Semantic features of early verb vocabularies

Sabrina Horvath[1], Leslie Rescorla[2], and Sudha Arunachalam[1]

[1]Boston University

[2]Bryn Mawr College

Author notes: Correspondence regarding this article should be addressed to Sabrina Horvath, the corresponding author (shorvath@bu.edu). Funding for this study was provided the NIH (K01 DC013306: PI Sudha Arunachalam).

This chapter has been submitted to the forthcoming volume, *Semantics in Acquisition* for publication by John Benjamins in the Trends in Language Acquisition Research series

Abstract

Much research has asked why verbs are difficult to acquire, and how toddlers nevertheless acquire them. Still, we know little about what *kinds* of verb meanings are easy or difficult to acquire. We revisit Rescorla and colleagues' data on vocabulary knowledge in toddlers acquiring English, Italian, Greek, Korean, and Portuguese measured using the Language Development Survey. We coded the survey's verbs for several semantic features to determine which features predict appearance in toddlers' vocabularies. For English, manner and result verbs were equally well known across samples, but verbs labeling durative events and events with fewer event participants were more likely to be known than those labeling punctual events and events involving more participants. Similar trends held in the other languages.

Keywords

Vocabulary Composition, Verbs, Lexical Semantics, Verb Learning, Cross-Linguistic, Language Development Survey

1. Introduction

Acquiring the meanings of verbs is a notoriously difficult challenge for young learners for several reasons, including the complexity of the meanings they encode (e.g., Gentner, 1978) and the difficulty of identifying the intended referent simply by observing the world when a new verb is uttered (e.g., Gleitman, 1990). But the trajectory of verb acquisition appears far from arbitrary; young children typically acquire similar verbs early on (e.g., Naigles et al., 2009). Several factors are likely to affect whether a verb will be easy or difficult to acquire, such as its frequency in the input (Goodman, Dale, & Li, 2008), the frequency and diversity of contexts in which it appears (e.g., Naigles & Hoff-Ginsberg, 1998), and the imageability of the concept it labels (e.g., Gillette, Gleitman, Gleitman & Lederer, 1999; Ma, Golinkoff, Hirsh-Pasek, McDonough & Tardif, 2009).

Here, we focus in more detail on the semantic properties of verbs and the concepts they denote as potential indicators of how likely a verb is to occur in the early lexicon. For example, we might predict that verbs denoting fleeting events are more difficult to acquire than verbs denoting long-lasting events, as there is simply less time to observe them. As yet there are no systematic studies of which kinds of meaning are easiest to acquire, nor do we know how universal such patterns might be across typologically different languages. Here, we take a first pass at these questions by investigating 2-year-old toddlers' verb vocabularies in a large sample of English-acquiring toddlers as well as toddlers acquiring Greek, Italian, Korean, and Portuguese to determine whether certain semantic features are more widely represented than others. Our data set comes from Rescorla's (1989) Language Development Survey, a parent report vocabulary checklist adapted for each of these languages.

In addition to analysis of parent reports of vocabulary, methods used to understand the composition of toddlers' early lexicons include experimental novel verb learning studies and diary studies. For the youngest toddlers, many studies have asked about the difficulty of acquiring verbs as compared to nouns, and whether such difficulty is universal or language-specific (e.g., Bornstein et al., 2004; Imai et al., 2008; Tardif, 1996; Tardif, Gelman, & Xu, 1999; Waxman et al., 2013). One factor invoked in such discussions is the different kinds of concepts to which (early-acquired) nouns and verbs typically refer; for example, Gentner (1982) argued that nouns are easier to learn because they often refer to concrete entities, whereas verbs often refer to relational concepts. But even within a grammatical category, different types of concepts are represented. For example, verbs can label states as well as actions, and even action verbs can differ in a variety of meaning-related features. For this reason we think it necessary to look at different types of verb meaning rather than only grammatical distinctions between nouns and verbs (e.g., Maratsos, 1990).

Some semantic properties of early verbs have been studied in prior work, albeit in a scattered way. For example, imageability of the concept being labeled relates to ease of verb acquisition (e.g., Gillette et al., 1999; Ma et al., 2009); verbs describing mental states may be particularly difficult to acquire for this reason (e.g., Papafragou, Cassidy, & Gleitman, 2007). Similarly, concrete action verbs may be more easily acquired than verbs labeling abstract concepts (e.g., Bassano, 2000). Novel verb learning studies, too, have used a variety of verb and event types, but different types are rarely contrasted within a single study (Naigles & Kako, 1993 is an important exception, as is Scott, Gertner, & Fisher, this volume). Perhaps the best studied semantic notion with respect to ease of acquisition in English-acquiring toddlers is whether a

verb encodes a manner or a result of action. To date, however, this literature is conflicted, as we will see below.

Central to our approach is the inclusion of data from a variety of languages. Despite linguistic and cultural differences, studies examining the composition of the lexicon, often using a vocabulary checklist, have found similarities in the words and word types that are early acquired across languages (e.g., Bornstein et al., 2004; Dale & Goodman, 2005). However, when it comes to specific verb types, we know little about the extent to which there are cross-linguistic similarities or differences. A notable exception to this is in the domain of manner and path verbs; this distinction has garnered much interest in the literature and has been the focus of much cross-linguistic research (e.g., Allen et al., 2007; Berman & Slobin, 1994). In the case of manner and path, because languages have a strong tendency to lexicalize one or the other, the expected outcome (and indeed the consistent finding) of such studies is that children have a bias corresponding to the bias evident in their language. In the current study, we examine dimensions that are *not* manifested in wholly or systematically different ways in the typologically different languages under investigation to ask whether within each language, some verb types appear in greater numbers than others, and whether such patterns are consistent across languages.

The specific semantic dimensions we investigate are: whether the verb encodes a manner or a result (e.g., *clap* vs. *close*); whether the verb describes events that are typically durative or punctual (e.g., *read* vs. *cough*); and the number of (semantic) event participants involved in the event the verb denotes (e.g., 1: *nap*, 2: *eat*, 3: *bring*). These distinctions are expected to provide insight into what kinds of semantic representations are easy to form.

1.1. Our dataset: Data from the Language Development Survey (Rescorla, 1989)

Rescorla's (1989) Language Development Survey (LDS) is a parent-report questionnaire of expressive vocabulary development designed to screen for language delay. Parents complete a 310-word checklist of expressive vocabulary, in addition to information about the toddler's family and medical history. The LDS has been shown to be a reliable and valid instrument (Rescorla, 1989). Normed on a U.S. national probability sample of 274 toddlers (Rescorla & Achenbach, 2000), the checklist has been adapted for use in several other countries.

For this study, we revisited the data collected by Rescorla and her colleagues, focusing on 45 verbs in the checklist. In addition to the English data, we analyzed data from five other language samples, reported originally for Greek in Papaeliou and Rescorla (2011), for Italian from two different regions—North Italy and Rome—in Rescorla, Frigerio, Sali, Spataro, & Longobardi (2014), for Korean in Rescorla, Lee, Oh, & Kim (2013), and for Portuguese in Rescorla, Nyame, and Dias (2016). In all cases, Rescorla and her team carefully translated and adapted the LDS to be culturally and linguistically appropriate. Overall, they noted considerable similarity in their U.S. and other samples with respect to number and types of words known by toddlers, setting the stage to ask more fine-grained questions about whether the same is true for verbs specifically and for specific semantic categories of verbs.

We chose to use data from the LDS for two reasons. First, the survey methods allowed for a much larger data sample than can be typically achieved through experimental paradigms or diary studies. Second, the survey questionnaire allowed us to study what children are doing naturally in the process of language development, as opposed to what they do in laboratory contexts.

2. Methods

2.1. Participants

The U.S. sample included 274 toddlers (133 males, 141 females) ranging in age from 18 to 35 months (mean age 26 months, SD 5 months). The toddlers were further grouped by age. The youngest group ranged from 18 to 23 months, the next from 24 to 29 months, and the oldest from 30 to 35 months. For detailed sample information, see Rescorla and Achenbach (2000). On average, toddlers knew 53% of the verbs on the checklist, but this varied widely across the age range, with many of the youngest toddlers knowing none and many of the oldest knowing all.

The sample sizes for all language groups are listed in Table 1. All toddlers were ages 18 to 35 months of age, with the exception of two from the Korean sample, one who was 16 months and the other 17 months. We excluded a small number of toddlers from the Greek sample who were over 35 months of age.

Table 1. Sample size

	English	**Greek**	**Italian (North Italy)**	**Italian (Rome)**	**Korean**	**Portuguese**
Total	274	260	324	175	2191	198
Male	131	127	168	93	1162	114
Female	141	133	156	82	1029	84
Youngest age group	101	40	86	48	807	49
Middle group	90	78	126	60	831	70
Oldest group	83	142	112	87	553	79

2.2. Verbs

Though we used the LDS checklist's own designation of "action" words to determine which words to include in our list of verbs, we excluded "dinner," "down," "lunch," "outside," "pattycake," "peekaboo," and "up" because they are not realized as verbs in adult speech. Note that the "action" words category of the checklist includes stative as well as eventive verbs. There were words in other sections of the checklist that in English have identical phonological forms for both nouns and verbs (e.g., snow, swing). We excluded these from our analyses because the forms for these in some of the other languages in our sample contained unambiguous morphological cues signaling their grammatical category. We only studied verbs that appeared on all languages' checklists.

2.3. Semantic dimensions

We coded each verb on three dimensions: whether it encodes a manner or result, whether the event it labels is punctual or durative, and the number of event participants typically associated with its referent.

2.3.1. Manner vs. Result

The distinction between manner and result verbs has garnered significant attention in the study of verb acquisition. However, the results of these studies do not clearly indicate a single trajectory. Some evidence suggests that toddlers' early productions demonstrate a bias for result meanings. Even at the one-word stage, the result components of events appear to be salient for toddlers. Across languages, early words express meanings like "all gone" or "all done" (e.g., Gopnik & Meltzoff, 1986; Behrens, 1993; de Lemos, 1981) and particles like "up" are used to

express changes of state (e.g., Clark, 1995; Clark, Carpenter, & Deutsch, 1995; Greenfield & Smith, 1976; Penner, Schulz, & Wymann, 2003; Tomasello, 1992). Once toddlers begin to use verbs to express state changes, result verbs are commonly attested. Huttenlocher, Smiley, and Charney (1983), for example, found that a majority of the verbs used by 2-year-olds were result verbs.

On the other hand, Gentner (1978) and Gropen, Pinker, Hollander, & Goldberg (1991) reported a manner bias; they found that children had more difficulty identifying changes of state as referents for result verbs than in identifying manners of motion as referents for manner verbs. Similarly, Bowerman (1982) found more argument structure errors with result verbs than manner verbs. One explanation for this is that children had more difficulty encoding appropriate meanings for the result verbs. Forbes and Poulin-Dubois (1997) found that toddlers under 2 years of age view manner as crucial to the meanings of familiar verbs; they were reluctant to extend familiar verbs —even those with resultive meanings, like “pick up”—to situations involving a different manner than their first training exemplar.

Novel verb learning studies testing extension of novel verb meanings to new situations have had mixed results. Behrend (1990) presented 3-year-olds with novel verbs in the context of a scene depicting both a manner and a change of state. When asked to extend the verbs to new events, children were more likely to extend them to actions with a different manner of motion from the original than a different result state, suggesting that they construed the result state as critical to verb meaning. However, when asked to name actions, the 3-year-olds were more likely to choose a verb encoding the manner of the action rather than result when both were appropriate. In contrast to Behrend’s (1990) findings, Forbes and Farrar (1995) found that both manner and result meanings could be extended in a novel verb learning task, dependent on the

variability (or lack thereof) among multiple learning opportunities. One important consideration for novel verb studies is whether children find particular kinds of meaning to be better candidates for what is being labeled by an unfamiliar verb. Choi and Arunachalam (2013) argued that, despite the fact that Korean more often labels path in lexical verbs and manner in satellite phrases (e.g., Choi & Bowerman, 1991), young Korean learners nevertheless preferentially assign manner meanings to novel verbs because it is easier to imagine a new manner of action than a new path of movement. A similar situation may hold for manner vs. result meanings, because although there may be many ways of doing something (manners), the number of possible outcomes (results) is limited.

Given the conflicting literature, it is unclear whether children have manner or result biases in early vocabulary development. Our approach in the current study offers a new perspective to this issue. We analyze data from a large data set—a large number of participants, and a large number of (familiar) words in each of several languages—and we ask about toddlers' existing productive vocabularies rather than examining the vagaries of a novel word learning context, in which it can be extremely difficult to equate the salience or naturalness of the manner and result components being depicted.

To pursue this, we coded the verbs on the LDS for whether they lexicalize manner or result. Fortunately for the purposes of this investigation, the manner vs. result distinction is well studied, particularly by Levin and Rappaport Hovav (e.g., 1991, 1995, 2010, 2013), who have noted a number of reflexes of manner vs. result encoding in argument realization patterns such as the appearance of manner, but not result verbs, in the conative alternation (e.g. *John hit at the wall / *John broke at the wall*) (see also Fillmore, 1970). They have also argued that manner and result are in strict complementarity; that is, a verb can encode only one of these two components

(but see Beavers & Koontz-Garboden, 2012; Husband, 2011; Rissman, 2015). For our coding, we used diagnostics in Beavers and Koontz-Garboden (2012) (e.g., if it is possible to deny the result of an action, the verb must be a manner verb, as with, *I* walked*, but nothing happened*, but not with #*I* closed *the door, but nothing happened*). We excluded stative verbs and verbs whose semantics we considered unclear on this basis, or whose semantics have been explicitly discussed in the literature and argued to be polysemous—notably, "cut" (Levin & Rappaport Hovav, 2010, 2013).

Although languages may differ in their specific representations of apparently translation-equivalent verbs, for present purposes we extend the coding for English to these other languages as an approximation. We await the development of language-specific diagnostics for each of the languages in our sample before refining our categories.

2.3.2. Durative vs. Punctual

If learning the meaning of a verb requires that a child match the linguistic referent to the action it denotes, one complication of verb learning particularly is the ephemerality of many actions. For example, if a toddler hears, "Look! The boy's gonna kick the ball!" but fails to quickly orient to the soccer player, she may not witness the kicking, and may thus miss an opportunity to acquire the verb's meaning. We predict, then, that verbs describing typically durative events will be more easily acquired than verbs describing punctual events. This is, of course, a hypothesis about averages; any given verb may not fall into this pattern. For example, although *breaking* is a punctual event, the resultant change of state can be quite salient. (The verb "break" is not on the LDS, although norms for the MacArthur-Bates Communicative Development Inventory suggest that it is relatively early acquired (Dale & Fenson, 1996).) To

date, we are aware of only one study that has examined this distinction between punctual and durative actions (Abbot-Smith, Imai, Durrant & Nurmsoo, in press), which found that children have difficulty learning verbs that describe punctual events.

We coded the verbs on the LDS as "durative" or "punctual," again omitting verbs that were stative or difficult to code along this dimension. Punctual verbs are either incompatible with or receive iterative interpretations when they occur with temporal expressions that denote a protracted duration (e.g., *#The glass broke for two hours*). Note that the durative vs. punctual distinction is orthogonal to the manner vs. result distinction; for example, semelfactive verbs like *clap*, of which the LDS has four, encode manner but reference an event that is temporally punctual (Comrie, 1976; Smith, 1991).

2.3.3. Number of obligatory event participants

The complexity of an event may be related to the number of event participants it necessarily involves. Events like *sleeping* require only one participant, while events like *giving* require a giver, a recipient, and a thing given. Fisher and colleagues have argued that toddlers initially map the number of entities they hear named in an utterance to the number of event participants in an event (e.g., Fisher, 1996; Gertner & Fisher, 2012; Yuan, Fisher, & Snedeker, 2012), indicating that the number of event participants is an important cue to which toddlers attend. We hypothesized that the more event participants required, the more difficult the verb would be to acquire. This is because it may be difficult for learners to identify which particular event among all those each event participant is involved in, or which participant's perspective on the event, is being encoded (Gleitman, 1990).

For this dimension, we coded the smallest number of event participants that could occur in the event described by the verb. For example, the verb *hit* obligatorily has an agent and a patient/theme, as in "The girl *hit* her teddy bear," but may also have an optional instrument, as in "The girl *hit* the ball with her racket." Here, we code *hit* as having two obligatory event participants. The distinction is similar to the number of syntactic arguments, except that we included instruments (e.g., for *cut,* which may be realized in a transitive sentence such as "I *cut* the paper," but typically requires an agent, patient/theme, and instrument) and implicit objects (e.g., for *eat*, which may be realized in an intransitive sentence but necessarily requires an agent and patient/theme).

2.4. Covariates

2.4.1. Frequency

We expect toddlers to more easily acquire verbs that are highly frequent in their input. To study the importance of the coded semantic dimensions while acknowledging the importance of input frequency, we included it as a factor in our analyses for English, but we lacked rich coded corpus data for the other languages. For English, we used Li's (2001) frequency counts of the speech uttered by parents, caregivers, and experimenters in the corpora in the CHILDES database (Li & Shirai, 2000; MacWhinney, 2000). We included all forms of the verb (e.g., infinitive, perfective, progressive); noun forms (e.g., *a kiss*) were also included because the tokens were not categorized by grammatical category. This yielded a large range of frequencies, from 64 (for *clap*) to 36,581 (for *go*). We grouped these as follows: low frequency (< 800

occurrences, e.g., *knock*), mid frequency (800-2,000 occurrences, e.g., *close*), and high frequency (> 2,000 occurrences, e.g., *give*). Table 2 lists the verbs in each group.

Table 2. Frequency groupings, based on the CHILDES Parental Corpus

Low Frequency (fewer than 800)	**Medium Frequency (800 to 2000)**	**High Frequency (more than 2000)**
catch	close	bring
clap	cut	come
cough	fix	eat
dance	hit	finish
feed	love	get
hug	open	give
jump	push	go
kick	read	have
kiss	ride	help
knock	run	look
nap	sing	make
shut	sleep	see
tickle	stop	show
	throw	sit
	walk	take
	wash	want

2.4.2. Imageability

Given the role attributed to imageability in prior work on verb acquisition (e.g., Gillette et al., 1999; Ma et al., 2009) we initially planned to include imageability, using Cortese and Fugett's (2004) imageability ratings; almost all of the LDS words were included in their list. However, imageability according to these ratings and frequency—coded as reported above—were inversely correlated for the verbs on the LDS (r = -0.74), and preliminary analyses indicated that imageability played far less of a role than frequency (but see Snedeker, Zeitlin, & Crawford, 2013). Thus, we ultimately did not include imageability in the analyses reported

below. The inverse correlation is not surprising given that many of the highest frequency verbs on the LDS are light verbs that are not very imageable, such as “get” and “make.”

3. Results

First, we coded each of the verbs from the LDS for the semantic dimensions of manner vs. result, punctual vs. durative, and minimum number of event participants, using the criteria outlined in section 2.3. Those verbs that could not be coded reliably in one of these dimensions were excluded from analysis for that particular dimension. The results of this coding are listed in Table 3.

Table 3. Semantic coding for all of the verbs that were included in the mixed-effects analyses. Dots indicate that a verb did not receive a code for a particular distinction, due to difficulty establishing the appropriate value (e.g., because of conflict in the literature).

Verb	Manner vs. Result	Durative vs. Punctual	Number of Event Participants
bring	result	punctual	3
catch	result	punctual	2
clap	manner	punctual	1
close	result	punctual	2
come	result	punctual	1
cough	manner	punctual	1
cut	.	.	3
dance	manner	durative	1
eat	result	durative	2
feed	.	durative	3
finish	result	punctual	.

fix	result	punctual	2
get	result	punctual	3
give	result	punctual	3
go	result	.	1
have	.	.	2
help	result	.	.
hit	manner	punctual	2
hug	manner	durative	2
jump	manner	punctual	1
kick	manner	punctual	1
kiss	manner	.	2
knock	manner	punctual	2
look	.	durative	2
love	.	.	2
make	result	.	2
nap	manner	durative	1
open	result	punctual	2
push	manner	.	2
read	manner	durative	2
ride	manner	durative	2
run	manner	durative	1
see	.	durative	2
show	manner	durative	3
shut	result	punctual	2
sing	manner	durative	1
sit	.	.	1
sleep	manner	durative	1
stop	result	punctual	.
take	result	punctual	3
throw	manner	punctual	2
tickle	manner	durative	2
walk	manner	durative	1
want	.	.	.
wash	manner	durative	2

Following this, for each verb in each language, we calculated the percentage of toddlers who were reported to use it (called a *percentage use score* following Rescorla and Safyer

(2013)). Note that this figure is not the same as the age at which the verb is acquired, but we would expect the two to be correlated; the earlier a verb is acquired, the more likely it is to be known across the age range represented in the sample. Table 4 lists the ten verbs with the highest percentage use score in each language. Notably, the lists are similar across languages, with verbs labeling bodily activities (*eat, sleep*) on all lists. Unsurprisingly, the two samples from Italy are the most similar to each other.

Table 4. Ten verbs known by the largest percentage of toddlers in each sample (alphabetical order)

English	**Greek**	**Italian (North Italy)**	**Italian (Rome)**	**Korean**	**Portuguese**
eat	eat	close	clap	eat	close
go	have	dance	close	get	come
hug	kiss	eat	dance	go	dance
kiss	love	go	eat	jump	eat
love	make	kiss	kiss	love	give
open	open	open	open	ride	open
see	read	ride	ride	see	sing
sit	run	run	run	sleep	sit
sleep	sleep	sleep	sleep	sit	sleep
stop	want	wash	wash	want	wash

Next, we asked whether toddlers' knowledge of the verbs was related to the semantic dimensions of manner vs. result, punctual vs. durative, and minimum number of event participants. In each analysis, we fit the raw data to a mixed-effects regression model (binomial family); the outcome measure was a binary measure of whether the toddler knew the verb. We included participant and verb as random factors and age group, gender, and the semantic dimension as fixed factors. Analyses were conducted using the glmer() function in R (v. 2.14.2) (Bates, Maechler & Bolker, 2012; R Development Core Team, 2012). To test significance, we

used the *z*-test and *p*-values output by glmer(). For the English analyses, we also included each verb's input frequency group (as listed in Table 2), and the interaction of frequency with the semantic dimension, as fixed factors.

3.1. Manner vs. Result

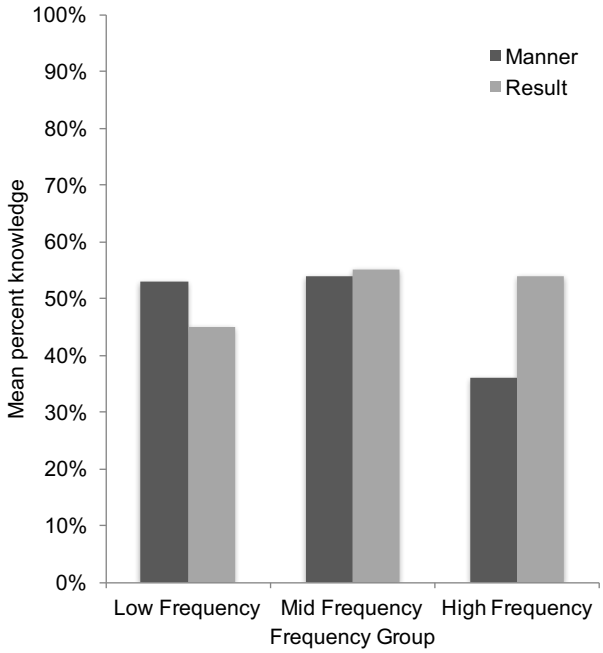
3.1.1. English

Our coding using the diagnostics in Beavers and Koontz-Garboden (2012) yielded 21 manner verbs and 16 result verbs; coding was done by the first and third authors. Interestingly, these were equally represented in the lexicons of young English learners. Across toddlers and verbs, mean knowledge of manner verbs was 52%, and of result verbs, 53%. Note that these percentages are not percentage use scores, which reveal the percentage of *toddlers* who know a particular word, but simply the average, collapsing across all toddlers and the 37 verbs, of the binary variable indicating whether each verb is known or not—that is, given, for example, 274 toddlers and 37 verbs for a total of 10,138 data points consisting of 0s and 1s, we asked what the average was across all of these data points. We call this measure *mean percent knowledge*. Figure 1 depicts scores by frequency group. A mixed-effects model with participant and verb as random factor, and gender, age group, frequency group, and whether the verb encoded manner or result as fixed factors yielded only main effects of gender and age group. Here, as with all analyses in which gender and age group were significant, females knew more verbs than males and older toddlers knew more verbs than younger toddlers. However, whether a verb encoded manner or result did not contribute significantly to this model, and thus we infer that the manner-

result distinction does not predict verb knowledge. Model parameter estimates are in Table 5 in the online supplementary material.

This finding, despite that it does not confirm most of the prior literature, some of which finds a manner bias and others of which finds a result bias, is perhaps satisfying nevertheless. That knowledge of manner and result verbs were similar suggests that across the lexicon—as opposed to within a small group of events and verbs tested in laboratory experiments—neither component or interpretation is salient to the exclusion of the other. Of course, it may be that within any given learning situation, a bias in one direction or the other exists, but toddlers apparently manage to overcome such difficulties to acquire both kinds of verbs within the first three years of life.

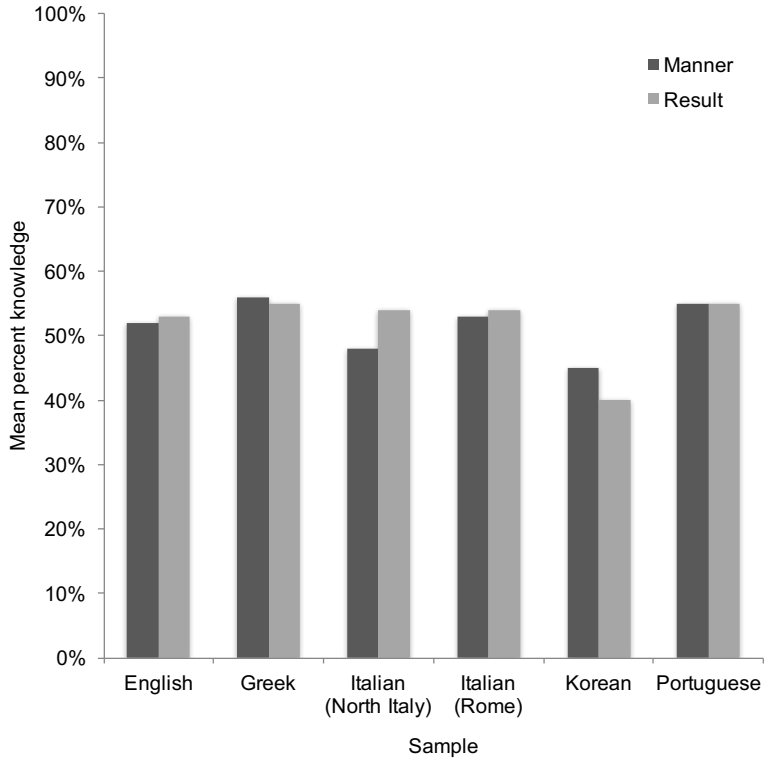
Figure 1. Mean percent knowledge of manner and result verbs by frequency group for English-acquiring toddlers



3.1.2. Other languages

Recall that we acknowledge that the classification of English verbs as manner or result verbs carries over only imperfectly to other languages, but we used it as a rough guide in the present analysis. The balanced representation of manner and result verbs held up across languages, as evident in Figure 2. In mixed-effects models for each language as described for English, we found no main effects of manner vs. result. For the Greek sample, we found a main effect of age group and a marginal effect of gender ($p = 0.05$). For the two Italian samples and the Korean sample, we found main effects of age group and gender. For the Portuguese sample, we found only a main effect of age group. Model parameter estimates are in Table 6 in the online supplementary material.

Figure 2. Mean percent knowledge of manner and result verbs across languages

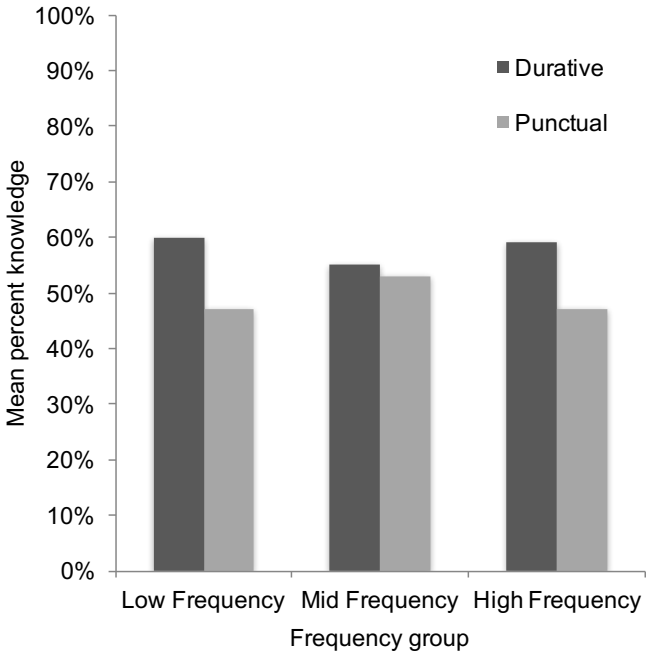


3.2. Durative vs. Punctual

3.2.1. English

Our coding, done by the first and third authors, yielded 15 durative verbs and 16 punctual verbs. For English, mean percent knowledge of durative verbs was 55%, and for punctual verbs, 49%; our mixed-effects model yielded a main effect of this factor ($p < 0.05$). We also found main effects of gender and age group, but no main effect or interaction involving frequency group. Model parameter estimates are in Table 7 in the online supplementary material. Figure 3 depicts the English scores by frequency group. Although toddlers' verb knowledge increased across frequency groups for both durative and punctual verb types, this was not robust enough to yield a statistically significant difference.

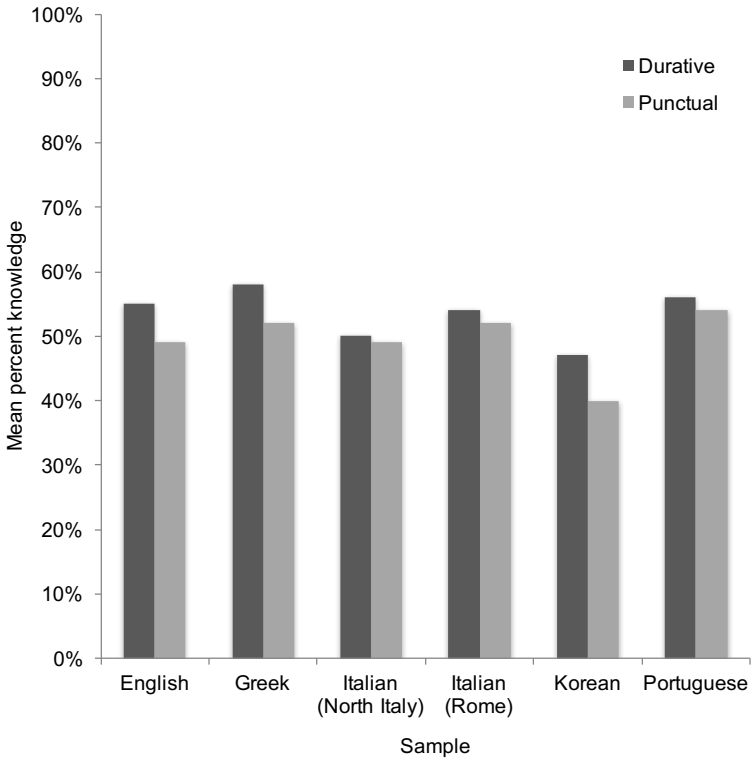
Figure 3. Mean percent knowledge for durative and punctual verbs by frequency group for English-acquiring toddlers



3.2.2. Other languages

See Figure 4. By contrast with English, among the other languages, only in Korean did we find an effect of whether a verb labeled a durative or punctual event ($p < 0.02$). In addition to this main effect, in all languages we found a main effect of age group; and for Greek, Italian, and Korean we also found a main effect of gender. For Portuguese, we did not find a gender effect (not surprisingly, given the lack of gender effect for manner vs. result). In all languages the trend, at least, is in the same direction as for Korean and English: durative verbs are better known than punctual verbs. Model parameter estimates are in Table 8 in the online supplementary material.

Figure 4. Mean percent knowledge for durative and punctual verbs across languages

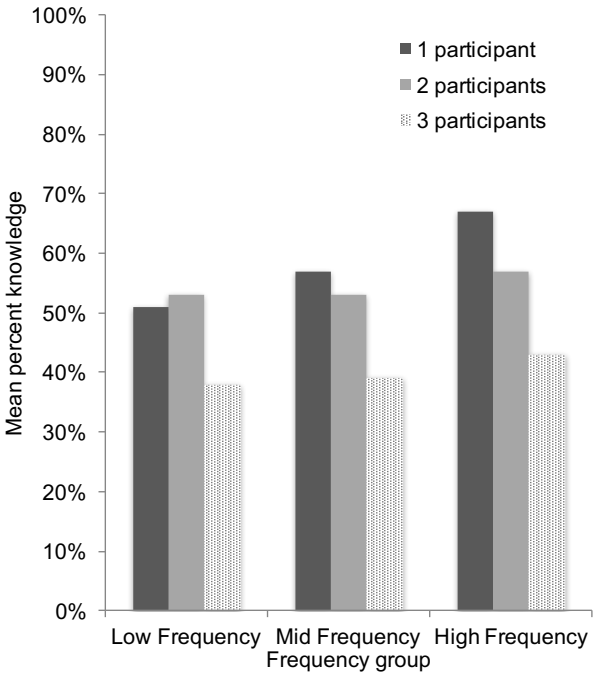


3.3. Number of obligatory Event Participants

3.3.1. English

Our coding yielded 13 1-participant verbs, 21 2-participant verbs, and 7 3-participant verbs. English learners showed a clear effect of the number of event participants; mean percent knowledge scores were 56% for 1-participant verbs, 54% for 2-participant verbs, and only 42% for 3-participant verbs. Inspection of Figure 5, which depicts these means by frequency group, reveals that the number of event participants appeared most important for high-frequency verbs. A mixed-effects model yielded the anticipated main effect of event participant number ($p < 0.005$), as well as main effects of age group, gender, and frequency. These findings indicate that the number of event participants mattered over and above differences in input frequency. Model parameter estimates are in Table 9 in the online supplementary material.

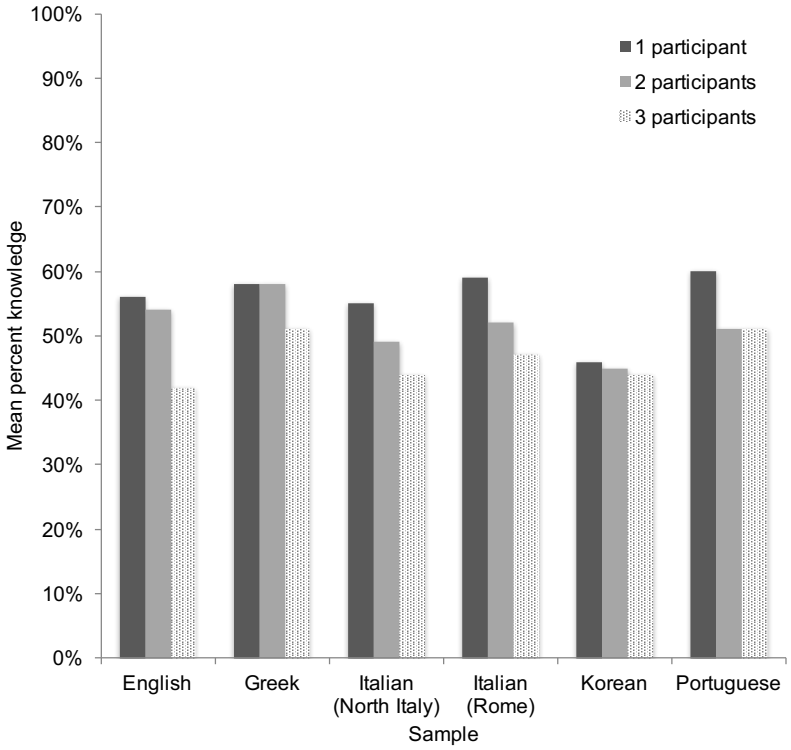
Figure 5. Mean percent knowledge for 1-, 2-, and 3-participant verbs by frequency group for English-acquiring toddlers



3.3.2. Other languages

Findings from the other languages were mixed. See Figure 6. Significant effects of event participant number obtained for toddlers from Rome and Portugal (both *p*s < 0.04). For Greek, Korean, and Northern Italian, there was no such effect. It was not the case in any language, however, that toddlers knew 2-participant verbs more than 1-participant verbs, or 3-participant more than 2-participant verbs, though in some cases percent knowledge was the same for two of the categories. All languages showed significant effects of age group and gender, with the exception of gender for Portuguese. Model parameter estimates are in Table 10 of the online supplementary material.

Figure 6. Mean percent knowledge for 1-, 2-, and 3-participant verbs across languages



4. Discussion

Our goal in the current study was to use vocabulary checklist data from a large number of toddlers and several languages to ascertain what kinds of verbs toddlers have in their productive vocabularies. We chose three semantic properties of the verbs: whether they describe a manner or result, whether they describe durative or punctual events, and whether these events involve one, two, or three event participants. We are most confident about our analyses of English, given that (a) the diagnostics we used are specific to English and translation equivalents in other languages may have quite different grammatical properties, and (b) we were only able to include input frequency for the English data. Nevertheless, it is intriguing that there appear to be similar trends across languages.

4.1 Summary of results

With respect to manner vs. result, we found no difference in any language group. For English, this was true even after accounting for the frequencies of the verbs in child-directed speech. Given that we aimed for a large-scale systematic analysis of manner and result verbs across the lexicon and across languages, it is interesting but perhaps not surprising that our findings point to a middle ground between those focused studies on novel verb learning or those focused on a small subset of verbs that have found either a manner preference or a result preference (see also van Hout, this volume, for related discussion). Our results thus contribute a new perspective on this manner/result distinction, indicating that once a large group of verbs, and a large group of toddlers, is investigated, biases for manner or result components wash out in toddlers' productive vocabularies.

Numerically, across language groups, verbs describing durative events were better known than verbs describing punctual events, although this difference was statistically reliable only for English (which had input frequency included in the analysis) and Korean. The directionality for these two languages, and the non-reliable trends for the other languages, are as predicted: we suspected that verbs describing events that are easily observed over a period of time would be easier to acquire than verbs describing events that occur quickly. The importance of durativity is interesting in light of the null result we found for the manner-result distinction; after all, manner verbs often describe durative events. Four of the punctual verbs on the LDS are semelfactives (manner verbs describing punctual events, such as *cough*), which might be expected to be more difficult to acquire given that they cross-cut other semantic categories, but in our data set the

mean percent knowledge for semelfactives (47%) was similar to that for non-semelfactive punctual verbs (49%). Nevertheless, semelfactives may be a useful place for future work to look to understand the ease or difficulty of acquiring verbs with particular semantic features.

There may also be differences in the frequency with which these verbs are used in different languages (recall that we only included frequency information for English) or the ways in which they are used. One relevant note for Italian is that the verb "clap" as listed on the LDS was not a single word, but rather "battere le mani," and this punctual verb was relatively well known compared to the other punctual verbs on the list; it could be that the semantic transparency of this phrase with the high-frequency word "mani" for "hands" increases ease of acquisition for Italian-acquiring toddlers.

For the number of event participants, too, where we found differences, they aligned with our predictions: across languages we saw numerically better knowledge of verbs with fewer event participants than more event participants, although this difference was only reliable in English, the Rome sample of Italian, and Portuguese. But importantly, in no language sample did the trends go in the opposite direction from English. For English, the reliability of event participant number over and above input frequency suggests that the complexity of an event plays a role in its acquisition. This does not necessarily mean that toddlers have difficulty representing complex events. It could instead be due to the presumably greater difficulty of identifying a verb's referent when more event participants are involved. For example, an event in which one person tosses an apple to another can be labeled as *throwing*, *catching*, or *giving*—the first two possibilities require only two event participants, while the third requires all three. A *sleeping* event, by contrast, is more likely to only have one salient individual in the visual scene, making it easier to identify this event participant as the only relevant one.

Although we had data from several languages, with some typological diversity, this study represents a convenience sample of languages for which we had LDS data. Nevertheless, we believe the overall similarity across language groups indicates some cross-linguistic trends, in line with other research examining larger-scale properties of vocabulary such as proportion of nouns and verbs (e.g., Bornstein et al., 2004). Even when we zoom in on verbs only, and semantic categories within verbs, our findings suggest that some of the same features are relevant across languages. Of course, there are limitations of our approach that particularly hinder our interpretation of these cross-linguistic patterns; we turn to these limitations below.

Methodologically, we claim that large-scale surveys can be useful for asking questions about what kinds of words children know. Drawing on semantic and syntactic notions from linguistic and language acquisition theory can provide a framework for categorizing the words along dimensions that will be relevant for learners' future linguistic development. Our approach also permits focus on how verb meanings affect ease of acquisition, while yet controlling for other factors like frequency that are already known to be important, to ascertain the independent influence of semantic features.

4.2. Limitations and future directions

Parent report checklists come with limitations. First, the LDS asks parents to report words their child *produces*. Production is likely to be easier for parents to accurately report than comprehension, but importantly, toddlers' comprehension far outstrips their production; in fact, according to recent evidence even 10-month-olds know the meanings of some verbs (Bergelson & Swingley, 2013). Further, parents may not elicit verb production in their toddlers to the same

degree they elicit noun production, and may thus not have heard the full range of verbs their toddler knows (Goldfield, 2000).

Second, checklists do not reveal the linguistic or extralinguistic contexts in which toddlers use verbs. There is ample evidence that toddlers' use of tense and aspect morphemes is initially strongly correlated with verb type; for example, past/perfect marking tends to appear first on verbs like "break" across languages (e.g., Slobin, 1985; Antinucci & Miller, 1976). The range of other words with which verbs are produced (e.g., the number and type of overt arguments) is also likely to be revealing. It may also be that children produce verbs but have incorrect semantic features as part of their representations of them. For this reason, it is important to integrate large-scale studies like ours with experimental and corpus work that can look more closely at children's comprehension and production of verbs. For example, related chapters by van Hout and Schulz (this volume) discuss whether children's early verb representations include correct encoding of telicity.

Third, the particular words chosen for inclusion on the checklist will determine the results of an analysis like ours. Although we included a large number of verbs—48—in our analyses, in principle it could be that of the verbs that do not appear on the list, punctual verbs are better known than durative verbs, thus evening out the distributions. We think this is unlikely; although in developing the LDS Rescorla did not specifically attend to these semantic dimensions as we have coded them here, her choice of words to include on the checklist was based on studies of early lexical development (Nelson, 1973; Rescorla, 1980), and includes high-frequency words that most toddlers are expected to know as well as less common words.

Fourth, a checklist provides insight into which words a child knows at a particular time point, rather than what happened when the child first encountered that verb. Novel verb learning

studies, by contrast, aim to address how and whether, on initial encounters, toddlers posit a correct representation of the novel verb's semantics. It is not surprising that these two approaches may provide different results, although a strength of having cross-sectional checklist data from a wide age range is that we can make inferences about which verbs were easier or more difficult to acquire even without observing the acquisition process.

There are admittedly several limitations associated with our English-centric approach; we categorized the verbs based on diagnostics for English, and these categories may not carry over perfectly to other languages. Manner and result classes do exist cross-linguistically (Levin, 2011), though their syntactic realization as well as the particular translation equivalents may differ. For example, it could be that "cut," argued to be polysemous between manner and result in English (Levin & Rappaport Hovav, 2013; Rappaport Hovav & Levin, 2010), necessarily entails a result in another language. We thus must proceed with caution in interpreting our findings, and we consider this important for future study; careful, language-specific, lexical-semantic analysis must precede thorough investigation of the acquisition question. We offer here a direction for further research, recognizing that ours is only a first attempt at what we consider a critical question of semantic development.

Another cautionary note with interpreting the results, and particularly null effects, in the non-English languages in our sample is that we were unable to include input frequency as a fixed effect; thus we cannot account for the fact that more frequently heard verbs are expected to be early and widely acquired, independently of their semantic properties. For English, we found that semantic features can affect acquisition over and above frequency. For the moment, then, we assume that the same will be true for other languages, although we hope that the coming years will bring larger and richer corpora of child-directed speech for a variety of languages.

Finally, we note that the LDS was developed as a screening tool to easily identify language delay in toddlers. In the current study we did not distinguish among toddlers based on vocabulary. Interestingly, toddlers with low vocabularies who are otherwise developing normally may shed light on whether the ease or difficulty of acquiring different verb types is semantic or conceptual. We might hypothesize that if toddlers with language delay are not delayed in conceptual understanding, they should have similar patterns to typically developing toddlers, even if attenuated (as with, for example, verbs denoting durative vs. punctual events). However, we might expect to see difference in knowledge based on linguistic features of verbs (as with manner vs. result verbs). Horvath, Rescorla, and Arunachalam (2015; in preparation) specifically compare toddlers with low vocabularies to toddlers in the normal range, finding that those at risk for language delay do show slightly different patterns with respect to the semantic features studied here. This is true despite that overall, across the full vocabulary, there are strong correlations between the words known by low-vocabulary and typical-vocabulary children (Rescorla, Alley, & Christine, 2001).

The implications of this line of work thus offer a deeper understanding of early vocabulary growth. We also believe that our findings will be important for understanding toddlers who are growing up multilingually, whose different languages may present different learning challenges for any particular lexical item, as well as toddlers with or at risk for language delays and disorders. For these toddlers, some verb types may be particularly unlikely to be acquired without intervention, and different verbs may be optimally presented in different linguistic and extralinguistic contexts.

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