a way that parallels a between-subjects design version of the study. In addition to counterbalancing the three blocks, items within each trial type were presented in four different orders to minimize order effects.

As described in more detail below, each trial consisted of the training phase and test phase (Figure 6). In the training phase, participants were presented with a novel verb and three motion events that shared only one of the three attributes (PATH, MANNER, or COLOR) but differed in the other two attributes. Thus, participants were prompted to associate the verb with that shared attribute, or the *invariant*. Previous research using the same set of PATHs and MANNERs found that young infants are already able to abstract PATH invariants and MANNER invariants across exemplars (Pruden et al., 2012; Pruden et al., 2013). In the test phase, participants were presented with two options and were prompted to choose the option that matched the learned novel verb. An attention getter animation was inserted before each trial (3-second animation of a baby laughing), in the middle of each block (i.e., after two trials; 3-second animation of dogs), and at the end of each block (3-second animation of Elmo). All verbal stimuli were recorded by a female native speaker of English.

Training phase

In this phase, participants watched three 6-second animation clips paired with an auditory presentation of a novel verb (e.g., *hirshing*; see Table 3 for all verbs used in the study). For example, in a PATH trial, participants were presented with three different animations of the same PATH. During each 6-second clip, the verb was repeated three times for a total of 9 verb labels across 18 seconds of exposure (“Look, she’s *hirshing*! Do you see her *hirshing*? Watch her *hirshing*!”).

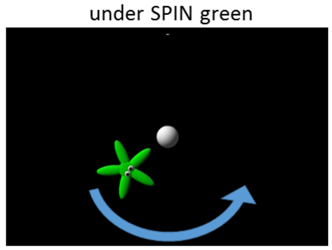
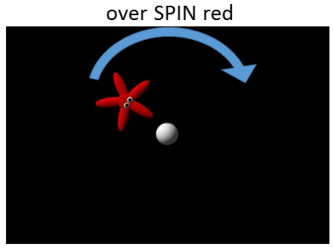
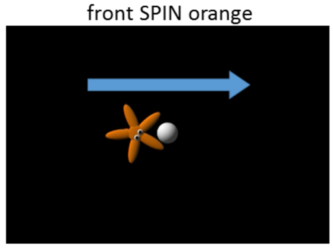
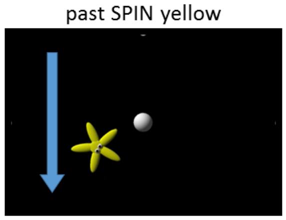
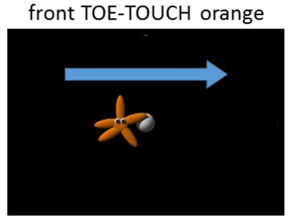
Phase	Visual Stimuli	Auditory Stimuli
Training 1	under SPIN green 	Look she’s *blicking*! Do you see her *blicking*? Watch her *blicking*!
Training 2	over SPIN red 	Look she’s *blicking*! Do you see her *blicking*? Watch her *blicking*!
Training 3	front SPIN orange 	Look she’s *blicking*! Do you see her *blicking*? Watch her *blicking*!
Test	past SPIN yellow  front TOE-TOUCH orange 	Do you see her *blicking*? Which one is *blicking*?

Figure 6. Sequence of a trial in the Verb Learning Task. This example depicts one of the MANNER trials in which the MANNER spin stays consistent as an invariant across the three training animations, and thus the participant was prompted to associate the novel verb “*blicking*” with spinning. The blue arrows did not appear in the actual animations but were added here to indicate PATHs.

Table 3.
Sequence of the Verb Learning Task

Block	Question #	Phase	Auditory Stimuli
Practice	Practice question 1	-	Which one is the cookie?
	Practice question 2	-	Which one is the donut?
Block 1	Question 1	Training	Look, she's *jorping*! Do you see her *jorping*? Watch her *jorping*!
		Test	Do you see her *jorping*? Which one is *jorping?*
	Question 2	Training	Look, she's *twilling*! Do you see her *twilling*? Watch her *twilling*!
		Test	Do you see her *twilling*? Which one is *twilling?*
	Question 3	Training	Look, she's *gopping*! Do you see her *gopping*? Watch her *gopping*!
		Test	Do you see her *gopping*? Which one is *gopping?*
	Question 4	Training	Look, she's *daxing*! Do you see her *daxing*? Watch her *daxing*!
		Test	Do you see her *daxing*? Which one is *daxing?*
	Add-on question 1	-	Do you see her *jorping*? Which one is *jorping?*
Practice	Practice question 3	-	Which one is the firetruck?
Block 2	Question 5	Training	Look, she's *zebbing*! Do you see her *zebbing*? Watch her *zebbing*!
		Test	Do you see her *zebbing*? Which one is *zebbing?*
	Question 6	Training	Look, she's *blicking*! Do you see her *blicking*? Watch her *blicking*!
		Test	Do you see her *blicking*? Which one is *blicking?*
	Question 7	Training	Look, she's *krading*! Do you see her *krading*? Watch her *krading*!
		Test	Do you see her *krading*? Which one is *krading?*
	Question 8	Training	Look, she's *frepping*! Do you see her *frepping*? Watch her *frepping*!
		Test	Do you see her *frepping*? Which one is *frepping?*
	Add-on question 2	-	Do you see her *zebbing*? Which one is *zebbing?*
Practice	Practice question 4	-	Which one is the dog?
Block 3	Question 9	Training	Look, she's *clooming*! Do you see her *clooming*? Watch her *clooming*!
		Test	Do you see her *clooming*? Which one is *clooming?*
	Question 10	Training	Look, she's *spulking*! Do you see her *spulking*? Watch her *spulking*!
		Test	Do you see her *spulking*? Which one is *spulking?*
	Question 11	Training	Look, she's *meeping*! Do you see her *meeping*? Watch her *meeping*!
		Test	Do you see her *meeping*? Which one is *meeping?*

Question 12	Training	Look, she's *hirshing*! Do you see her *hirshing*? Watch her *hirshing*!
	Test	Do you see her *hirshing*? Which one is *hirshing?*
Add-on question 3	-	Do you see her *clooming*? Which one is *clooming?*

Test phase

The test phase used the split-screen presentation in which two options were presented side by side on the same screen. Two animations – a *target* and a *distracter* – were simultaneously presented. For the particular Referent Type tested in the trial (PATH, MANNER, or COLOR), the target contained the specific feature (a specific kind of PATH/MANNER/COLOR; e.g., jumping jacks) that repeatedly appeared in the training phase, i.e., the feature that participants were expected to associate with the novel verb. The distracter contained a novel feature for the particular Referent Type tested, but had the other two features in common with the last training animation (the animation the participant watched right before the test phase) (see Kraemer, Rosenberg, & Thompson-Schill, 2009 for a similar design). For example, in a PATH trial, one side of the screen displayed Starry moving in the same PATH seen across the three animations in the training phase, paired with a novel MANNER and COLOR (the target video); the other side showed the animation moving in a novel PATH but with a MANNER and COLOR from the last training animation (the distracter video). Participants were prompted to choose one of the two options (e.g., "Do you see her *blicking*? Which one is *blicking*?"). If the participant correctly learned the association between the verb and the PATH of motion, she should choose the target video. The correct answer appeared on the left and right side of the screen with equal frequency.

To ensure that children understood the pointing task, we included four practice questions throughout the experiment. Participants who did not respond correctly to any of the practice questions were to be removed from the sample, but this never occurred. Two practice questions were incorporated in the beginning of the session to ensure that children understood the task before going into the main questions. In addition, we included one practice question after each of the first and second blocks to remind children that they were supposed to point to the referent of a word (see Table 3). In all practice questions, two static images (e.g., a picture of a cat and a picture of a dog) were presented side by side on the screen and participants were asked to point to one of the two images (e.g., "Which one is the dog?"). As the main purpose of the practice questions was to ensure that participants, especially young children, were able to properly show their answers through pointing, all questions were designed to be easy for participants in all age groups (see Table 3 for the list of practice questions). In addition, at the end of each block, one of the questions from the block was repeated but with four animations (the correct choices from the four trials in the block). This add-on question was included simply to encourage participants to pay attention to the associations between a verb and its potential referent; if participants knew that they were going to be tested on the verb-referent mappings, they would be more likely to attend to both verbs and animations. These questions were incorporated because, in pilot testing, several adult participants indicated that they started to ignore the verbs mid-way through the experiment and simply looked for an invariant among motion events (see Table 3).

Procedure

All participants met individually with the experimenter. Although the setting was very similar across participants, some children were tested in a lab setting (*N* = 23 for 2-year-olds and *N* = 17 for 4-year-olds) whereas other children were tested at their schools or childcare centers (*N* = 25 for 2-year-olds and *N* = 31 for 4-year-olds). Participants were seated in front of a 13.3-inch laptop screen on which all visual stimuli in the Verb Learning Task were presented. The entire session took 10-15 minutes for 2-year-olds (Verb Learning Task only), and 20-30 minutes for 4-year-olds and adults (Verb Learning Task and Vocabulary Test).

The parents of child participants filled out the background questionnaire (for both 2- and 4-year-olds) and the MCDI (only for 2-year-olds) before the Verb Learning Task whereas adult participants filled out the background questionnaire after the Verb Learning Task. Among the parents of the 2-year-old participants, there were two parents who did not return the MCDI to us and two parents who only completed the first page of the form. For 4-year-olds and adults, the Verb Learning Task was administered first, followed by the Vocabulary Test. The fixed order was used to prevent the Vocabulary Test from affecting participants' performance on the Verb Learning Task. For example, one of the questions on the Vocabulary Test asks the child to select "red," and that question may prime children to focus more on COLOR in the Verb Learning Task than they would naturally. For adults, the background questionnaire was administered after the Verb Learning Task to avoid the possibility that the question about color blindness in the background questionnaire would prime participants to focus on COLOR.

Responses were coded online for both the Verb Learning Task and PPVT, but sessions with children were also videotaped for offline coding. While it was generally clear where the participant was pointing to in the test phase, we took the additional precaution of having 25% of the child experiment tapes re-coded by a blind observer. Reliability with live coding was 100%.

Data Analysis

For each trial, participants' pointing responses were coded in terms of whether they pointed to the correct answer or not (1 = correct, 0 = incorrect). The accuracy in the Verb Learning Task was used as a dependent variable in all statistical analyses. Referent Type (PATH vs. MANNER vs. COLOR), Age (2-year-olds vs. 4-year-olds vs. adults), and Vocabulary (scores from the MCDI/PPVT) were included as independent variables as demanded by the question being investigated.

Research Question 1: Talmy's Categories in 2-year-olds

Our first research question is whether it is easier for young children to learn the meaning of a novel verb when the verb refers to aspects of motion events that are consistently and prominently lexicalized across the world's languages than aspects that are less consistently or never lexicalized. As such, we predicted 2-year-olds should be best at abstracting PATH, followed by MANNER, and then COLOR in the Verb Learning Task.

The average accuracy was compared across the three Referent Types (PATH, MANNER, and COLOR). The distribution of scores on the Verb Learning Task approximately followed the normal distribution within each Referent Type, and thus the data were first analyzed using parametric tests, ANOVAs and *t*-tests. When the omnibus test yielded significance, follow-up pairwise *t*-tests were performed to examine differences in accuracy among PATH, MANNER, and COLOR. The data from the first block of the Verb Learning Task were also analyzed in another ANOVA with Referent Type as a between-subject variable.

Research Question 2: Developmental Changes in Verb Learning Biases

Our second question concerns developmental changes in verb learning biases across ages. We hypothesized that chronological age predicts language-specific verb learning patterns such that a MANNER bias is stronger for 4-year-olds than 2-year-olds, and also for adults than 4-year-olds. The average accuracy from all age groups were put into one ANOVA with Referent Type (PATH vs. MANNER vs. COLOR) as a within-subject factor, and Age (2-year-olds vs. 4-year-olds vs. adults) as a between-subject factor. When the omnibus test yielded significance, follow-up contrasts were performed.

Research Question 3: Individual Differences in Verb Learning Biases

The last research question is whether the size of vocabulary predicts the learning patterns in the Verb Learning Task. We hypothesized that 2-year-olds with larger vocabularies may already show a MANNER bias. Correlations between vocabulary scores and accuracy in the Verb Learning Task were first calculated. For all significant correlations, regression analyses were conducted. As the study design included both categorical (Referent Type) and continuous variables (Vocabulary) and the outcome (Accuracy) was a binary variable (correct vs. incorrect), Generalized Linear Mixed Models (GLMMs) with logit (log-odds) as the link function were chosen (Jaeger, 2008; see also Emerson et al., 2015). GLMMs with logit as the link function are essentially logistic regressions with both fixed and random effects. GLMMs were used here partially because they can be more powerful than parametric tests such as an ANOVA that assumes normal distribution (Emerson et al., 2015), as they allow us to analyze the accuracy data without averaging across trials, and thus we could evaluate effects of individual items (i.e., trials). The GLMMs constructed here were also used to test by-item random effects to ensure that the effect of referent types (PATH, MANNER, and COLOR) found in ANOVAs (Research Question 1) was not driven by specific test items.

GLMMs were generated in R (R Development Core Team, 2016) using the *lme4.glmer* function (Bates, Maechler, Bolker, & Walker, 2014). All models were fit by maximum likelihood using adaptive Gauss-Hermite quadrature (nAGQ = 1). The Akaike information criterion (AIC) and Bayesian information criterion (BIC) measures were used to the estimated goodness of fit for each model. These widely-used measures reward models that give a better fit to the observed data but penalize more complex models. The estimated goodness of fit becomes inflated every time any factor is added to a model, including poor predictors, and thus it is critical to penalize complex models (i.e., models with more predictors or degrees of freedom) to avoid overfitting. For both the AIC and BIC, a lower score represents better overall model fit.

CHAPTER 3

RESULTS

Research Question 1: Talmy's Categories in 2-year-olds

Our first question evaluates whether it is easier for young children to find verb-referent mappings for concepts that are lexicalized consistently across the world's verb systems than for concepts that are less consistently or never lexicalized. We hypothesized that the verb learning pattern of 2-year-olds, who just began the process of verb acquisition, is most likely to reflect the lexicalization patterns found across languages. Therefore, we tested whether it was easier for 2-year-olds to associate a novel verb with PATH than MANNER, and MANNER than COLOR (PATH > MANNER > COLOR).

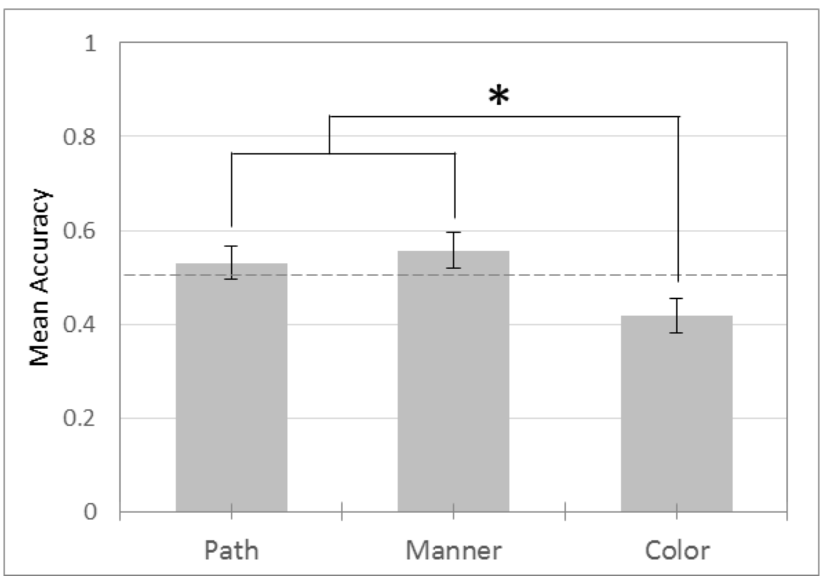


Figure 7. Mean accuracy of English-speaking 2-year-olds choosing the correct answer across the three Referent Types (PATH, MANNER, and COLOR). The dotted line indicates the chance level accuracy (50%). The error bars represent the ±1 standard error.

The distribution of scores on the Verb Learning Task approximately followed the normal distribution within each Referent Type (PATH, MANNER, and COLOR), and thus the data were analyzed using parametric tests (ANOVAs and *t*-tests). A one-way repeated measures ANOVA compared accuracy across the three Referent Types (see Figure 7). The omnibus test revealed a main effect of Referent Type ($F(2,94) = 3.87$, $p = .02$, $\eta^2 = .07$). Three planned contrasts comparing each pair of Referent Types found that accuracy was higher for PATH than COLOR ($t(47) = 2.11$, $p = .04$, $d = 0.22$) and MANNER than COLOR ($t(47) = 2.65$, $p = .01$, $d = 0.27$). However, no difference was found between PATH and MANNER ($t(47) = .51$, $p = .61$, $d = 0.05$). Thus, English-speaking 2-year-olds were more likely to associate a novel verb with PATH (mean accuracy = .53) or MANNER (mean accuracy = .56) than COLOR (mean accuracy = .42). Additional one-sample *t*-tests suggested that 2-year-olds' accuracy was at chance on PATH ($t(47) = .84$, $p = .41$, $d = 0.12$) and MANNER trials ($t(47) = 1.47$, $p = .15$, $d = 0.21$) and below chance on COLOR trials ($t(47) = -2.27$, $p = .03$, $d = -0.33$).

As the present study used a within-subject design, a concern may be that the observed advantage of PATH and MANNER over COLOR was confounded by the difficulty of switching attentional focus between Referent Types. To resolve this concern, we separately analyzed the data in the first block of the study which should reflect the response patterns without any intrusion. When the data from the first block were extracted, the PATH/MANNER over COLOR pattern was found, and mean accuracy was .50, .57, and .42 for the PATH, MANNER, and COLOR groups, respectively (Figure 8). However, a one-way ANOVA with Referent Type as a between-subject factor, testing the data from the first block only, did not yield significance ($F(2,48) = 1.60$, $p = .21$, $\eta^2 = .01$). The lack of significance is likely due to insufficient power as there were only 16 subjects per Referent Type.

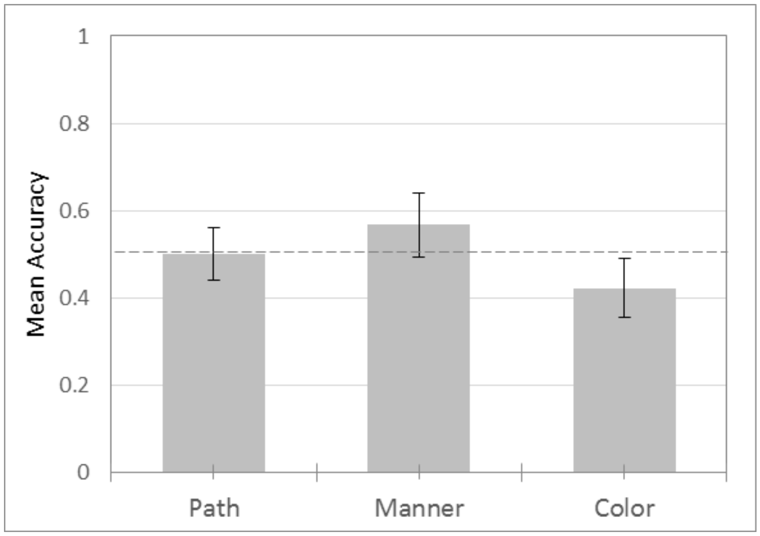


Figure 8. Mean accuracy of English-speaking 2-year-olds choosing the correct answer across the three Referent Types (PATH, MANNER, and COLOR) in the first block. The dotted line indicates the chance level accuracy (50%). The error bars represent the ±1 standard error.

Research Question 2: Developmental Changes in Verb Learning Biases

Our second question concerns developmental changes in verb learning biases. In order to investigate the developmental trajectory, we compared accuracy in the Verb Learning Task between 2-year-olds, 4-year-olds, and adults (Figure 9). As in Research Question 1, parametric tests were used to analyze the data as the distribution of scores on the Verb Learning Task approximately followed the normal distribution within each Referent Type (PATH, MANNER, and COLOR). A two-way repeated measures ANOVA was conducted to determine the effects of Age (2 years old vs. 4 years old vs. adults) and Referent Type (PATH vs. MANNER vs. COLOR) on accuracy in the Verb Learning Task.

The omnibus test found a main effect of Referent Type (F(2, 282) = 59.13, $p < .001$, η^2 = .26) and an interaction between Age and Referent Type (F(4,282) = 14.27, $p < .001$, η^2 = .15), but no main effect of Age (F(2,141) = 1.32, $p = .27$, $\eta^2 = .02$).

Follow-up contrasts examined the patterns of verb learning in two ways. First, simple contrasts within each Referent Type evaluated whether the accuracy on trials for each Referent Type (PATH, MANNER, or COLOR) changes with age. This analysis examined whether ability to map a novel verb onto a particular feature would become stronger over development. As English is a manner-heavy S-language, we predicted that older individuals with more experience with English would be better at extracting a MANNER invariant across exemplars than younger individuals, reflecting the development of a MANNER bias in verb learning. In other words, this analysis evaluated whether attention to MANNER is heightened with development. Second, the same data can be analyzed with respect to the "relative weights" between features. Research suggests that language experience not only heightens individuals' attention to certain aspects of events but also dampens their attention to aspects that are unmarked in their native language (Göksun et al., 2010). Based on this idea, we speculated that, as English-speaking children acquire the language-specific MANNER bias, their PATH bias is consequently dampened. To evaluate this possibility, we tested interaction contrasts between Referent Type and Age and examined whether the difference in accuracy between Referent Types changes with age.

First, examining the verb learning bias to each Referent Type, the following patterns were found. The accuracy in PATH trials was significantly higher for 2-year-olds than for 4-year-olds (t(423) = 3.39, $p < .001$, d = 0.69) and higher for adults than 4-year-olds ($t(423) = 2.82$, $p = .01$, $d = 0.58$). As predicted, the accuracy in MANNER trials was significantly higher for 4-year-olds than 2-year-olds ($t(423) = 2.62$, $p = .01$, $d = 0.53$) and higher for adults than 4-year-olds ($t(423) = 3.10$, $p = .002$, $d = 0.63$). The accuracy in COLOR trials was not different between 2-year-olds and 4-year-olds ($t(423) = .34$, $p = .73$, $d = 0.01$), but was significantly lower for adults than 4-year-olds ($t(423) = 3.24$, $p = .001$, $d = .66$). These findings suggest that the MANNER bias in verb learning becomes stronger with age. In contrast, the PATH bias is dampened by age 4 and is heightened again later on. Children's performance on COLOR trials did not differ between ages 2 and 4; however adult participants showed an even weaker tendency to associate a verb with COLOR.

Next, we explored the possibility of "heightening and dampening" by conducting six 2 (Age) x 2 (Referent Type) ANOVAs, testing whether the difference in accuracy between each possible pair of Referent Types (MANNER vs. PATH, MANNER vs. COLOR, and PATH vs. COLOR) differed between 2- and 4-year-olds and between 4-year-olds and adults. For example, to examine the "MANNER over PATH" bias in accuracy, we conducted an ANOVA with Age (2 vs. 4) as a between-subject factor and Referent Type (PATH vs. MANNER) as a within-subject factor. The "MANNER over PATH" bias in accuracy was significantly greater for 4-year-olds than 2-year-olds ($F(1,94) = 20.58$, $p < .001$, $\eta^2 = .11$). In contrast, the difference in accuracy between PATH and MANNER trials did not differ between 4-year-olds and adults ($F(1,94) = .03$, $p = .86$, $\eta^2 < .001$). The difference in accuracy between MANNER and COLOR trials was comparable between 2-year-olds and 4-year-olds ($F(1,94) = 2.71$, $p = .10$, $\eta^2 = .02$) whereas adults showed a stronger "MANNER over COLOR" bias than 4-year-olds ($F(1,94) = 20.85$, $p < .001$, $\eta^2 = .10$). Finally the difference in accuracy between PATH and COLOR differed significantly between 4-year-olds and 2-year-olds ($F(1,94) = 7.60$, $p < .01$, $\eta^2 = .04$) and between 4-year-olds and adults ($F(1,94) = 17.57$, $p < .001$, $\eta^2 = .07$). These analyses suggest that PATH bias and MANNER bias may develop hand in hand. Between ages 2 and 4, English-speaking children seem to heighten their attention to MANNER of motion while dampening their attention to PATH. The results of this analysis also suggest the heightened attention to MANNER over PATH seems to stay consistent between age 4 and adulthood.

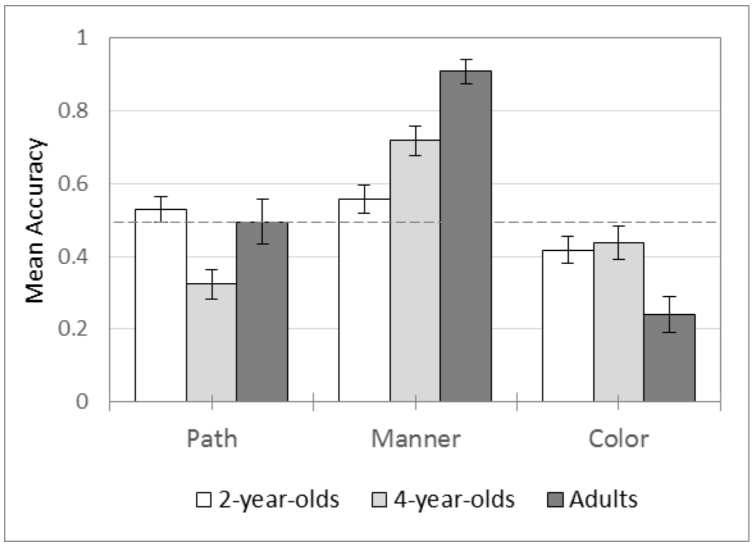


Figure 9. Developmental changes in the accuracy. The dotted line indicates the chance level accuracy (50%). The error bars represent the ±1 standard error.

Research Question 3: Individual Differences in Verb Learning Biases

Our next research question is whether individual differences in language skills predict performance in the Verb Learning Task. We first calculated correlations between accuracy in the Verb Learning Task and scores on the vocabulary measures (the MCDI for 2-year-olds and PPVT for 4-year-olds and adults). Then, we built GLMMs to examine whether there is a statistically significant relationship between participants' vocabulary scores and their verb learning biases. In addition, these GLMMs tested random effects of test items to confirm that the effects found with ANOVAs for Research Question 1 were not driven by the choice of test items.

As participants' verb learning biases aligned with the lexicalization patterns found in their native language (i.e., MANNER bias), there may be an interaction between Referent Type in the Verb Learning Task (PATH, MANNER, and COLOR) and vocabulary scores. More specifically, we suspected that individuals with higher vocabulary scores might have a stronger tendency to associate a novel verb with MANNER of motion than do their peers.

2-year-olds

Correlations between accuracy in the Verb Learning Task and vocabulary scores were calculated for the overall verb learning scores as well as each of the three Referent Types. For 2-year-olds, correlations were also calculated for each type of word including verbs, prepositions, and relational terms (verbs + prepositions). As shown in Table 4, no significant correlation was found, suggesting that vocabulary scores did not predict how 2-year-olds found a referent of a novel verb.

As all correlations were insignificant, we did not build a GLMM with Vocabulary Scores as a predictor. However, as discussed earlier, we still tested a GLMM with logit as the link function to confirm that the effect of Referent Type found in ANOVAs in assessing Research Question 1 was not due to random effects of items and holds without assuming a normal distribution. The model included a fixed intercept, fixed effects for Referent Type, and random effects for Referent Type (conditioned on items). MANNER was coded as the baseline, and the model suggests that accuracy was higher in the MANNER trials than in the COLOR trials, but not significantly different between the MANNER and PATH trials (Table 5). The results confirmed that, for English-speaking 2-year-olds, forming verb-referent associations is easier for PATH and MANNER than for COLOR, even with random effects of items controlled.

Table 4.
Correlations between accuracy in the Verb Learning Task and vocabulary scores (2-year-olds)

	All Vocab	MCDI	Verb	Prep.	Relational
PATH	.14	.09	.09	.16	.11
MANNER	.05	.10	.06	.04	.06
COLOR	.05	-.07	.02	-.01	.01
All	.13	.08	.10	.11	.11

Notes. MCDI = All vocabulary items in the MacArthur Short Form Vocabulary Checklist: Level II (Form A); Prep. = Preposition; Relational = Relational term.

Table 5.
Fixed effects for the GLMM (2-year-olds)

	B	*SE*	Wald Z	*P*
Intercept	.24	.20	1.15	.25
Referent Type (PATH)	-.11	.32	-.35	.72
Referent Type (COLOR)	-.56	.25	-2.23	.03 *

*$p < .05$. **$p < .01$. ***$p < .001$.

4-year-olds

The vocabulary scores did not predict 4-year-olds' performance in the Verb Learning Task either. As we expected an interaction between Referent Type (PATH, MANNER, and COLOR) and vocabulary scores, correlations were calculated for each of the three Referent Types as well as for overall scores. As shown in Table 6, no significant correlation was found, suggesting that vocabulary scores did not predict how 4-year-olds found a referent of a novel verb.

Following the case of 2-year-olds, we built a GLMM with logit as the link function to examine whether 4-year-olds' accuracy in the Verb Learning Task differed across Referent Types when random effects of items were accounted for. The model included a fixed intercept, fixed effects for Referent Type, and random effects for Referent Type (conditioned on items). As accuracy was expected to be different for MANNER trials compared to the other two Referent Types (PATH and COLOR), MANNER was coded as the baseline. The model suggests that accuracy in the MANNER trials was significantly greater than accuracy in the PATH trials or COLOR trials (Table 7), suggesting that, for English-speaking 4-year-olds, forming verb-referent associations is easier for MANNER than PATH or COLOR.

Table 6.
Correlations between accuracy in the Verb Learning Task and vocabulary scores (4-year-olds)

	Vocabulary
PATH	0.13
MANNER	-0.08
COLOR	-0.07
All	-0.02

Table 7.
Fixed effects for the GLMM (4-year-olds)

	B	*SE*	Wald Z	*P*	
Intercept	.95	.21	4.59	<.001	***
Referent Type (PATH)	-1.69	.26	-6.55	<.001	***
Referent Type (COLOR)	-1.20	.25	-4.74	<.001	***

*$p < .05$. **$p < .01$. ***$p < .001$.

Adults

Similarly, we examined whether adults' accuracy in the Verb Learning Task is related to their vocabulary scores. Correlations were calculated between vocabulary scores and each Referent Type (PATH, MANNER, and COLOR). Vocabulary scores were positively correlated with accuracy in the Verb Learning Task for MANNER (r = .53, p

< .001), suggesting that participants with higher vocabulary scores were better at learning the association between a novel verb and MANNER of motion than their lower-scoring peers. The correlation between verb learning accuracy and vocabulary scores was marginally significant for COLOR ($r = .27$, $p < .07$) and insignificant for PATH ($r = -.13$, $p = .38$). As vocabulary scores were correlated with accuracy for MANNER trials in the Verb Learning Task, vocabulary scores were included as a predictor in the following regression models.

Following the suggestion by Barr, Levy, Scheepers, and Tily (2013), we first generated a full model that included a fixed intercept, fixed effects for Referent Type, fixed effects for Vocabulary, interaction between Referent Type and Vocabulary, and random effects for Referent Type (conditioned on subjects and items). The PPVT scores were standardized into z-scores. Table 8 displays the fixed effects for this full model. The interaction between Referent Type and Vocabulary was significant ($B = 1.90$, $SE = .52$, $p < .0001$), suggesting that English-speaking adults with higher language scores have a stronger tendency to associate a novel verb with MANNER of motion than their peers with lower language scores. The results also confirmed that the differences in the Verb Learning accuracy were not driven by particular items used in the study.

Table 8.
Fixed effects for the full model (Model 1)

	B	*SE*	Wald Z	*P*
Intercept	-.82	1.32	-.62	.53
Referent Type	.93	1.07	.88	.38
Vocabulary	-2.46	.92	-2.66	.01**
Referent Type x Vocabulary	1.90	.52	3.66	< .001***

*$p < .05$. **$p < .01$. ***$p < .001$.

To evaluate goodness of fit of the full model (Model 1), three additional models with fewer factors were also generated (Table 9). Model 2 and Model 3 each tested random effects of items and subjects, respectively. Model 4 tested fixed effects of Language with random effects for Referent Type (conditioned on subjects and items). A model with Referent Type as a solo fixed-effect predictor and random effects for Referent Type (conditioned on subjects and items) was also tested, but failed to converge properly. The Akaike information criterion (AIC) and Bayesian information criterion (BIC) measures were used to the estimated goodness of fit for each model. For both the AIC and BIC, a lower score represents better overall model fit. According to both AIC and BIC, the full model (Model 1) yielded the best goodness of fit.

Table 9. Estimated goodness of fit for the models generated.

Model	Model Specifications	AIC	BIC	LL
1	1 + ReferentType * Vocabulary + (ReferentType|Item) + (ReferentType|Subject)	512.3	555.9	-246.2
2	1 + ReferentType * Vocabulary + (ReferentType|Item)	602.9	633.4	-294.4
3	1 + ReferentType * Vocabulary+ (ReferentType|Subject)	717.7	748.2	-351.9
4	1 + Vocabulary + (ReferentType|Item) + (ReferentType|Subject)	529.2	564.1	-256.6

Note. AIC: Akaike information criterion; BIC: Bayesian information criterion; LL: log-likelihood value.

CHAPTER 4

DISCUSSION

Languages are not "neutral coding systems of an objective reality" (Slobin, 1996, p. 91). If the world's languages differ in how they express thoughts and events, learning to map word onto world cannot be an easy task. Yet, young language learners seem to effortlessly and efficiently acquire words. How do they figure out the specific ways in which their native language carves up the dynamic and continuous world? Using Talmy's semantic categories of motion as a toehold, this dissertation evaluated the possibility that the semantic organization of the verb system itself reflects how children naturally infer meanings of motion verbs.

Talmy's linguistic analysis of how verbs encode motion events provides an excellent framework for evaluating the issue because (1) verbs label motion events very differently across languages, and (2) Talmy's analysis provides us with a set of potentially universal categories that are represented in the world's verb systems to differing degrees: PATH, MANNER, and COLOR. In this dissertation, we use the natural variation to ask, (1) whether it is easiest to learn the meaning of a novel verb for PATH, followed by MANNER, and then COLOR, (2) whether the verb learning pattern changes with development as children learn a specific language, and (3) whether individual differences in language skill predict the learning patterns. We hypothesized, based on prior literature, that young children just beginning to learn verbs would be more likely to associate a verb with PATH than MANNER, and with MANNER than COLOR (Research Question 1). However, this learning pattern was expected to change with language experience such that older individuals (Research Question 2) or individuals with advanced language skills

(Research Question 3) would have developed a stronger language-specific bias (i.e., MANNER bias for English speakers). As summarized below, our study largely confirmed these hypotheses, while also raising a few unexpected findings.

Research Question 1: Talmy's Categories in 2-year-olds

Our first question concerns the psychological reality of Talmy's semantic categories of motion. More specifically, we asked whether it is easier for 2-year-olds to infer the meaning of a novel verb when the verb refers to an aspect of events that is consistently lexicalized across the world's languages than aspects that are lexicalized less consistently or never. We predicted that, if Talmy's semantic categories align with the ways in which young children learn new verbs, 2-year-olds should be best at abstracting PATH, followed by MANNER, and then COLOR, as referents of the verbs (the PATH > MANNER > COLOR bias). The most critical question here was whether 2-year-olds associate a novel verb with COLOR of an actor, an aspect that is never lexicalized in verb systems. This question has never been investigated in the literature.

Two-year-olds were significantly better at abstraction of PATH and MANNER than of COLOR (PATH = MANNER > COLOR). Thus, 2-year-olds already grasped that COLOR was unlikely to be the referent of the verb. The results suggest that even at a time when children are learning their first verbs, they already possess a basic understanding of what features verbs encode. This finding confirmed our hypothesis – it is easier to learn labels for semantic categories that are represented similarly and consistently across the world's verb systems (PATH and MANNER of motion) than categories that are never represented (COLOR of an actor). Our results not only provide support for the Typological

Prevalence Hypothesis (Gentner & Bowerman, 2009), but also extend the theory by studying dynamic events at the level of the category or cluster of words, and most importantly, by including concepts that are never lexicalized in the world's verb systems.

Surprisingly, with regard to the difference between PATH and MANNER, however, our prediction was not fully confirmed. We expected 2-year-olds to show higher accuracy on PATH trials than on MANNER trials as PATH is more consistently represented across the verb system in the world's languages than is MANNER. Two-year-olds' performance, however, was indistinguishable for PATH and MANNER. This pattern seems to contradict the previous study by Maguire et al. (2010) which found that 2-year-olds preferred to associate a novel verb with PATH over MANNER. We suggest that the dissociation between the two studies might be due to the difference in task demands and methods.

As discussed earlier, Maguire et al. (2010) examined which feature, PATH or MANNER, children preferred to associate with a verb. In contrast, the present study asked children to find an invariant feature among multiple exemplars and measured the children's accuracy in mapping a verb to the invariant. In other words, our study examined the ease of mapping – whether children were able to find the referents of verbs. What Maguire et al. demonstrated is how children are using their initial bias to quickly link world to word, when they encounter a novel word for the first time. The task presented in this dissertation, in contrast, asks not merely what they will do as a heuristic for mapping a word onto its referent, but rather, whether they can abstract different features (PATH, MANNER, COLOR) that are retained across events which vary in other features. One could argue that this latter approach approximates the cross-situational use of words in the real world setting. Our findings suggest that, when young children are asked to abstract the commonality among multiple exemplars, they do equally well for those features that are represented in the world's languages. Thus, and importantly, these task differences make compatible what might otherwise look on the surface to be contradictory findings.

Bannard and Tomasello (2012) also noted that preferential looking and pointing may be measuring two distinct phenomena. In their word learning study, 2-year-olds who learned word-object associations in one of the conditions (non-social setting) looked longer at the correct option, but failed to point to the correct option. Research with adults also suggests that, when hearing a word, adults look not only at the referent of the word but also at related objects (Cooper, 1974; Huettig & Altmann, 2004, 2011; Moores, Laiti, Chelazzi, 2003). Bannard and Tomasello (2012) suggest that preferential looking may be testing a non-referential relationship between a word and its referent, a possibility that must be further explored. This difference in methodology may be as important as the difference in the conceptual task demands.

It must also be noted that 2-year-olds' accuracy in the Verb Learning Task was at chance even on PATH and MANNER trials. Two-year-olds appeared to be ambivalent about whether a novel verb should be associated with PATH or MANNER. Importantly, this pattern should not be taken as an indication that 2-year-olds failed the task, because they clearly showed higher accuracy on PATH and MANNER trials than on COLOR trials. Instead, their chance-level performance adds to the evidence suggesting that, when learning a novel verb, 2-year-olds pay attention to both PATH and MANNER and do not have a strong tendency to select one or the other as the referent for a verb. Recall that the distracter presented in the test phase showed familiar features, for the two non-targeted attributes. For example, on a PATH trial, the test phase presented the correct option (the trained PATH +

novel MANNER and COLOR) and the distracter, which showed a novel PATH along with *the MANNER and COLOR that appeared in the last training animation*. If children paid attention equally to both PATH and MANNER, it must have been highly difficult for them to choose one or the other option. When COLOR was tested, in contrast, children showed a preference to the familiar PATH and MANNER (+ novel COLOR) over the trained COLOR (+ novel PATH and MANNER), demonstrating their awareness that PATH and MANNER are more likely to be the referents for verbs than COLOR.

In sum, our results provide new evidence for the psychological reality of Talmy's semantic categories and its link to the Typological Prevalence Hypothesis. Two-year-olds, who are at a very early stage of learning verbs, were more likely to associate novel verbs with the features that are typically encoded in verbs than features that are not encoded in the verb system in any language. We also found that 2-year-olds were equally good (or equally bad) at finding referents for PATH verbs and MANNER verbs. This result suggests that young language learners make the dichotomous distinction between lexicalized concepts vs. non-lexicalized concepts only, instead of differentiating all semantic categories in fine detail. This finding also highlights the strength of the current study, as the pattern would not be evident without testing a category that is never encoded in verbs.

Research Question 2: Developmental Changes in Verb Learning Biases

Our second question examined developmental changes – how the verb learning biases are modified as children become older and gain more language exposure. We hypothesized that 4-year-olds and adults would have a stronger verb-to-MANNER bias than 2-year-olds because the bias would support efficient word learning in English.

However, there were two other possible scenarios. First, older individuals may be generally better at finding an invariant across exemplars and thus may show high accuracy regardless of referent types (PATH, MANNER, and COLOR). Second, Emerson et al.'s memory task found a PATH bias in adult English speakers (Emerson et al., 2015), and the universal PATH bias may appear in our task as well.

A two-way ANOVA examined whether Age (2 years old vs. 4 years old vs. adults) and Referent Type (PATH vs. MANNER vs. COLOR) individually and/or interactively predicted participants' performance in the Verb Learning Task. The results of the ANOVA and follow-up contrasts suggested that the verb learning biases were quite different across age groups. The MANNER bias in particular changed dramatically over time, with 4-year-old English speakers showing a stronger MANNER bias than 2-year-olds, and adults showing an even stronger bias. Thus, by age 4, children are already sensitive to the kinds of features typically encoded in motion verbs in their native tongue and they are able to use language-specific biases to abstract invariants as the referents of novel verbs. Interestingly, the MANNER bias continues to become stronger even after age 4.

Again, asking a similar question, Maguire et al. (2010) also found a MANNER bias in preschoolers. Their task, however, may be less nuanced compared to our task as the preference pattern found in their study suggests that 4-year-olds already have the adult-like MANNER bias. Looking at the ease of mapping rather than mapping preference, our data instead suggest that 4-year-olds' MANNER bias might be weaker than that of adults, and the bias continues to develop after age 4.

Further, unlike adults whose performance exactly mirrored how their language (English) encodes motion events (MANNER > PATH > COLOR), 4-year-olds did not perform better on PATH trials than on COLOR trials. This finding is especially intriguing because younger children, 2-year-olds, already had a bias to prefer PATH over COLOR as the referent of a verb. Four-year-olds seemed to be fixated on the fact that an English motion verb generally refers to MANNER of motion, and they lacked attention to PATH. Young children are known to overgeneralize linguistic rules at the levels of lexicon (e.g., doggie to refer to all animals), morphology (e.g., sitted) and syntax (e.g., "Don't say me that"; see Ambridge, Pine, Rowland, Chang, & Bidgood, 2013 for a review). Although these overgeneralization errors are typically found in younger children, it is possible that the MANNER dominance in our 4-year-olds reflects young children's tendency to find set rules in language and strictly follow the rules. Our study demonstrated that 4-year-olds are still learning the verb patterns in their native language and developing language-specific verb learning biases.

However, it is also important to note that, even though accuracy on PATH trials was much lower for 4-year-olds than adults, the difference in accuracy between PATH trials and MANNER trials did not differ across the two age groups. That is, 4-year-olds were already weighing MANNER over PATH as much as adults. Thus, when we consider PATH and MANNER in relation to each other, children seem to heighten MANNER and dampen PATH in verb learning contexts by age 4 and keep the "MANNER over PATH" bias into adulthood. Although 4-year-olds' ability to abstract an invariant among multiple exemplars is still developing, they may already possess adult-level sensitivity to the frequency with which PATH and MANNER are encoded in English verbs.

Our data suggest that English-speaking adults are better at finding a referent for MANNER than PATH. However, in their memory study, Emerson et al. (2015) found that learning word-referent associations is easier between a verb and PATH than between a verb and MANNER even for English speakers. Why did the two studies result in opposing implications? We suggest that the two studies tapped into two distinctive processes involved in word learning: attention and memory. In the language and thought literature, it has been suggested that language directs people's *attention* to specific aspects of the environment (Malt, submitted), yet has only a minimal effect on how well the information is *remembered* (Wright, Davies, & Franklin, 2015). One possibility is that, as an individual becomes proficient in a specific language, they come to automatically shift their *attention* to a language-specific feature (e.g., MANNER in English); however, once the link between a word and its referent is established, it is easier to remember the words for concepts that are more prevalent across languages (e.g., PATH). This possibility must be further explored in future research.

The developmental patterns found in this study demonstrated the complex trajectory children follow as they learn language-specific ways of segmenting the world. Two-year-olds showed the universal verb learning biases and attended more to PATH and MANNER than COLOR. Two-year-olds seemed to lump the possible referents of verbs together and ignore the impossible, which must be an efficient learning strategy as speakers of any language must learn both PATH and MANNER verbs. By age 4, however, children develop a language-specific bias, and English-speaking children attended more to MANNER than PATH or COLOR. Whereas 4-year-olds seemed to focus almost exclusively on MANNER and did not learn PATH verbs better than COLOR verbs, adult English speakers showed the "graduated" sensitivity, attending more to MANNER than PATH, and PATH than COLOR. These findings illustrate the complexity of the development of verb learning biases that had not been previously reported.

Research Question 3: Individual Differences in Verb Learning Biases

Our last research question asks whether individual differences in language skills or experience with the language impacts verb learning. Based on previous studies (Choi, 2006; Göksun, 2010; Pulverman et al., 2008), we hypothesized that English speakers with a large vocabulary would show a stronger MANNER bias. Recent research by Konishi et al. (2016) also found that infants' ability to form categories of PATH and MANNER at 13 to 15 months of age predicted how well they did on a verb vocabulary test at 27 to 33 months of age, suggesting that individuals' ability to form categories within dynamic scenes may be critical for their ability to learn motion verbs. As such, we hypothesized that children with higher vocabulary scores would be more likely to have a language-specific learning bias (i.e., MANNER bias for English speakers) than their peers with lower language skills.

To our surprise, neither the overall vocabulary nor the vocabulary scores for verbs predicted 2-year-olds' performance in the Verb Learning Task. These null results suggest that the 2-year-olds have similar verb learning biases regardless of their vocabulary levels. However, it may be too early to conclude that there is no link between vocabulary and the verb learning bias as differences found at the group level are not always found at the individual level (e.g., Na, Grossmann, Varnum, Kitayama, Gonzalez, & Nisbett, 2010). Although 2-year-olds' vocabulary scores ranged widely from 49 to 235 words (mean = 178.77, SD = 54.10), their accuracy in the Verb Learning Task varied less (PATH: mean = .53, SD = .24; MANNER: mean = .56, SD = .27, COLOR: mean = .42, SD = .25) compared to the adult data, where we found the relationship between the vocabulary level and verb learning biases (PATH: mean = .50, *SD* = .43; MANNER: mean = .91, *SD* = .23; COLOR: mean = .24, *SD* = .34). Because our results suggest that the strong MANNER bias develops sometime between ages 2 and 4, a critical next step may be additionally testing 3-year-olds and analyzing vocabulary scores in all children together.

The regression models found an interaction between Referent Type (PATH, MANNER, and COLOR) and vocabulary scores in adults. The interaction suggests that adults strengthen their language-specific word learning biases as they learn more words, and vocabulary scores accounted for the difference in accuracy across types of referent. Adults with higher vocabulary scores were more likely to have the language-specific bias (MANNER > PATH > COLOR). Although we expected one's tendency in language learning to be linked to language skills, it was a surprise that adults with established language skills would show different verb learning patterns depending on their vocabulary level. A similar finding, however, has been reported previously. For example, testing the way children and adults form categories within dynamic events, George (2014) found no effect of vocabulary for children, but did find a marginal effect of vocabulary for adults.

There are a few possible explanations for this finding. The first possibility is what we expected in children – the influence of vocabulary size on verb learning biases. English speakers with a large vocabulary may have developed a stronger MANNER bias because they learn more about the labeling patterns in their language than their peers with lower language scores. It is also possible that adults with stronger word-learning biases learned new words efficiently and quickly and thus developed a larger vocabulary than others. Finally, the relationship between vocabulary level and the verb learning bias may be mediated by another factor such as personality, motivation towards the task, and attitude for language learning in general. We cannot distinguish between these possibilities based on the current data, and future research should evaluate these possible underlying mechanisms.

Future Directions

This dissertation found that English-speaking children start from the PATH/MANNER > COLOR bias and then eventually develop the MANNER > PATH > COLOR bias as they learn the specific patterns in which their mother tongue expresses motion. We suggest that 2-year-olds' PATH/MANNER > COLOR bias may reflect the universal tendency children start from regardless of which language they are learning. This claim, however, cannot be truly supported until speakers of other languages are tested. In particular, it would be critical to examine speakers of a V-language such as Spanish. Future research must explore whether speakers of a V-language show the PATH/MANNER > COLOR bias at age 2 and the PATH > MANNER > COLOR pattern later on.

Although this dissertation is concerned with the *linguistic* process – how children and adults learn verbs – our findings seem to align with what has been reported in the language and thought literature, as differences in the accuracy between PATH and MANNER were found in abstraction tasks that measure attention (this dissertation and Maguire et al., 2010) but not in memory tasks (Emerson et al., 2015). Research on language and thought suggests that language may direct attention, but has minimal influence on how memory functions (Drivonikou, Kay, Regier, Ivry, Gilbert, Franklin, & Davies, 2007; Gilbert, Regier, Kay, & Ivry, 2006; Malt, submitted; Roberson, Pak, & Hanley, 2008; Winawer et al., 2007; Wright, 2012; Wright et al., 2015; but see Brown, Lindsey, & Guckes, 2011; Witzel & Gegenfurtner, 2011). Further, many studies reported that linguistic labels automatically shift one's attention even when the use of language is not prompted and when language seems irrelevant (Lupyan, 2012, Tan, Chan, Kay, Khong, Yip, & Luke, 2008; Thierry, Athanasopoulos, Wiggett, Dering, & Kuipers, 2009).

As this dissertation only tested the linguistic process of how individuals find referents of novel verbs, we do not yet know whether our findings reflect a general attentional bias or a linguistic one. The possibility exists that language shifts one's attention in similar ways in both linguistic and non-linguistic contexts. Future research must examine whether language shifts one's attention between PATH, MANNER, and COLOR, regardless of whether the given task is linguistic or not, and how much overlap exists between the linguistic and non-linguistic processes of conceptualizing motion events.

Conclusions

The relation between language and the human mind has been widely and heatedly debated for centuries. Although the majority of research focuses on how language influences the way we think, the other direction of influence – from world to word – is also of interest (Wolff & Malt, 2010). Using Talmy's semantic categories of motion as a starting point in this investigation, this dissertation evaluated how the semantic organization of language may be related to the ways in which children learn about event categories and might be implicated in the ease of learning verbs for those categories. The ways in which verbs label concepts vary widely across languages, and thus verbs are "hard words" to learn (Gleitman, Cassidy, Papafragou, Nappa, & Trueswell, 2005). We suggest that young language learners are able to solve the complex task of verb learning partially because verbs mark semantic elements of motion that are "natural" to us (Gentner & Bowerman, 2009).

The results of this study largely confirmed the psychological reality of Talmy's categories. We found that, for 2-year-olds who just started learning verbs, it is easier to learn verbs for semantic categories that are represented consistently across languages (PATH and MANNER of motion) than categories that are not encoded in any verbs in the world (COLOR of an actor). Our results not only provide support for the Typological Prevalence Hypothesis (Gentner & Bowerman, 2009), but also extend the theory by studying dynamic events at the level of category or cluster of words, and most importantly, by including concepts that are never lexicalized in the world's verb systems. We also demonstrated developmental changes in the word-to-world mappings. By age 4, children acquire a language-specific bias that enables efficient verb learning, although the bias continues to develop. This dissertation demonstrates how the semantic organization of language can provide a window into the complex process of verb learning. Our findings add a unique contribution to understanding the ways in which universal as well as language-specific factors may facilitate and constrain language development.

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APPENDIX A

LIST OF ANIMATIONS USED IN THE VERB LEARNING TASK

		PATH	MANNER	COLOR
PATH Trial 1	Video 1	past	spin	blue
	Video 2	past	jumping jacks	yellow
	Video 3	past	twist	red
	Correct	past	bend down	green
	Distracter	under	twist	red
PATH Trial 2	Video 1	around	spin	red
	Video 2	around	twist	green
	Video 3	around	bend down	orange
	Correct	around	jumping jacks	yellow
	Distracter	front	bend down	orange
PATH Trial 3	Video 1	front	jumping jacks	green
	Video 2	front	bend down	orange
	Video 3	front	toe touch	yellow
	Correct	front	spin	blue
	Distracter	over	toe touch	yellow
PATH Trial 4	Video 1	under	jumping jacks	yellow
	Video 2	under	toe touch	green
	Video 3	under	spin	red
	Correct	under	twist	orange
	Distracter	over	spin	red
MANNER Trial 1	Video 1	around	bend down	red
	Video 2	front	bend down	yellow
	Video 3	past	bend down	green
	Correct	under	bend down	blue
	Distracter	past	twist	green
MANNER Trial 2	Video 1	under	twist	yellow
	Video 2	past	twist	green
	Video 3	around	twist	blue
	Correct	front	twist	orange
	Distracter	around	toe touch	blue
MANNER Trial 3	Video 1	under	spin	green
	Video 2	over	spin	red
	Video 3	front	spin	orange
	Correct	past	spin	yellow
	Distracter	front	toe touch	orange
MANNER Trial 4	Video 1	front	jumping jacks	orange
	Video 2	under	jumping jacks	yellow
	Video 3	over	jumping jacks	red
	Correct	around	jumping jacks	green
	Distracter	over	spin	red

COLOR Trial 1	Video 1	front	jumping jacks	orange
	Video 2	over	spin	orange
	Video 3	past	twist	orange
	Correct	under	bend down	orange
	Distracter	past	twist	blue
COLOR Trial 2	Video 1	under	bend down	red
	Video 2	over	spin	red
	Video 3	front	toe touch	red
	Correct	past	jumping jacks	red
	Distracter	front	toe touch	green
COLOR Trial 3	Video 1	around	spin	yellow
	Video 2	past	twist	yellow
	Video 3	under	jumping jacks	yellow
	Correct	around	toe touch	yellow
	Distracter	under	jumping jacks	orange
COLOR Trial 4	Video 1	past	twist	green
	Video 2	front	jumping jacks	green
	Video 3	around	bend down	green
	Correct	over	spin	green
	Distracter	around	bend down	blue

APPENDIX B

RESULTS OF THE STIMULUS SELECTION STUDY

Trial Type	Animation 1	Animation 2	*t*	*df*	*p*
PATH	past	under	.70	13	.50
	around	front	.65	12	.53
	front	over	1.49	11	.16
	under	over	.09	12	.93
	past	front	.86	12	.41
	around	over	1.35	11	.20
	around	under	.27	11	.79
MANNER	bend down	twist	.23	13	.82
	jumping jacks	bend down	1.05	12	.31
	spin	toe touch	.46	11	.65
	twist	spin	1.60	12	.14
	twist	toe touch	1.14	11	.28
	jumping jacks	spin	1.41	12	.18
	jumping jacks	toe touch	.39	13	.71
	spin	bend down	.95	13	.36
COLOR	green	red	.04	12	.97
	yellow	orange	.88	11	.40
	blue	yellow	.40	13	.70
	orange	red	.11	11	.91
	blue	green	.79	12	.44
	orange	blue	1.23	12	.24

APPENDIX C

BACKGROUND QUESTIONNAIRE FOR ADULTS

TICL
Temple Infant & Child Lab

Background Questionnaire

Name: ______________________________

DOB: __________

Your ethnic background (please circle all that apply):

a) American Indian or Alaskan Native
b) Asian or Pacific Islander
c) Black or African American (not of Hispanic Origin)
d) Hispanic or Latino
e) White or Caucasian (not of Hispanic origin)
f) Other, please specify: __________________

Have you had any significant health problems, including hearing or vision impairment? If so, please describe____

Do you have a parent, sibling, or child with color blindness? __________

Language(s) you speak: ____

For languages other than English, what is your proficiency level? Please describe.

____
_

APPENDIX D

BACKGROUND QUESTIONNAIRE FOR CHILDREN

TICL
Temple Infant & Child Lab

Background Questionnaire

CHILD INFORMATION

Child's Name: ________________________________

Child's DOB: __________

Child's ethnic background (please circle all that apply):

a) American Indian or Alaskan Native
b) Asian or Pacific Islander
c) Black or African American (not of Hispanic Origin)
d) Hispanic or Latino
e) White or Caucasian (not of Hispanic origin)
f) Other, please specify: ___________________

Has your child had any significant health problems, including hearing or vision impairment? If so, please describe____

Does your child have a parent or sibling with color blindness? __________

Language(s) spoken at home:
____

For languages other than English, what percentage of the time is your child exposed to this language (e.g., 20%)? ______________

APPENDIX E

VOCABULARY MEASURE FOR 2-YEAR-OLDS

MacArthur Short Form
Vocabulary Checklist: Level II (Form A)

Child's Name ______________________ **Sex** ________

Birthdate ______________________ **Today's Date** ______________________

VOCABULARY CHECKLIST

Children understand many more words than they say. We are particularly interested in the words your child SAYS. Please mark the words you have heard your child use. If your child uses a different pronunciation of a word, mark it anyway.

baa baa	◯	hat	◯	sky	◯	all gone	◯
meow	◯	necklace	◯	party	◯	cold	◯
ouch	◯	shoe	◯	friend	◯	fast	◯
uh oh	◯	sock	◯	mommy	◯	happy	◯
woof woof	◯	chin	◯	person	◯	hot	◯
bear	◯	ear	◯	bye	◯	last	◯
bird	◯	hand	◯	hi	◯	tiny	◯
cat	◯	leg	◯	no	◯	wet	◯
dog	◯	broom	◯	shopping	◯	after	◯
duck	◯	comb	◯	thank you	◯	day	◯
horse	◯	mop	◯	carry	◯	tonight	◯
airplane	◯	plate	◯	chase	◯	our	◯
boat	◯	trash	◯	dump	◯	them	◯
car	◯	tray	◯	finish	◯	this	◯
ball	◯	towel	◯	fit	◯	us	◯
book	◯	bed	◯	hug	◯	where	◯
game	◯	bedroom	◯	listen	◯	beside	◯
applesauce	◯	bench	◯	like	◯	down	◯
candy	◯	oven	◯	pretend	◯	under	◯
coke	◯	stairs	◯	rip	◯	all	◯
cracker	◯	flag	◯	shake	◯	much	◯
juice	◯	rain	◯	taste	◯	could	◯
meat	◯	star	◯	gentle	◯	need	◯
milk	◯	swing	◯	think	◯	would	◯
peas	◯	school	◯	wish	◯	if	◯

Has your child begun to combine words yet, such as "nother cookie" or "doggie bite?"

◯ **Not Yet** ◯ **Sometimes** ◯ **Often**

Additional Word List
Please check off all words that your child SAYS:

VERBS:

_______ bite	_______ blow	_______ break	_______ dry
build	bump	buy	take
_______ catch	_______ chase	_______ clap	_______ think
_______ climb	_______ close	_______ cook	_______ wait
_______ cry	_______ cut	_______ dance	_______ watch
_______ drink	_______ drive	_______ drop	_______ write
dump	eat	fall	feed
_______ find	_______ finish	_______ fit	_______ fix
_______ get	_______ give	_______ go	_______ hate
_______ have	_______ hear	_______ help	_______ hide
_______ hit	_______ hold	_______ hug	_______ hurry
jump	kick	kiss	knock
_______ lick	_______ like	_______ listen	_______ look
_______ love	_______ make	_______ open	_______ paint
_______ pick	_______ play	_______ pour	_______ pretend
_______ pull	_______ push	_______ put	_______ read
ride	rip	run	say
_______ see	_______ shake	_______ share	_______ show
sing	sit	skate	sleep
_______ slide	_______ smile	_______ spill	_______ splash
_______ stand	_______ stay	_______ stop	_______ sweep
_______ swim	_______ swing	_______ bring	_______ talk
_______ taste	_______ tear	_______ carry	_______ throw
_______ tickle	_______ touch	_______ clean	_______ wake
_______ walk	_______ wash	_______ cover	_______ wipe
_______ wish	_______ work	_______ draw	

PREPOSITIONS AND LOCATIONS:

_______ about	_______ above	_______ around	_______ at
_______ away	_______ back	_______ behind	_______ beside
by	down	for	here
_______ inside/in	_______ into	_______ next to	_______ of
off	on	on top of	out
_______ over	_______ there	_______ to	_______ under
_______ up	_______ with		