22 A Constructivist Account of Child Language Acquisition

BEN AMBRIDGE AND ELENA LIEVEN

1. Introduction

The aim of this chapter is to outline a constructivist account of the process of language acquisition, and to summarize the supporting evidence for this account, drawing on examples from some of the most intensively studied acquisition domains. Our goal is not to outline a generalized historical constructivist account, but rather to begin to sketch a new account that, in some small but significant ways, departs from previous proposals. In other words, while the account that we will outline here of course owes a considerable debt to earlier constructivist accounts (e.g., Bates and MacWhinney, 1982; Pine and Lieven, 1993; Langacker, 2000; Tomasello, 2003; Dąbrowska, 2004a; Goldberg, 2006), we are speaking for no one but ourselves. We do not, in general, compare this account against rival theoretical approaches (cf. Ambridge and Lieven, 2011; Ambridge, Pine, and Lieven, in press), which we mention only very briefly, purely for comparative purposes.

That said, the account that is presented here is probably best understood with the aid of just a little historical context. Since at least Chomsky (1957), the dominant view of language acquisition has been one under which children have innate knowledge of linguistic categories and phrases (e.g., [VERB], [NOUN], [VERB PHRASE], [NOUN PHRASE]) and some language-general rules for combining them into phrases (e.g., a [VERB PHRASE] contains either a [VERB] followed by a [NOUN PHRASE] or vice versa – e.g., [*kick*] [*the ball*] / [*the ball*] [*kick*] – with each language committing itself exclusively to one of the two possible orders).

The constructivist approach, which dates back to at least Braine (1963), arose primarily as a challenge to such claims. The basic idea (e.g., Berko, 1958; R. Clark, 1976; MacWhinney, 1975, 1982; Peters, 1983) is that children's very earliest linguistic representations are not adult-like categories and rules (e.g., [VP] = [V, NP]), but rote-learned concrete holophrases (*I+want+it*) and low-level, lexically specific slot-and-frame patterns or schemas (e.g., *I'm [X]ing it*). Only gradually do children abstract across these holophrases and lexical schemas to arrive at adult-like fully abstract constructions (e.g,. Tomasello, 2003). The constructivist approach is emergentist in two senses. First, it is

The Handbook of Language Emergence, First Edition. Edited by Brian MacWhinney and William O'Grady.

emergentist in the sense that the generalizations that underlie linguistic competence emerge from the analysis of linguistic units stored in memory (initially, rote-learned holophrases), rather than being innately specified (as under many rival accounts). Second, the approach is emergentist in the sense that children's language acquisition is emergent from – indeed, a by-product of – their use of language as a social tool. Children are not "trying" to learn syntax; they are not conducting formal analyses of linguistic structure, combining content-free algebraic symbols, setting parameters, or building abstract linguistic categories for their own sake; they are *using* language, to cajole, to control and to communicate.

Presumably as a reaction to the prevailing claim of very early abstract knowledge, most research conducted within the constructivist framework has focused on demonstrating that young children's knowledge is lexically specific (see Tomasello, 2000, 2003 for reviews). As a consequence, the constructivist approach has often been interpreted – by both its critics and its advocates – as claiming that, until some relatively advanced age (perhaps around thee years) *all or most* of children's knowledge consists of rote-learned holophrases and lexical schemas, with any demonstration of earlier abstract knowledge taken as evidence against the approach.

In our view, this is a misinterpretation. The central claim of the constructivist approach relates not to age – "children do not have abstract knowledge until age X" – but to process: Children start out with holophrases, which develop, via a process of abstraction, first into lexical schemas, and finally into adult-like abstract constructions. Importantly, this process, whilst protracted and gradual, begins as soon as children have, in principle, two stored exemplars across which to abstract.

Thus, early abstract knowledge does not falsify the constructivist account: Any abstract knowledge could, in principle, have been arrived at via a process of abstraction across stored exemplars, rather than having been present all along, regardless of the age of the child. Lest this claim seem too strong, it should be borne in mind that a child who can relate *teddy* to a picture of a teddy in a book, to her own teddy and to a bear in the zoo has already made an abstraction; and studies with newborn infants suggest that some phonological abstractions are formed *in utero* (e.g., Moon, Cooper, and Fifer, 1993).

Nevertheless, the constructivist account does make an eminently falsifiable prediction. Because the process outlined above is input-driven, and because children's input (and uptake) is uneven, so children's knowledge is predicted to be uneven, in ways that correspond systematically to the language to which they are exposed. In more concrete terms, the prediction is that children will show better linguistic performance (in whatever task), when they are able to make use of a string (*I+want+it*) or lexical schema (e.g., *I'm [X]ing it*), that they have frequently encountered and thus stored in memory. Children will show worse performance on an equivalent utterance for which no stored string or template is available, even if that utterance is formally identical when analyzed at the level of adult linguistic categories (e.g., *John kissed Sue*, which – like *I want it* or *I'm eating it* – can be analyzed as having the structure [$NP_{SUBJECT}$] [VP [V] [NP_{OBJECT}]]). Furthermore, even when children have formed adult-like abstract constructions, they will show better performance for utterances that constitute prototypical instances of those constructions.

On our reading of the literature, these predictions have yet to be falsified, and, indeed, enjoy considerable empirical support. In this chapter, we summarize our constructivist account of development, and the current state of the empirical evidence, for each of four particularly well-studied domains: the acquisition of (1) determiners, (2) inflectional morphology (3) basic word order, and (4) more advanced constructions (datives, locatives, passives, questions, and relative-/complement-clause constructions).

2. Determiners

We begin by considering one of the smallest and most restricted linguistic domains: the English determiner system. Setting aside, for a moment, both pragmatic aspects of the system and more borderline category members, all children have to learn is that English has two determiners, *the* and *a(n)*, and that – on the whole[1] – if a particular noun has appeared with one determiner it can appear with the other (e.g., *the ball*, *a man*; *the book*, *a man*, etc.). The highly restricted nature of this system means that it constitutes both an excellent example with which to illustrate the constructivist account, and a popular test case for this approach.

The constructivist account of the acquisition of this system runs as follows. Suppose a child hears, and stores, the following strings:

a ball	the ball
a book	the book
a doggie	the rain
a man	the juice

The child will schematize across the strings in the first column to form the lexically-specific slot-and-frame schema *a [X]* and across the strings in the second column to form the schema *the [Y]*. This process is outlined in more detail later. For now, the important point is simply that these schemas allow children to produce determiner+noun combinations that they have never heard before. For example, a child who had heard *a man* but not *the man* could produce this latter combination by inserting *man* into her *the [Y]* schema.

Because the schematization process is slow and gradual, there will be a point early in development in which these slot-and-frame schemas are not yet fully formed, with children relying – at least some of the time – on the use of rote-learned strings (e.g., *a+man; the+rain*). Thus the constructivist account makes a simple prediction: If we can catch children at this very early stage, there will be some nouns that appear in their speech with *a* and not *the* – and vice versa - because only the former has been stored as part of a rote-learned string (e.g., the child has stored *a+man* but not *the+man*), and a productive schema that could be used to generate it (e.g., *the [Y]*) has not yet been formed. Of course, in any given sample of adult speech, some nouns will be used with *a* and not *the*, or vice versa, simply for discourse reasons (e.g., the phrase *a drink* is used much more frequently – often with *Do you want …* – than *the drink*). So the prediction is not simply that children's overlap between *the* and *a* uses of a particular noun will be low – the same is true for adults – but that this overlap will be significantly *lower* for children than for adults (i.e., their caregivers).

Precisely how to test this prediction fairly has been the subject of a long-running methodological debate (Pine and Martindale, 1996; Pine and Lieven, 1997; Valian, Solt, and Stewart, 2009; Yang, 2013; Pine, Freudenthal, Krajewski, and Gobet, 2013). The upshot is that it is important to restrict the analysis to nouns that (1) can combine grammatically with both *the* and *a(n)* (e.g., **an advice*), (2) are used at least twice by a given speaker (hence giving the potential opportunity for overlap to be observed) and (3) are used by both a given child and his caregiver (otherwise, adult overlap rates are artificially depressed by low-frequency nouns that have little opportunity to appear with both *the* and *a*, and which children do not use). When this is done (Pine et al., 2013), naturalistic data studies reveal a significantly lower overlap rate for children (31%) than for their caregivers (47%), a finding that constitutes support for the constructivist account. Incidentally, this finding also constitutes evidence against rival accounts under which young children have an adult-like determiner category, possibly with some innate basis (Valian, 1986; Yang, 2013), unless one is prepared to posit some additional "conservative application" overlay on the child's system.

However, as we stressed in the introduction, abstract knowledge is not all-or-nothing, and these findings do not demonstrate that young children are relying entirely on rote-learned determiner+noun strings. Indeed, Pine and Martindale (1996) argued that children showed evidence of having acquired some low-level slot-and-frame schemas (e.g., *That's a [THING]*; *On the [SURFACE]*) which, despite their rather contextually specific nature, do enable at least some nouns (e.g., *table*, *chair*) to be used with both *a* and *the*.

2.1 *From rote-learned phrases to lexically specific schemas*

As well as being an important test case for the constructivist account, the English determiner system is useful as an example of the process of schematization assumed by this account (a process first outlined by MacWhinney, 1975). Returning to the example above, suppose that the child has stored the strings *a ball*, *a book*, *a doggie*, *a man*, *the ball*, *the book*, *the rain*, and *the juice*. The child then schematizes across the first four strings to form an *a [X]* schema, and across the last four strings to form a *the [Y]* schema.

The use of *X* and *Y* to denote the slots is particularly important for two reasons. First, we have avoided using terms that relate to adult categories (e.g., [NOUN]) in order to emphasize the claim that children have not formed such categories (indeed, we suggest below that they may *never* do so). Second, we have avoided using a generic term to label both slots (e.g., [THING]), in order to emphasize the claim that the [X] and [Y] slots have different, though overlapping, properties.

What does it mean for a slot to have a property? The property of a slot is a weighted average of all the items that have appeared in this position in the input utterances that gave rise to the schema. So, for this artificially restricted example, the property of the [X] slot will be a weighted average of the properties of *ball*, *book*, *doggie*, and *man*, whilst the property of the [Y] slot will be a weighted average of *ball*, *book*, *rain*, and *juice*. What we have in mind here is something like MacWhinney's (1975: 68) process of *superimposition* that "compares lexical items on both phonological and semantic levels to determine the areas of optimal fit and residual differences." See the Appendix for a preliminary attempt to flesh out in more detail this notion of a "weighted average."

But a weighted average of *which* properties: their meanings, their sounds, their stress patterns? In principle, any of these things; indeed, any properties that the child can perceive. If the items that appear in a particular position in the source utterances are similar with respect to a given property (e.g., meaning), then the slot in the resultant schema will exhibit a particular value with regard to this property (these properties are fuzzy and probabilistic, as opposed to categorical). So, for the present example, the slots in the *a [X]* and *the [Y]* categories will have high and low values respectively for the semantic property of discreteness (see Appendix).

If the items that appear in a particular position in the source utterances are dissimilar with respect to a given property (e.g., the sound of the first phoneme), then the slot in the resultant schema will not exhibit any particular value on this dimension. That is, if the source items exhibit heterogeneity with regard to a given property, the slot will also exhibit heterogeneity with regard to this property (see Appendix). So, for example, because the items that give rise to the slot in the *the [Y]* schema – *ball*, *book*, *rain*, and *juice* – do not share any particular phonological properties, so the slot does not exhibit any particular phonological properties either (for discussion of the role of variability in slot formation see Bowerman and Choi, 2001; Bybee 1995; Janda, 1990; Barðdal 2009; Suttle and Goldberg, 2011; Dąbrowska and Szczerbiński, 2006).

The significance of slot properties is that only items whose properties overlap sufficiently with those of the slot may be inserted grammatically into this slot (e.g., Langacker, 2000: 17). This notion of overlap is also fuzzy and probabilistic, rather than deterministic. Consider, for example, our example schema *a [X]*, whose slot has a high value and low heterogeneity for the semantic property of *discreteness*. Words that exhibit this property to a sufficient degree can be inserted into this slot (e.g., *a cat*, *a table*). If a word that does not exhibit this property to a sufficient degree is inserted into this slot, a less than fully grammatical string results (e.g., **a sand*). But if we insert a borderline case, something that has an intermediate degree of discreteness (e.g., *milk*, which is generally continuous, but could denote a discrete serving), an intermediately grammatical string results (e.g., *?a milk*). In contrast, because the slot in the *the [Y]* schema has an intermediate value and – more importantly – high heterogeneity for the semantic property of discreteness, it can accept pretty much any "entity" noun as a slot-filler (e.g., *the milk*, *the water*). This example is worked out more fully in the Appendix.

The reason for giving such a detailed account of the acquisition of the English determiner system is that the account presented above is a microcosm of the constructivist account of language acquisition in general (or, at least, of rote phrases and schematization; a third stage – analogy – is outlined in the section on basic word order). The process by which rote-learned strings give rise to schemas whose slots exhibit probabilistic semantic, phonological, and pragmatic properties is assumed to operate in all domains of language acquisition, and across all languages.

2.2 *Implications of the constructivist account of determiner acquisition*

Before moving on to some of these other domains, we consider some broader implications of the account of determiner acquisition outlined above. The first is that, because slots take on whatever properties are shared by the items that appeared in the relevant position in the source utterances, "ignoring" dimensions along which these items do not share a particular property, there is no need to specify in advance which types of properties children will look for when forming grammatical generalizations. This is just as well, since the types of properties that slots exhibit vary hugely cross-linguistically, including, for example, humanness, animacy, and whether or not the speaker witnessed the event. That said, we would not wish to exclude the possibility of very general attentional or perceptual biases that make, say, humans, speech sounds, or the ends of utterances particularly salient.

The second implication is that, because the slot-formation process is sensitive to commonalties along (in principle) any dimension, many slots exhibit constellations of properties of different types (that is, we follow MacWhinney, 1982: 92, in interpreting slots "in terms of clusters of vectors rather than single … features"). Indeed, to find examples of slots that exhibit semantic, phonological, and pragmatic properties at the same time, we need look no further than the English determiner system. Consider the fact that, before nouns that start with a vowel, speakers must use *an* instead of *a*. Whilst the traditional approach has been to posit pronunciation variations of "the same" word, this phenomenon falls naturally out of the present account, on the assumption that there are two indefinite constructions – *a [X]* and *an [Z]* – that have the phonological properties of starting with consonant and vowel sound respectively.

The different pragmatic functions of *the* and *a/an* can be accommodated in the same way. The slots in the schemas *a [X] / an [Z]* and *the [Y]* have the functional-pragmatic properties of referring to discourse-old and discourse-new entities respectively. Thus, the slot in the schema *an [Z]* exhibits, at the same time, semantic (*discrete entity*), phonological (*starts with a vowel*), and pragmatic (*discourse-new*) properties. An infelicitous utterance results if the speaker uses a filler in a slot with which it does not share sufficient overlap on any one of these properties (e.g., **an advice* (semantic mismatch); **an cat* (phonological mismatch); **an orange* (a pragmatic mismatch, assuming that we have already been talking about this orange)). Incidentally, we note in passing that accounts under which children have innate knowledge of a DETERMINER and a NOUN category and a rule for combining them (e.g., Valian, 1986; Yang, 2013), will still need to posit something very like this type of probabilistic semantic, phonological, and pragmatic learning to account for such cases anyway.

A final, and perhaps controversial, implication of this account is that there is no need for learners to construct either conventional Universal Grammar-style grammatical categories such as [NOUN] and [DETERMINER], or even finer-grained, language-specific, input-based categories such as [ENGLISH MASS NOUN] or [ENGLISH TRANSITIVE VERB]. The reason is that, provided the child stores the semantic, phonological (etc.) properties of every word and every construction slot, which she will have to do anyway, she already knows which words can be used in any given construction: the words whose properties overlap sufficiently with those of the construction. There is nothing to be gained by grouping together the words that can act as fillers for the same slot, and calling them a "category."[2]

Indeed, there are at least two good reasons not to do so. The first is that the compatibility between particular words and constructions is a matter of degree; indeed many words can be coerced into constructions with which they are only marginally compatible (often to yield some special interpretation). The second, and more fundamental, reason for not maintaining off-line categories of slot-fillers is that, in many cases, it is impossible to do so. Many properties – such as being discourse-old or discourse-new, which governs the relative compatibility between a noun and the *a [X]* and *the [Y]* constructions – are not inherent properties of words at all. Hence it would not be possible to store a category of "*discourse-old nouns*" (or AGENTs or PATIENTs). To the extent that these are "categories" at all, they are ad hoc categories (Barsalou, 1983), generated on the fly, emergent from the search for a suitable slot-filler. If this search can turn up a filler whose *pragmatic* properties overlap sufficiently with those of the slot, it can presumably turn up a filler whose semantic and phonological properties overlap sufficiently with those of the slot just as easily.

3. Inflectional Morphology

The constructivist account of the acquisition of inflectional morphology is essentially the account of determiner acquisition outlined above, translated into a new domain. Consider, for example, the acquisition of the German present tense inflectional paradigm for a regular (–*en*) verb (e.g., *spiel**en*** 'to play').

1sg Ich spiel**e** (I play)	1pl Wir spiel**en** (We play)
2sg Du spiel**st** (You play)	2pl Ihr spiel**t** (You play)
3sg Er/Sie spiel**t** (He/She plays)	3pl Sie spiel**en** (They play)

The child begins by acquiring a number of rote-learned concrete holophrases, at the level of both individual verb forms and subject+verb combinations:

spielt	*Er+spielt* (He plays)
bekommt	*Er+bekommt* (He gets)
trinkt	*Er+trinkt* (He drinks)

The child then abstracts across these stored strings to yield the following lexically specific slot-and-frame schemas:

t   Er [Y]t

Again, we use [X] and [Y] rather than traditional linguistic category labels (e.g., [VERB] or [STEM]) to emphasize the fact that children are assumed not to be in possession of such categories. Exactly as for the determiner schemas discussed above, these slot-and-frame patterns are productive in that children may insert any filler whose properties overlap sufficiently with those of the slot. Thus, considering semantic properties, children may insert a word denoting an action, an event or a state of affairs (e.g., *Er [lieb]t*; He likes), but not one that denotes, for example, a concrete object. In this case, these slots do not exhibit any particular phonological properties, though we will subsequently discuss some that do.

As for the determiner system, it is important to emphasize that the constructivist account does not claim that all of children's early morphological knowledge consists of rote-learned strings. Although this schematization process is long and protracted, it begins as soon as children have, in principle, two stored forms across which to schematize. Thus, on the one hand, even very young children are likely to have acquired slot-and-frame schemas whose source forms are highly frequent in the input (e.g., 3sg, *Er [Y]t*). On the other hand, even relatively old children are unlikely to have acquired schemas whose source forms are extremely infrequent (e.g., 3pl, *Sie [Z]en*). Thus the constructivist prediction again relates not to age ("children's knowledge of morphology is concrete until age X") but to unevenness: Children will show good performance when they are able to use either (1) a rote-learned ready-inflected form or (2) a slot-and-frame schema formed on the basis of frequent exposure to suitable source utterances, but poor performance when they are not.

There is considerable support for this prediction. For example, highlighting the role of rote-learned ready-inflected forms, a naturalistic-data study of child Spanish (Aguado-Orea, 2004) found that an error rate of 5% for 1sg forms doubled to 10% when just the two most frequent – and hence potentially rote-learned – forms (*quiero* 'I want' and *puedo* 'I can') were excluded. This study also found that both children studied used significantly fewer different forms of each verb than their caregivers. Importantly, this finding is not simply a consequence of adults having a larger repertoire of verbs or morphemes; it holds even when restricting the analysis to verbs and morphemes used by both children and their caregivers. Krajewski (2008) reported very similar findings for Polish (though similar studies of English, Spanish, and Italian – Pine, Lieven, and Rowland, 1998; Gathercole, Sebastián, and Soto, 1999; Pizzuto and Caselli, 1994 – failed to include these crucial vocabulary controls).

Considering the role of morphological slot-and-frame schemas, Aguado-Orea (2004) found an error rate of close to zero for 3sg forms, but 34–58% (depending on the child) for 3pl forms: exactly the finding that is expected, given that source forms for a 3sg *[X]a* schema are considerably more frequent in the input than source forms for a 3pl *[X]an* schema. Similar findings were reported in a naturalistic-data study of Brazilian Portuguese (Rubino and Pine, 1998), and an elicited production study of Finnish (Räsänen, Ambridge, and Pine, 2014).

Although its impoverished morphology makes translating such studies into English less than straightforward, when this is done similar findings are obtained (e.g., Theakston, Lieven, and Tomasello, 2003; Theakston and Lieven, 2005; Theakston, Lieven, Pine, and Rowland, 2005; Theakston and Rowland, 2009; Rowland and Theakston, 2009; Wilson, 2003; Pine, Conti-Ramsden, Joseph, Lieven, and Serratrice, 2008; Räsänen, Ambridge, and Pine, 2014). Neither are such findings restricted to verb morphology. Similar findings for noun morphology were reported by Leonard, Caselli, and Devescovi (2002) for Italian, and by Dąbrowska (2001, 2004b, 2005, 2008a, 2008b), Dąbrowska and Szczerbiński (2006) and Krajewski, Lieven, and Theakston (2012) for Polish (though again, there is some evidence of the beginnings of abstraction from an early age: Dąbrowska and Tomasello, 2008; Krajewski, Theakston, Lieven, and Tomasello, 2011).

3.1 The role of phonology

The morphological systems discussed in this section so far do not have any particular phonological restrictions. Many systems, however, do exhibit such restrictions, two particularly well-studied examples being the Arabic and German noun-plural systems (Forrester and Plunkett, 1994; Hare, Elman, and Daugherty; Plunkett and Nakisa, 1997; Köpcke, 1998; Hahn and Nakisa, 2000; Kauschke, Kurth, and Domahs, 2011; Behrens, 2002, 2011). Such restrictions are incorporated into the present framework by an assumption already introduced above: that slots exhibit phonological properties that derive from a weighted average of the items that appeared in this position in the source utterances. For example, the German *-s* plural marker appears with a wide variety of phonologically heterogeneous nouns. Consequently the [X] slot in the morphological *[X]s* slot-and-frame schema has no particular phonological properties, and can readily accommodate all-comers (including, for example, foreign borrowings with non-nativelike phonology). Other markers, such as *-e*, appear with a smaller set of phonologically homogeneous nouns (the vast majority end in *t/d*, with a much smaller number ending in *-s/-r/-k*). Consequently, the [Y] slot in the morphological *[Y]e* slot-and-frame pattern probabilistically exhibits the phonological property of ending in *-t* > *–d* > *–s/-r/-k*, and the greater the extent to which a novel noun is compatible with this property, the more likely it is to receive the *-e* plural marker, as opposed to one of the alternatives (e.g., Köpcke, 1998; Hahn and Nakisa, 2000). The same holds for any other dimensions along which slot-fillers share a particular property (for example, gender and animacy are two such dimensions for some German noun classes).

3.2 Type frequency versus heterogeneity

The account outlined above raises an interesting question: Is a particular slot more productive (more open to new fillers) when it has higher "type frequency" – i.e., when more different items have appeared in this position in the source utterances (Bybee, 1995, 2001) – or is type frequency simply functioning as a proxy for heterogeneity? Certainly, all other things being equal, the greater the number of unique items that appear in a particular position, the greater the likelihood that these items will be heterogeneous (in terms of phonology, semantics, gender, etc.), thus giving rise to a slot that exhibits no particular properties, and hence no particular restrictions. Findings from investigations into the German noun plural suggest the latter possibility: the *[X]s* schema appears to be one of the most productive schemas (see also Behrens, 2011, on *-en*), although it has considerably lower type frequency than many others, presumably due to its diversity.

Although the findings from an adult study (Suttle and Goldberg, 2011) suggest unique roles for type frequency and (here, semantic) heterogeneity, we are aware of only one child study that has attempted to unpack these two factors. In a novel-noun elicited-production study of the Polish case-marking system, Dąbrowska and Szczerbiński (2006) found that phonological heterogeneity was a better predictor of productivity than type frequency for 4-year-olds and adults, whilst the opposite was true for 2-year-olds. For three-year-olds, the two predictors were similar. However, these results should be interpreted with caution, given the extremely high correlation between these authors' measures of type frequency and phonological heterogeneity (r=0.91, p<0.001). Future research should focus on morphological systems that better allow these predictors to be disconfounded. Our own sketch of the schematization process (see Appendix) does not incorporate a role for type frequency beyond that which falls naturally out of heterogeneity, but this is an aspect of the account that may need to change in the light of future research.

3.3 *The effect of phonological neighborhood density*

In the meantime, a related finding that warrants explanation is the apparent importance of phonological analogy, even for slots that do not place phonological restrictions on the fillers that may appear therein. Consider, for example, the Finnish present-tense 1sg morpheme *-n*. Due to the highly regular nature of Finnish morphology, all verbs, regardless of their phonology, take *-n* in 1sg form. Why, then, are children more likely to supply the correct form for verbs with a large number of phonological neighbors (*kerää-n* '*I pick up*', *herää-n* '*I wake up*') than for verbs that do not (Räsänen, Ambridge, and Pine, 2014; see also Kirjavainen, Nikolaev, and Kidd, 2012, for a similar finding for the Finnish past-tense system)? Why, in a similar vein, are English children more likely to supply a regular *-t* (orthographically, *–ed*) past-tense form for real and novel verbs that are similar to several existing regular verbs (*kiss/kissed*, *miss/missed*, *hiss/hissed*, *wish/wished*) than those that are not (e.g., *match*) even though all are compatible with the *[X]t* schema (Marchman, 1997; Marchman, Wulfeck, and Weismer, 1999; Ambridge, 2010; Theakston, Krajewski, Keeble, and Woollams, 2013)?

One possible explanation for these *phonological neighborhood density* effects is that, rather than using slot-and-frame schemas, children sometimes arrive at an inflected form by direct phonological analogy with one or more stored rote-learned, ready-inflected forms. However, this explanation seems a little ad hoc; why should children rely on one-shot analogies more in the domain of morphology than elsewhere? An explanation that is more consistent with the general approach that we are outlining here emphasizes that the property of a slot is a weighted average of the properties of all the items that have appeared in the relevant position in the source utterances. Thus even when these items are sufficiently heterogeneous as to mean that a slot exhibits no *restrictive* phonological properties, it nevertheless retains a preference for fillers that share the "flavor" of its source items, in the form of a weighted average (much as we propose for sentence-level categories in the following section). For example, to put some crude numbers on it, the [X] slot in the English past-tense *[X]t* schema might derive from 30% *-iss* verbs (*kiss*, *miss*, *hiss*), 20% *-ish* verbs (e.g., *wish*, *dish*), and 50% miscellaneous verbs (e.g., *clip*, *bake*): sufficiently variable that any novel verb can be accommodated, sufficiently weighted that a novel verb such as *wiss* or *biss* feels most at home (i.e., is rated as a particularly "good-sounding" regular past-tense form; see Albright and Hayes, 2003; Ambridge, 2010).

There is also a third, and perhaps most satisfactory, possibility;[3] one that we have already touched upon in the section on determiner acquisition. Perhaps what constructivist theorists call schemas or constructions are no more than helpful mnemonics for particularly frequent kinds of generalizations. Perhaps, in fact, all generalizations are formed on the fly on the basis of stored strings, with schemas merely "immanent in their instantiations" (Langacker, 2000: 7). On this account, there is no difference between generating *wiss*→*wissed* (1) by phonological analogy with *kissed*, *missed* and *hissed* and (2) by inserting *wiss* into a *[X]t* slot-and-frame schema, with which – by virtue of the occurrence of *kiss*, *miss*, and *hiss* in its source utterances – it is particularly compatible. In fact, although rarely discussed in relation to child language acquisition (notable exceptions are Ninio, 1993 and Abbot-Smith and Tomasello, 2006[4]), such *exemplar-based* models of linguistic knowledge are well established in the adult psycholinguistics literature (e.g., Skousen, 1992; Nosofsky, 1992; Chandler, 2002; Daelemans, Zavrel, Van der Sloot, and Van den Bosch, 2010).

3.4 Optional infinitives and pronoun case-marking errors

Finally, it would be remiss of us to end this section without touching upon a phenomenon that has proved particularly central to the development of constructivist theory: so-called "optional infinitives." The phenomenon is that, across many different languages (e.g., English, German, Dutch, Russian, Swedish) children produce utterances that lack tense and agreement marking such as **He eat cake* (cf. *He eat**s**/**is** eating cake*) or **Er Kuchen essen* 'He cake to eat' (cf. *Er **isst** Kuchen* 'He eats/is eating cake'). Many different non-constructivist accounts of the phenomenon have been proposed, all of which share the assumption that children are failing to mark tense and/or agreement in some formal grammatical sense (e.g., Rizzi, 1994; Radford, 1996; Wexler, 1998; Legate and Yang, 2007). However, none of these accounts can explain the simple finding that the rate of such errors varies dramatically across verbs within a given language (e.g., Freudenthal, Pine, and Gobet, 2010; Räsänen, Ambridge, and Pine, 2014; Ambridge and Lieven, 2011: 152). The constructivist account explains this phenomenon as the result of children rote-learning input strings, and omitting material from the start of utterances (e.g., *~~Does~~ he eat cake? He ~~can~~ eat cake*; *Er ~~kann~~ Kuchen essen*), due to a large recency effect and a smaller primacy effect in memory (Ebbinghaus, 1913 [1885]). A computer model that instantiates this account (MOSAIC) explains the observed variation in error rates both within and across languages (Freudenthal, Pine, Aguado-Orea, and Gobet, 2007; Freudenthal et al., 2010), as well as children's performance in experimental elicitation tasks (e.g., Theakston, Lieven, and Tomasello, 2003).

It is important to note that this account cannot explain the very high rates of such errors observed in English (and perhaps other Germanic languages). Räsänen et al. (2014) provided evidence that this is due to a "defaulting" effect whereby children who cannot retrieve a rote-learned 3sg form (e.g., *eats*) or schema (e.g., *[X]s*) instead default to the lexical form of the relevant verb with the highest surface frequency: in every case, the "bare" form (e.g., *eat*). Rasenen et al. showed that, across verbs, the higher the proportion of bare vs. 3sg *-s* forms in a representative input corpus, the higher the rate of "OI" errors vs. correct 3sg -s inflection for that verb.

What unites the MOSAIC and defaulting explanations is their assumption of children's early reliance on stored strings (here, ready-inflected verb forms and subject+verb combinations). Thus this central assumption of the constructivist account offers a ready explanation for a phenomenon that has eluded formal linguistic accounts. This assumption also explains a related phenomenon: children's non-nominative-subject errors (e.g., *Me do it*; *Her eat cake*), which are seen as deriving from a combination of truncating input strings (e.g., *~~Let~~ me do it*) and defaulting to the form with the highest surface frequency in the input (e.g., *Her* > *She*) (Kirjavainen, Theakston, and Lieven, 2009; Ambridge and Pine, 2006). Thus, optional-infinitives and non-nominative subjects are a particularly interesting phenomenon, in that stored rote-learned strings lead not to well-formed utterances, but to errors.

4. Basic Word Order

4.1 Analogy and adult-like abstract constructions

In order to be able to produce and comprehend utterances that they have never heard before, children need to acquire abstract representations at the sentence level. Under the constructivist account, these representations are argument structure constructions:

[B]	Intransitive construction (e.g., *The ball rolled*)
[Y] [Z]	Transitive construction (e.g., *John rolled the ball*)
[Q] [R] *to* [S]	Prepositional-object (PO)-dative construction (e.g., *John rolled the ball to Sue*); see Section 5.

An important characteristic of these constructions, which differentiates them from the determiner and morphological constructions discussed above, is that different instantiations of the same construction often share no lexical material. Consequently, slot-and-frame schemas will not suffice. Children must move from slot-and-frame schemas to fully abstract constructions[5] (i.e., from *item-based patterns* to *feature-based* patterns; MacWhinney, 1982).

The constructivist approach has offered two different accounts of this transition.

MacWhinney (1975, 1982, in press) proposes an account based on the notion of feature cancellation. Suppose that the child has schematized across the following stored utterances, and arrived at the following slot-and-frame schemas (which use meaningful slot labels, purely for convenience):

I'm eating it	*Mummy kissed Daddy*
I'm hitting it	*Daddy kissed Mummy*
I'm kicking it	*Mummy kissed the baby*
I'm [ACTION]ing it	[KISSER] kissed [KISSEE]

Under MacWhinney's account, children *superimpose* these schemas, which – as we saw earlier with regard to schematization – involves "comparing lexical items on both phonological and semantic levels to determine the areas of optimal fit and residual differences" (MacWhinney, 1975: 68). For example, *I* and *KISSER* overlap on dimensions such as humanness, animacy, and agency, and so combine to yield a primitive type of [AGENT] category. This process, when applied over many such slot-and-frame schemas (or individual lexical instantiations of them) yields fully abstract constructions, or *feature-based patterns*, such as [AGENT] [ACTION] [PATIENT].

The second account (Tomasello, 2003) is similar, but focuses on the notion of *relational* similarity, as opposed to similarity between individual items. For example, the schemas *I'm [ACTION]ing it* and *[KISSER] kissed [KISSEE]* share some kind of AGENT–ACTION relation (*I-[ACTION]* and *[KISSER]-kissed*) and ACTION–PATIENT relation (*[ACTION]* *it* and *kissed [KISSEE]*). The claim is that this type of relational overlap (between many such pairs of schemas) is sufficient for children to *analogize* across them via a process of *structural alignment*, and hence move towards an abstract [AGENT] [ACTION] [PATIENT] sentence-level argument-structure construction.

With regard to the question of how these semantically based constructions broaden into adult-like abstract constructions (for example, *The situation justified the measures* does not conform to the [AGENT] [ACTION] [PATIENT] pattern), both MacWhinney and Tomasello advocate a role for functionally based distributional analysis. For example, children expand the [ACTION] slot into a [VERB] slot on the basis of similarity between pairs of actional and non-actional verbs (e.g., *kiss*, *justify*) at both the distributional level (e.g., ***He** kiss**ed** … ; **He** justifi**ed***) and the functional level (both predicate something of "He").

There exists some empirical evidence for Tomasello's claim that learners can analogize across different exemplars using structural alignment (e.g., Kotovsky and Gentner, 1996; Gentner and Medina, 1998), but only from non-linguistic domains, and only for older children (generally those 6 years and older) and adults. For example, in one study, Markman and Gentner (1993) showed adults a picture of a car towing a boat and another of a truck towing the same car. When asked to indicate the item in the second picture that was "the same" as the car in the first, participants ignored the literal match and chose the truck. That is, they aligned the TOWER-TOWEE structure of the two pictures and saw commonalties between the two TOWERs.

Although there is currently good evidence for the *existence* of abstract constructions (at least on our reading of the literature), there is insufficient evidence to choose between these different accounts of how they are formed. In the meantime, we suggest two small modifications that may somewhat reduce the burden on the learner. First – and this may be implicit in both accounts anyway – children do not have to analogize all the way from something like [AGENT] to something like [SUBJECT] in one leap. Rather, the process of analogy could proceed via a series of baby steps, which could have some overlapping lexical material in common (e.g., "GETTING it" is like "HOLDING it" is like "HAVING it"; "WATCHING Mummy" is like "LOOKING AT Mummy" is like "SEEING" Mummy is like "HEARING Mummy" is like "UNDERSTANDING Mummy"). Second, it may well be the case, particularly for the transitive, that the endpoint is not a single construction (in this case, [SUBJECT] [VERB] [OBJECT]) at all. Perhaps adults have (at least) the following six different transitive constructions (again, meaningful slot labels are used for convenience only; each slot is a weighted average of the items that appeared in this position in the source utterances).

Contact (non-causative)	[AGENT] [ACTION] [PATIENT]	John hit Bill
Causative	[CAUSER] [ACTION] [CHANGE]	John broke the plate
Experiencer-Theme	[EXPERIENCER] [EXPERIENCE] [THEME]	John heard Bill
Theme-Experiencer	[THEME] [EXPERIENCE] [EXPERIENCER]	John scared Bill
"Weigh" construction	[THING] [MEASURE/COST/WEIGH] [AMOUNT]	John weighed 100lbs
"Contain" construction	[CONTAINER] [CONTAIN] [CONTENTS]	The tent sleeps four people

Given that the constructivist account posits rampant redundancy anyway (perhaps even storage of every utterance ever heard), there is certainly no *a priori* reason to posit a single transitive construction as opposed to six, or, indeed, sixty. Neither is there any reason to eschew multiple constructions with the same word order on the grounds of avoiding construction-level polysemy. Learners must deal with polysemy at the lexical level as well as – for many languages – the level of morphological schemas (e.g., German has two morphological *[X]t* schemas, for 3sg and 2pl present tense).

Certainly the idea of several different transitive constructions, each made up of slots exhibiting their own constellation of semantic, pragmatic (etc.) properties, seems more consistent with the approach we are developing here than the alternative: a single construction in which AGENTS, CAUSERS, EXPERIENCERS, CONTAINERS and so on are somehow seen as similar.[6] Indeed, the fact that transitive causative errors with more direct causers are rated as less unacceptable (e.g., **The comedian's joke giggled Lisa* > **The comedian giggled Lisa*; Ambridge, Pine, Rowland, Jones, and Clark, 2009) is evidence that the slots of the transitive causative construction have semantic properties that are presumably not shared by noncausative transitive constructions. Similarly, the fact that, in a recognition test, adults were lured into "recognizing" highly prototypical transitives that they had not in fact seen (e.g., *He sliced the bread*; Ibbotson, Theakston, Lieven, and Tomasello, 2012) argues for a division between prototypical (contact/causative) transitives and others.

But, to reiterate, this account of the formation of abstract sentence-level constructions from slot-and-frame schemas is essentially just speculation; we are aware of no studies that have tested this proposal directly.

4.2 Early schemas

In contrast, the claim that children's earliest sentence-level representations are lexically specific slot-and-frame schemas (which derive ultimately from rote-learned utterance wholes[7]) is extremely well supported empirically. To stress a point that we have made several times already, the claim is not that children have no abstract sentence-level representations until (for example) age 3;0. Rather, the process of abstraction begins as soon as children have – in principle – two exemplars to abstract across. The claim relates not to age but to unevenness: Children will show excellent performance when they can make use of a well-learned sentence-level slot-and-frame schema, and worse performance when they cannot. Here is some evidence for this claim:[8]

- Pine and Lieven (1993; see also Lieven, Pine, and Dresner-Barnes, 1992; Lieven, Pine, and Baldwin, 1997) showed that 77% of children's naturalistic utterances could have been generated by one of just 10 slot-and-frame patterns (e.g., *It's a [X]*), two-thirds of which had precedents in the form of recurrent (apparent) frozen phrases (e.g., *It's a car*).
- Lieven, Salomo, and Tomasello (2009) found that 58–78% of utterances in a small test corpus of child utterances were either verbatim repetitions of previous utterances (possibly rote-learned phrases) or could have been generated by a single operation, such as inserting a filler into a construction slot (see also Lieven, Behrens, Speares, and Tomasello, 2003; Dąbrowska and Lieven, 2005).

- Bannard, Lieven, and Tomasello (2009) used a mathematical model to generate slot-and-frame schemas automatically based on recurring strings in child corpora. Using these schemas, the model was able to generate 60–80% of children's utterances at 2;0. Adding a NOUN category improved coverage at 2;0, and to a lesser extent at 3;0, whilst adding a VERB category improved coverage at 3;0 only. This finding constitutes evidence of gradual generalization (i.e., formation of abstract construction slots).
- Ambridge and Lieven (2011: 221) summarized 14 elicited-production studies in which a novel verb was trained in an intransitive, passive or no-argument construction (e.g., *This is called "tamming"*) and then elicited in a transitive construction (e.g., *Ernie is tamming the ball*). Unsurprisingly, the proportion of children able to produce a transitive with the novel verb rose steadily from around 20% at 2;6 to around 90% at 5;6. This finding alone constitutes little support for the constructivist approach, as it is consistent with various uninteresting explanations, such as decreasing performance limitations with age (Fisher, 2002). A much more compelling – but little remarked – finding is that, particularly for younger children, the vast majority of all arguments (e.g., 90% in Dodson and Tomasello, 1998) were pronouns (e.g., *He's tamming it*), suggesting that children were relying heavily on the use of slot-and-frame schemas such as *He's [X]ing it*. Investigating this issue more directly, Childers and Tomasello (2001) found that explicitly training children on these schemas using familiar verbs (e.g., *He's pushing it*) increased the proportion of two-year-olds able to produce a transitive with a novel verb (e.g., *He's tamming it*) from 9/20 to 17/20 (see also Abbot-Smith, Lieven, and Tomasello, 2004).
- In a very similar vein, Akhtar's (1999) finding that children's ability to correct a "weird word order" (e.g., *Elmo the car gopping*) to SVO increases with age is well known. Less well known, but potentially more important, is the finding that children used pronouns frequently (around 50% of all arguments) when correcting to SVO (e.g., *He's gopping it*), but never when imitating SOV or VSO. This again suggests that, when producing novel SVO transitives, younger children rely heavily on slot-and-frame schemas such as *He's [X]ing it* (see also Abbot-Smith, Lieven, and Tomasello, 2001; Matthews, Lieven, Theakston, and Tomasello, 2004, 2007).
- Again, in a similar vein, the syntactic priming study of Savage, Lieven, Theakston, and Tomasello (2003; see also 2006) is best known for its conclusion that abstract priming does not occur until some time after age 4, a finding that is almost certainly incorrect (Huttenlocher, Vasilyeva, and Shimpi, 2004; Shimpi, Gámez, Huttenlocher, and Vasilyeva, 2007; Bencini and Valian, 2008; Rowland, Chang, Ambridge, Pine, and Lieven, 2012). But more important is the often ignored fact that Savage et al.'s 3–4 year olds *did* show both active→active and passive→passive priming when the prime sentences used lexically specific slot-and-frame schemas that children could reuse in their own productions (*It is [X]ing it* or *It got [X]ed by it*).
- Younger children's reliance on slot-and-frame schemas is also evidenced in comprehension studies. Childers and Tomasello (2001: Study 2) found that two-year-olds showed significantly better performance when asked to enact novel transitive sentences with pronouns (e.g., *He's meeking it*) than with full NPs (e.g., *The dog's meeking the car*), even though the entities to be manipulated were never named in the pronoun condition.

The findings of preferential-looking and pointing studies are often argued to constitute evidence against the constructivist account. In fact, they constitute evidence only against an extreme version of the account that posits virtually no generalization until (say) age 3;0, and positive evidence *for* an account based around a protracted period of generalization that begins as soon as children have – in principle – two exemplars across which to generalize. The headline finding is that, if presented with an audio sentence such as *The duck is glorping the bunny*, children – in some cases as young as 1;9 – look longer at, or point to, a video screen where a duck is performing a novel action on a bunny, rather than vice versa (Gertner, Fisher, and Eisengart, 2006; Noble, Rowland, and Pine, 2011; Fernandes, Marcus, Di Nubila, and Vouloumanos, 2006).

But this effect is fragile. Children fail if the actions on the two screens are identical (with the roles reversed), or if they are not given a training session in which the same characters subsequently used at test enact sentences with familiar verbs (Chan, Meints, Lieven, and Tomasello, 2010; Dittmar, Abbot-Smith, Lieven, and Tomasello, 2008). They struggle on intransitives with conjoined subjects (e.g., *The duck and the bunny are glorping*), seemingly interpreting them as if they were simple transitives (e.g., *The duck is glorping the bunny*) (Hirsh-Pasek and Golinkoff, 1996; Kidd, Bavin, and Rhodes, 2001; Bavin and Growcott, 2000; Noble, Rowland, and Pine, 2011). They struggle on transitives with non-canonical mappings, interpreting, for example, "the one who's blicking the balloon from the other one" as if it were "the one who's blicking the balloon *to* the other one" (Fisher, 1996).

Taken as a whole, this pattern of findings is exactly what one would expect if young children have only the very first tentative outline of an abstract [X] [Y] [Z] transitive construction, where the [X] slot is probabilistically associated with properties such as moving first, moving towards the other character, instigating contact with this character, and so on (Abbot-Smith and Tomasello, 2006). This schema gives the wrong interpretation for sentences with conjoined subjects or non-canonical mappings and cannot be accessed at all unless it is "primed" in a training session with familiar verbs.

We conclude this section by discussing a common objection to this account: Isn't it all far too Anglocentric? Positionally based schemas and constructions might work well enough for languages that follow relatively strict word order, but what about languages that do not (though see Stoll, Abbot-Smith, and Lieven, 2009)? Whether or not the constructivist account can accommodate findings from any particular language is, of course, an empirical question. However, we see no reason why the account outlined in this chapter could not be applied directly to very different languages. Suppose, for the sake of argument, that there exists a language that uses entirely free word order, with all roles indicated using case marking. Although the positional patterns outlined in the present section would be quite useless, this simply shifts the burden onto the morphological schemas discussed in the previous section. Indeed, this previous section summarizes evidence from a relatively free word order language (Polish) that schemas built around noun case-marking morphemes are learned in the same way as those built around verbal tense/agreement markers (e.g., the English past-tense *[X]ed* schema). In reality, most "free" word order languages are probably better described as displaying pragmatic word order. This too is handled comfortably by the present account, on the assumption that the slots that make up sentence-level constructions (e.g., the [X] [Y] [Z] transitive construction(s)) probabilistically exhibit not only semantic properties, but also pragmatic properties (e.g., being discourse-old).

What *is* Anglocentric is the alternative: taking categories, rules, and analyses developed largely on the basis of English, and trying to cram all languages into this template. Indeed, evidence from typology suggests that even such apparently fundamental lexical categories as VERB and ADJECTIVE do not seem to be universal (Evans and Levinson, 2009; McCawley, 1992; Dixon, 2004; Haspelmath, 2007). Given this considerable cross-linguistic diversity, the only viable solution is to posit that abstract representations are built from the input, on an entirely language-specific basis, i.e., exactly the approach taken by constructivist accounts.

4.3 The retreat from error

Before moving on to consider more advanced constructions, we owe the reader an account of why children make errors, and how they come to stop making them. Essentially errors have two sources. The first is the use of a rote-learned string in an inappropriate context. We have already met several errors of this type including the use of (1) a 3sg verb form in a 3pl context (e.g., in Spanish, Brazilian Portuguese, and Finnish), (2) a truncated non-finite string in a finite context (e.g., ~~does~~ he eat cake) and (3) a truncated non-nominative string in a nominative context (e.g., *~~let~~ me do it*). The second source of error is the use of an item in a schema or construction slot with which it is less than optimally compatible. Examples include the use of an irregular verb in the English past-tense [X]-*ed* schema (e.g., **[sleep]ed; *[sing]ed*) and the use of an intransitive-only verb in the [X] [Y] [Z] transitive-causative construction (e.g., *[*The funny joke*] [*giggled*] [*Lisa*]).[9]

Under the present account, the mechanism that causes children to make these errors is the same mechanism that causes children to stop making these errors: competition (e.g., MacWhinney, 2004). A speaker has a given message that she wishes to express. All stored forms – from single words, through slot-and-frame schemas, to abstract constructions – compete for the right to express this message. Early in development, the wrong form may win out, because it is more frequent and hence more strongly represented (e.g., 3pl *juega* over 3sg *juegan*), or because children have not yet learned an alternative schema/construction with a more appropriate slot ("appropriate" in this context means exhibiting phonological, semantic, etc. overlap between the slot and its filler). This is the case when, for example, the child uses *sleep* in the regular *[X]-ed* schema instead of the more appropriate irregular *[Y+vowel shortening]-t* schema, or uses *giggle* in the transitive causative construction (e.g., **The funny joke giggled Lisa*) instead of the periphrastic causative (*The funny joke made Lisa giggle*).

Children retreat from error as they learn schemas/constructions whose slots have better fits for the items in the message. Two factors are important here: statistics and semantics. With regard to statistics, children learn probabilistic links between particular items (e.g., *giggle*) and particular constructions (e.g., periphrastic causative, intransitive), which cause these constructions to be activated at the expense of competitors (e.g., transitive causative) when the relevant item (e.g., *giggle*) is part of the speaker's intended message. Consequently, the likelihood of children's using (e.g., Brooks, Tomasello, Dodson, and Lewis, 1999), accepting (Ambridge, Pine, Rowland, and Young, 2008; Ambridge, Pine, Rowland, Jones, and Clark, 2009; Ambridge and Rowland, 2009), and comprehending (Dittmar, Abbot-Smith, Lieven, and Tomasello, 2013) verbs in non-attested constructions decreases with increasing verb frequency.[10] With regard to semantics, children learn the fine-grained semantic properties of particular construction slots (e.g., that the [Z] slot in the [X][Y][Z] construction denotes direct causation), meaning that verbs that are not compatible with this meaning (e.g., *giggle*) are a better fit for slots in other, competing constructions such as the intransitive and periphrastic causative (Ambridge, Pine, Rowland, Jones, and Clark, 2009; Ambridge, Pine, Rowland, and Chang, 2012; Ambridge, Pine, Rowland, Freudenthal, and Chang, 2014; Ambridge, Pine, and Rowland, 2011).

We should end this section by acknowledging that we have presented only a brief outline of the retreat from overgeneralization here; at least in part because this is a topic that we have covered particularly extensively elsewhere: Ambridge and Lieven, 2011: 242–265; Ambridge, Pine, Rowland, Chang, and Bidgood, 2013).

5. More Advanced Constructions

The previous sections have outlined a constructivist account of language acquisition, focusing on the basic morphological and syntactic schemas and constructions that constitute the “bread and butter” of everyday language use. A charge that is sometimes leveled at the constructivist account, however, is that it struggles in the face of more complex utterances, that it cannot account for the acquisition of three-argument constructions (e.g., datives, locatives), movement-constructions (e.g., passives, questions), and multiple-clause constructions (e.g., relative- and complement-clause constructions). Our goal in this section is to argue that, on the contrary, all of these phenomena can be explained using the basic assumptions that we have outlined above, without the need for any additional theoretical machinery. That said, it is certainly the case that these areas have attracted considerably less attention from constructivist researchers, which is one of two reasons for the relative brevity of this section (the other, of course, being the ubiquitous “space limitations”).

It is for these two reasons that we do not discuss here other more complex phenomena such as scope and binding (anaphora). Nevertheless, we have argued elsewhere that these phenomena can indeed be explained under the framework that we are outlining here.[11] For example, Ambridge and Lieven (2011: 343) pointed out that children are much better at interpreting the types of scope constructions that are frequent in their input (e.g., *There is an [X] [Y]ing every [Z]*) than those that are less frequent (e.g., *Every [X] is [Y]ing a [Z]*; Brooks and Sekerina, 2006), whilst Ambridge (2013) argued that many real-world scope phenomena are best understood in terms of competing constructions. With regard to binding, Ambridge and Lieven (2011: 259) argued that “Principle C” violations such as *She*$_i$ *said that Sarah*$_i$ *likes poetry* can be understood as the use of an item (*Sarah*) in a slot with which it is pragmatically incompatible. Here, the speaker has chosen to use a construction *[PRONOUN*$_i$*] [VERB] that [PRONOUN*$_i$*]*, whose [PRONOUN] slots exhibit the pragmatic property of denoting a recoverable referent; hence the use of a full NP (*Sarah*) rather than a pronoun (*she*) in this slot is anomalous.

5.1 Three-argument constructions

Many languages have some kind of dedicated transfer construction. English has two: the double-object (DO) and prepositional-object (PO) datives.

[B] [C] [D]	DO-dative construction (e.g., *John sent Sue the letter*)
[Q] [R] *to/for* [S]	PO-dative construction (e.g., *John sent the letter to Sue*)

Exactly as for other constructions, children begin by storing a number of rote-learned utterance wholes (*Gimme it*; *I'll tell you a story*), across which they then abstract to acquire slot-and-frame schemas (*Gimme [X]*; *I'll [Y] you a story*). We are aware of no studies that have directly attempted to find evidence of these holophrases or schemas in children's speech. However, suggestive evidence comes from the naturalistic data study of Campbell and Tomasello (2001), who showed that just nine verbs were used by at least six of the seven children studied (*give*, *read*, *bring*, *take*, *show*, *tell*, *get*, *buy*, and *make*), with the single verb *give* accounting for around 50% of all dative tokens. This study also found that children's dative uses were highly similar to their parents'. For example, DO-dative uses of *give* outnumbered PO-dative uses of *give* by around 3:1, in both parental and child speech. Other verbs, such as *make*, showed a PO-bias in some parents and a DO-bias in others, with children generally replicating this pattern in their own speech.

Later, children abstract across these schemas to acquire more abstract constructions. Exactly as for the simpler constructions discussed above, priming, comprehension and novel-verb production studies demonstrate that children have at least some abstract knowledge of these two constructions by a relatively young age (though in this case 3–4, rather than 1–2; Shimpi et al., 2007; Thothathiri and Snedeker, 2008; Conwell and Demuth, 2007; Rowland, Chang, Ambridge, Pine, and Lieven, 2012). Again, though, a closer look at the data suggests that these findings reflect only the first tentative outlines of an abstract construction. For example, Conwell and Demuth (2007: Experiment 2) found that novel verbs taught in the PO-dative were extended to the DO-dative only 8% of the time. Exactly as for the transitive construction, Rowland and Noble (2010) found that children showed significantly better (comprehension) performance for prototypical datives that were consistent with possible slot-and-frame patterns (e.g., *I'm [X]ing the [Y] to [NAME]*).[12]

Finally, via this process of gradual abstraction, children arrive at abstract PO- and DO-dative constructions whose slots exhibit probabilistic semantic and – in some cases – phonological properties. For example, the third slot in the DO-dative prototypically denotes a human recipient or potential possessor, which is why it is odd to say **I sent Chicago the package* (cf. *I sent the package to Chicago*), whilst the second ("VERB") slot has the probabilistic phonological property of monosyllabicity/first-syllable stress, which is why it is odd to say **I suggested him the idea* (cf. *I suggested the idea to him*) (Pinker, 1989). Ambridge, Pine, Rowland, Freudenthal, and Chang (2014) and Ambridge, Pine, Rowland, and Chang (2012) showed that independently obtained ratings of verbs' semantic and phonological properties were able to predict their relative acceptability in PO- and DO-dative constructions.

English also has a second pair of three-argument constructions, the figure- and ground-locatives (e.g., *Lisa sprayed water onto the flowers*; *Lisa sprayed the flowers with* *water*). This construction has received considerably less attention than the dative, but, again, the evidence suggests that children's earliest uses are closely tied to the language that they hear (Twomey, Chang, Ambridge, submitted), and that learners eventually acquire a construction whose slots place probabilistic semantic restrictions on the verbs that can appear felicitously therein (Ambridge, Pine, and Rowland, 2012).

5.2 "Movement"-constructions

Movement constructions are so called because, under traditional approaches, they are generated from phrases that have canonical word order, via syntactic movement. For example, a passive such as *The ball was kicked* is generated from the VP *kicked the ball* by (amongst other processes) the movement of the Determiner Phrase *the ball* from "OBJECT" to "SUBJECT" position (SPEC IP). Similarly, a question such as *What can he eat?* is generated by movement of both the *wh*-word (*what*) and the auxiliary (*can*) from *He can eat what?*

The constructivist account does not posit movement. Rather, these constructions are abstracted from input utterances using the same processes outlined above. With regard to passives, although there are few studies of the early stages, the available data (e.g., Israel, Johnson, and Brooks, 2000) again suggest that children start out with rote-learned holophrases (e.g., *It's broken*), across which they abstract to form, first, lexically specific schemas (e.g., *[X] is broken*) and, ultimately, abstract constructions (e.g., *[X] BE/GET [Y] by [Z]*). Again, although children show some early successes with the construction (e.g., Bencini and Valian, 2008; Messenger, Branigan, and McLean, 2011; Messenger, Branigan, McLean, and Sorace, 2012), they perform best when they can use a well-learned slot-and-frame schema (e.g., *It got [X]ed by it*; Savage et al., 2003[13]), particularly if they receive direct training on this schema (Brooks and Tomasello, 1999). Conversely, when faced with non-canonical passives that are a poor fit to their emerging *[X] BE/GET [Y] by [Z]* construction, children struggle, even at age 6. For example, the [Y] ("VERB") slot has the probabilistic semantic property of "action that affects the patient." Children show excellent performance when this slot is filled by a verb with compatible semantics (e.g., *Bob was* ***hit*** *by Wendy*) and poor performance when the verb has less compatible semantics (e.g., *Bob was* ***seen*** *by Wendy*) (Horgan, 1978; Fox and Grodzinksky, 1998; Gordon and Chafetz, 1990; Hirsch and Wexler, 2006; Maratsos, Fox, Becker, and Chalkley, 1985; Sudhalter and Braine, 1985; Gordon and Chafetz, 1990; Pinker, Lebeaux, and Frost, 1987; Meints, 1999; Messenger, Branigan, and McLean, 2012; Ambridge, Bidgood, Pine, Rowland, and Freudenthal, submitted).[14]

With regard to questions, constructivist studies have tended to focus not on children's abstract question constructions, but on the earlier stages. There exists a considerable body of evidence that children's earliest questions are rote-learned holophrases or formed using lexical slot-and-frame schemas. With regard to holophrases, Labov and Labov (1978) reported an error rate of 80% for *what* questions with a full auxiliary, dropping to 23% with a contracted auxiliary; a difference likely due to the frequent use of the single question *What's that?* With regard to slot-and-frame schemas, both naturalistic (e.g. Kuczaj and Brannick, 1979; Rowland and Pine, 2000; Rowland, 2007; Dąbrowska and Lieven, 2005) and experimental studies (e.g., Ambridge, Rowland, Theakston, and Tomasello, 2006; Ambridge and Rowland 2009) provide evidence that children seem to be using schemas such as *What are [X][Y]ing?* (e.g., *What are you doing?*): Exactly as for all of the other constructions discussed in this review, utterances that could have been produced using such a schema (identified on the basis of children's previous utterances and/or their input) displayed significantly lower error rates than those that could not. There is some evidence to suggest that children may produce questions by combining individual slot-and-frame schemas (e.g., Dąbrowska and Lieven, 2005; Ambridge and Rowland, 2009: 249). This is consistent with the account that we are developing here, on the assumption that a slot-and-frame schema can itself serve as a slot-filler in another schema. Indeed this assumption is necessary to explain recursion, as in the case of the multiple-clause constructions discussed in the following subsection.

5.3 *Relative- and complement-clause constructions*

Relative clause sentences – or, at least the standard "textbook" examples – contain a clause that provides additional information about either the subject or the object of the main clause (e.g., *The dog [that the pig jumped over] bumped into the lion*). Again, the empirical data suggest that children (1) start out with holophrases and slot-and-frame schemas, moving only gradually towards abstract constructions, and (2) show significantly better performance on relative clause sentences that are highly consistent with these schemas and constructions. In an analysis of naturalistic data, Diessel and Tomasello (2000) found that the majority of children's relative clause sentences were presentational relatives (e.g., *Here's a tiger that's gonna scare him*), consistent with simple slot-and-frame schemas (e.g., *Here's a [X] that [Y]*), rather than full abstract constructions. Similarly, Kidd, Brandt, Lieven, and Tomasello (2007) found that 75% of children's object relatives had inanimate main clause objects, whilst 87% of relative clause subjects were one of three pronouns: *I*, *we*, and *you*. This means that a very large proportion of children's relative clause utterances could have been generated using schemas such as (*There's the [X] that I [Y]ed*). Even later in development, when children's knowledge becomes more abstract, they still show better performance for relative clause sentences that are consistent with these construction prototypes, even when these are object as opposed to subject relatives and hence – from a formal linguistic perspective – more complex (e.g., Kidd et al., 2007; Diessel and Tomasello, 2005). Similar findings were also observed for German (Diessel and Tomasello, 2005; Brandt, Kidd, Lieven, and Tomasello, 2009) and Hebrew (Arnon, 2010).

Complement clause sentences contain a sentence-like clause that serves as the subject or (more commonly) object of the verb in the main clause (e.g., *John wondered* ***[whether the boy had eaten the cake]***). Again, the linguistic complexity of these textbook examples hides the fact that children's earliest utterances are highly stereotypical, and could have been generated using slot-and-frame schemas. For example, Diessel and Tomasello (2001) found that 98% and 100% of children's complement clause sentences with *bet* and *guess* respectively had *I* as subject, suggesting that children start out with *I bet [X]* and *I guess [Y]* schemas that function simply as hedges or attention-getters (see Limber, 1973 and Bloom, Rispoli, Gartner, and Hafitz, 1989, for similar findings). Again, when children's ability to repeat or produce these structures is examined naturalistically (Brandt, Lieven, and Tomasello, 2010) or probed experimentally (Kidd, Lieven, and Tomasello, 2006, 2010), they show better performance when they are potentially able to use a well-learned high-frequency slot-and-frame schema (e.g., *I think [she is riding the horse]*) than when they are not (e.g,. *I pretend [she is riding the horse]*).

6. Conclusion

Whatever the domain of acquisition, the constructivist account holds that children start out with rote-learned holophrases (e.g., *I'm eating it*; *I'm hitting it*; *I'm kicking it*) across which they abstract to acquire lexically specific slot-and-frame schemas/patterns (e.g., *I'm [X]ing it*). In at least some domains, children then analogize across these schemas to arrive at fully abstract constructions (e.g., the transitive *[X] [Y] [Z]* construction(s)). Although long and protracted, the processes of schematization and analogy *begin* as soon as children have stored – in principle – two relevant utterances across which to abstract. Importantly, each slot in the resulting schema or construction probabilistically exhibits the semantic, pragmatic, phonological (etc.) properties of the items that appeared in this position in the relevant source utterances. The greater the degree of overlap between a slot and its potential filler, the more easily the resulting utterance is produced and comprehended, and the greater the extent to which it is rated as acceptable by adults.

As we have stressed throughout this chapter, the prediction that follows from this account relates not to age ("children do not have abstract knowledge until age X") but to unevenness: Children will display significantly better performance when they can use a stored holophrase or slot-and-frame schema, and/or when the target utterance is a highly prototypical instance of the relevant abstract construction (i.e., exhibits high slot-filler overlap). On our reading of the literature, this prediction is well supported in every domain in which it has been tested, including all of those included in this review: determiners, morphological constructions, basic syntax, and more complex constructions.

Although the present chapter has not touched upon rival approaches (cf. Ambridge and Lieven, 2011; Ambridge, Pine, and Lieven, in press), it is difficult to imagine how any account that did not posit the gradual abstraction of constructions from the input could account for any one of the many lexical and prototype effects summarized here. Thus, although the constructivist approach faces many challenges, not least providing an account of precisely how children move from slot-and-frame patterns to abstract constructions, on our view the findings summarized above are sufficient to lead us to conclude that some form of constructivist, input-based account is the only realistic candidate for a viable theory of language acquisition.

Appendix: The "weighted average"

The process of schematization assumed in the present account makes several references to the notion of a "weighted average." In this appendix, we aim to flesh out this concept in a little more detail. The mathematical formulation that we present here should not be taken literally; our goal is merely to outline the *kind of thing* we mean by "weighted average." For example, the weighting function is not necessarily linear; there may well be threshold and/or ceiling effects. Neither is it clear exactly what counts as a "type" or "token," given that no two instantiations of the same word will be phonologically identical.

With these caveats in mind, we return to an example of schematization outlined in the main text: slot and frame patterns for the English determiner system.

	Occurrences of string in the input	*Semantics: Discreteness of the entity referred to (0–1)*
a ball	1	1.0
a book	1	1.0
a doggie	3	1.0
a man	5	1.0
the ball	1	1.0
the book	1	1.0
the rain	3	0.0
the juice	5	0.4*

*We assume that discreteness is not itself a discrete property. So the entity referred to by the string “the juice” might have a value of 0.4 for discreteness because, for example, the referent of the string seemed to be a discrete serving of juice on 2/5 occasions. But nothing hinges on this assumption; the procedure works in the same way if we assume binary encoding of semantic features at the input stage.

The property (e.g., the semantic property of discreteness) of a slot (e.g., [X] in the schema *a [X]*) is an average of the semantic properties of every item that has appeared in that position, weighted by the number of times that it has done so.

So the slot in the *a [X]* construction has a value of 1.0 for the semantic property of discreteness, $(1 \times 1 + 1 \times 1 + 3 \times 1 + 5 \times 1)/10$, whilst the slot in the *the [y]* construction has a mean value of 0.46, $(1 \times 1 + 1 \times 1 + 3 \times 0 + 5 \times 0.4)/10$.

This weighting explains the finding that a slot that is highly skewed towards one particular filler largely takes on the properties of that filler (Casenhiser and Goldberg 2005; Goldberg, Casenhiser, and Sethuraman, 2004; Goldberg, Casenhiser, and White, 2007). For example, the properties of the “VERB” slot in the double-object dative construction (not just semantic, but also morphophonological) are largely those of *give*, which accounts for the lion’s share of all occurrences of this construction (Ambridge, Pine, Rowland, Freudenthal, and Chang, 2014).

Just as important as a slot’s value for a particular property is its heterogeneity or variability with regard to this property (e.g., Suttle and Goldberg, 2011), which (at least for the purposes of this toy example) we can estimate as the Gini coefficient. The Gini coefficient (Gini, 1921) is a measure of heterogeneity typically used to express income inequality within a country, and is defined as half of the relative mean difference. The relative mean difference is the mean absolute difference between each pair of values in the set, divided by the mean of the whole set. Thus the Gini coefficient ranges from 0 (complete income equality/semantic homogeneity) to 1 (complete income inequality/semantic heterogeneity). It may be useful to suggest an alternative term for the Gini coefficient when applied to the domain of language acquisition: the LAMP (Language Acquisition Measure of Productivity).

It is easy to see that the Gini coefficient for the *a [X]* schema is zero (all the fillers are identical on the relevant semantic property). The Gini coefficient for the *the [Y]* schema is 0.5 (an alternative simpler measure is the standard deviation: zero and 0.37 respectively).

Thus because the *a [X]* construction has a very high score on the semantic property of discreteness (1.0) with zero heterogeneity, essentially any noun which does not score very close to 1.0 on the dimension of discreteness will be ungrammatical in the construction (e.g., **a sand*). Because the *the [Y]* construction has an intermediate score on this property and – more importantly – relatively high semantic heterogeneity, any noun will make a semantically consistent, and hence grammatical, slot filler (provided, of course, that is consistent with the slot's pragmatic properties, etc.). Note that if the Gini coefficient is "too high" it would probably make more sense to posit multiple constructions that are distinct with regard to the relevant property, as discussed in the main text with regard to the English transitive constructions. (Of course, this involves picking an arbitrary cut-off value; one possibility is the value that results if half of the items have a value of 1.0 on the relevant dimension, whilst the other half have a value of 0.0. For a set of 10 items, this cut-off value is 0.56).

Of course, this naive characterization cannot capture all of the relevant phenomena observed in the language acquisition literature. For example, there is evidence that strings that are "too" frequent take on the status of frozen phrases, and do not contribute to schematization or generalization at all (e.g., Bybee, 2001). Neither does this account incorporate any role for presumably important factors such as memory, attention, salience and – since spoken language unfolds in time – linear processing (e.g., O'Grady, chapter 4, this volume). Finally, it would seem likely that the relative weighting of pragmatic versus semantic versus phonological slot-filler (mis)matches depends on the task in hand (e.g., sending an unambiguous message in an emergency, versus rating sentences in a grammaticality judgment task, versus producing the past-tense forms of novel verbs in an elicited production study).

Ultimately, probably the only way in which we will begin to address this complexity and to accurately characterize the schematization process is with the aid of computational models that take approximations of child-directed speech as input and produce output that can be directly compared with that of real children (e.g., Chang, Dell, and Bock, 2006; Freudenthal et al., 2007; Solan, Ruppin, Horn, and Edelman, 2003; Daelemans et al., 2010).

NOTES

1 Mass nouns (e.g., *rain, advice*) are an exception that we shall discuss shortly. Such nouns may appear with *the*, or with no determiner (e.g., *Rain is depressing*), but not – in general – with *a*.

2 An anonymous reviewer for this chapter objected that "one thing that might be gained from grouping all of the fillers of a particular slot into a single category is that they might all behave alike with respect to some other process" (e.g., "NPs" can all serve as antecedents for definite pronouns). But this is precisely the point. The reason that, for example *John*, *The boy*, and *The boy who is laughing* can all serve as antecedents for definite pronouns is that they share certain semantic and pragmatic similarities (e.g., making reference to an individual). Grouping them together into a category is an unnecessary intermediate step. Indeed, since one can create new NPs at will ("The colorless green

boy who, etc., … etc.), grouping them into a free-standing off-line category is an *impossible* step. To borrow a phrase to which we will return elsewhere, "categories" such as NP are merely "immanent in their instantiations" (Langacker, 2000: 7).

3 Yet another possibility is that there are several different routes – (1) use of a stored form, (2) use of an independently represented slot-and-frame schema, (3) phonological analogy to stored forms (e.g., Abbot-Smith and Tomasello, 2006) – and that which route is used on any given occasion depends on factors such as how recently this form, or phonologically similar forms, occurred in prior discourse.

4 "A major point of contention within the categorization literature in general is whether learners develop abstractions that supersede (and essentially efface) the experienced exemplars, as in a 'pure' version of prototype theory or, alternatively, whether generalization occurs solely through online analogical comparison to a set of previously learned exemplars. We opt in the end for a kind of hybrid model comprising both abstractions and the retention of the exemplars of which those abstractions are composed" (p. 276).

5 We are agnostic with regard to whether this transition occurs for constructions that always share some closed-class lexical material between instantiations – for example the determiner and morphological constructions – given that an inventory of slot-and-frame schemas would, in principle, suffice.

6 It is for this reason that we diverge from Tomasello's (2003) account in not positing a separate role for distributional analysis in this construction-formation process. If children have (at least) six different transitive constructions, there is no need to assimilate (for example) *kiss* and *justify* into a single unitary transitive construction on the basis of distributional similarity between the two. This is not to dispute the claim that children perform distributional learning. Our claim, rather, is that the gradual probabilistic construction-abstraction process outlined here *is* the particular form of distributional learning that children use.

7 Until recently, the empirical data demonstrated only that many of children's utterances were *potentially consistent* with the use of rote-learned multi-word holophrases. However, four recent studies (Bannard and Matthews, 2008; Matthews and Bannard, 2010; Arnon and Snider, 2010; Arnon and Clark, 2011) have provided fairly direct evidence for the claim that these holophrases are indeed stored. Young children's utterances are more fluent and/or accurate when they are able to make use of a multi-word string that is of high frequency in the input (even when individual word and bigram frequency are controlled for).

8 Incidentally, although Tomasello's (1992) *verb-island hypothesis* is perhaps the single best-known constructivist study and theoretical claim, note that most of the "islands" that children appear to be using in the studies summarized here are organized not around verbs (e.g., *[X] kick [Y]*), but around pronouns, auxiliaries, inflectional morphemes, and other closed-class items (e.g., *He's [X]ing it*). Thus, as Tomasello concedes (e.g., Childers and Tomasello, 2001: 746), this particular hypothesis, or at least the privileged status that it accords to verbs, seems to be incorrect (see also McClure, Pine, and Lieven, 2006).

9 To the extent that a particular construction has particular "contextual" (i.e., semantic, functional, pragmatic, etc. properties), errors of the first type (use of an item in an inappropriate context) can be seen as special cases of errors of the second type (use of an item in an inappropriate construction). For example, the *reason* it is wrong to say **He eat cake* is that the [Y] slot in the [X] [Y] [Z] transitive construction exhibits the semantic/functional properties of denoting an event that is bounded in time.

10 Thus under this account, effects such as *entrenchment* (Braine and Brooks, 1995) and *pre-emption* (Goldberg, 1995) are seen not as separate mechanisms, but as mnemonics for frequency effects arising from the same construction-competition process.

11 We do not wish to deny that factors such as linear processing (O'Grady, chapter 4, this volume) might play a role too. The point is that we see no reason to believe that these phenomena demand an entirely different kind of explanation (such as that offered by traditional linguistic accounts).

12 The findings of Rowland et al.'s (2012) priming study suggest that, by 3;8, children's knowledge of the PO- and DO-dative constructions is as abstract as adults', and that young children do not show a lexical boost when the same verb is used in the prime and target sentence. However, this study

(unlike Rowland and Noble, 2010) does not address the issue of whether children or adults show better performance when they are potentially able to use a lexical frame such *I'm [X]ing the [Y] to [NAME]*; indeed, participants hardly ever used pronouns in this study.

13 This study reported a "lexical-boost" effect whereby the youngest children showed priming only when the prime sentence used a slot-and-frame schema – *It got [X]ed by it* – that could also be used to produce the target sentence. A more recent study of the dative constructions (Rowland et al., 2012) found no lexical-boost effect for young children, and indeed suggested that such effects may be a red herring, reflecting not the priming of slot-and-frame schemas but explicit memory of the prime sentence. But setting aside controversy over the lexical boost, a separate finding from the Savage et al. (2003) study provides evidence for the use of slot-and-frame schemas: In the condition in which children frequently produced passives (around 1.5 passives per child), 3- and 4-year-olds used pronouns twice as often as nouns. In the condition in which they rarely produced passives (under 0.5 passives per child) 3- and 4-year-olds used pronouns half as often as nouns. In other words, children are much better at producing passives when they can use schemas such as *It got ACTIONed by it*.

14 Indeed, there is evidence to suggest that some adult speakers may never acquire a fully abstract passive construction. Dąbrowska and Street (2006) found that, amongst a group of adults who read only rarely, and hence had little experience with this construction, which is rare in spoken discourse, around one-third showed at-chance performance on a comprehension task. Thus, although we have presented a one-size-fits-all account here, individual differences in level of abstraction as a function of literacy and educational level constitute a phenomenon that requires further empirical investigation, and incorporation into theoretical accounts of acquisition.

REFERENCES

Abbot-Smith, K., E. Lieven, and M. Tomasello. 2001. What preschool children do and do not do with ungrammatical word orders. *Cognitive Development* 16(2): 679–692.

Abbot-Smith, K., E. Lieven, and M. Tomasello. 2004. Training 2;6-year-olds to produce the transitive construction: The role of frequency, semantic similarity and shared syntactic distribution. *Developmental Science* 7(1): 48–55.

Abbot-Smith, K. and M. Tomasello. 2006. Exemplar-learning and schematization in a usage-based account of syntactic acquisition. *Linguistic Review* 23(3): 275–290.

Aguado-Orea, J. J. 2004. The acquisition of morpho-syntax in Spanish: Implications for current theories of development. PhD thesis, University of Nottingham.

Akhtar, N. 1999. Acquiring basic word order: Evidence for data-driven learning of syntactic structure. *Journal of Child Language* 26: 339–356.

Albright, A. and B. Hayes. 2003. Rules vs. analogy in English past tenses: A computational/experimental study. *Cognition* 90: 119–161.

Ambridge, B. 2010. Children's judgments of regular and irregular novel past tense forms: New data on the dual- versus single-route debate. *Developmental Psychology* 46(6): 1497–1504.

Ambridge, B. 2013. Just who didn't eat what, exactly? Negation and universal quantification in the real world. *Linguistic Approaches to Bilingualism* 3(3): 287–288.

Ambridge, B. and E. V. M. Lieven. 2011. *Child Language Acquisition: Contrasting Theoretical Approaches*. Cambridge: Cambridge University Press.

Ambridge, B. and J. M. Pine. 2006. Testing the agreement/tense omission model using an elicited imitation paradigm. *Journal of Child Language* 33(4): 879–898.

Ambridge, B., J. M. Pine, and E. V. M. Lieven. In press. Child language acquisition: Why Universal Grammar doesn't help. *Language*.

Ambridge, B., J. M. Pine, and C. F. Rowland. 2011. Children use verb semantics to retreat from overgeneralization errors: A novel verb grammaticality judgment study. *Cognitive Linguistics* 22(2): 303–323.

Ambridge, B., J. M. Pine, and C. F. Rowland. 2012. Semantics versus statistics in the retreat from locative overgeneralization errors. *Cognition* 123(2): 260–279.

Ambridge, B., J. M. Pine, C. F. Rowland, and F. Chang. 2012. The roles of verb semantics, entrenchment and morphophonology in the retreat from dative argument structure overgeneralization errors. *Language* 88(1): 45–81.

Ambridge, B., J. M. Pine, C. F. Rowland, F. Chang, and A. Bidgood. 2013. The retreat from overgeneralization in child language acquisition: Word learning, morphology and verb argument structure. *Wiley Interdisciplinary Reviews: Cognitive Science* 4: 47–62.

Ambridge, B., J. M. Pine, C. F. Rowland, D. Freudenthal, and F. Chang. 2014. Avoiding dative overgeneralisation errors: Semantics, statistics or both? *Language, Cognition and Neuroscience* 29(2): 218–243.

Ambridge, B., J. M. Pine, C. F. Rowland, R. L. Jones, and V. Clark. 2009. A semantics-based approach to the "no negative evidence" problem. *Cognitive Science* 33(7): 1301–1316.

Ambridge, B., J. M. Pine, C. F. Rowland, and C. R. Young. 2008. The effect of verb semantic class and verb frequency (entrenchment) on children's and adults' graded judgements of argument-structure overgeneralization errors. *Cognition* 106(1): 87–129.

Ambridge, B. and C. F. Rowland. 2009. Predicting children's errors with negative questions: Testing a schema-combination account. *Cognitive Linguistics*, 20(2): 225–266.

Ambridge, B., C. F. Rowland, A. Theakston, and M. Tomasello. 2006. Comparing different accounts of non-inversion errors in children's non-subject wh-questions: "What experimental data can tell us?" *Journal of Child Language* 30(3): 519–557.

Arnon, I. 2010. Rethinking child difficulty: The effect of NP type on children's processing of relative clauses in Hebrew. *Journal of Child Language* 37(1): 27–57.

Arnon, I. and E. V. Clark. 2011. When "on your feet" is better than "feet": Children's word production is facilitated in familiar sentence-frames. *Language Learning and Development* 7: 107–129.

Arnon, I. and N. Snider. 2010. More than words: Frequency effects for multi-word phrases. *Journal of Memory and Language* 62: 67–82.

Bannard, C., E. Lieven, and M. Tomasello. 2009. Modeling children's early grammatical knowledge. *Proceedings of the National Academy of Sciences* 106(41): 17284–17289.

Bannard, C. and D. Matthews. 2008. Stored word sequences in language learning: The effect of familiarity on children's repetition of four-word combinations. *Psychological Science* 19(3): 241–248.

Barðdal, J. 2009. *Productivity: Evidence from Case and Argument Structure in Icelandic*. Amsterdam: John Benjamins.

Barsalou, L. W. 1983. Ad hoc categories. *Memory and Cognition* 11(3): 211–227.

Bates, E. and B. MacWhinney. 1982. Functionalist approaches to grammar. In E. Wanner and L. Gleitman (eds.), *Language Acquisition: The State of the Art*, pp. 173–218. New York: Cambridge University Press.

Bavin, E. L. and C. Growcott. 2000. Infants of 24–30 months understand verb frames. In S. Perkins and S. Howard (eds.), *New Directions in Language Development and Disorders*, pp.169–177. New York: Kluwer.

Behrens, Heike. 2002. Learning multiple regularities: Evidence from overgeneralization errors in the German plural. In B. Skarabela, S. Fish, and A. H.-J. Do (eds.), *Proceedings of the 26th Annual Boston University Conference on Language Development*, pp. 72–83. Somerville, MA: Cascadilla Press.

Behrens, Heike. 2011. Cues to form and function in the acquisition of German number and case inflection. In E. V. Clark and I. Arnon (eds.), *Experience, Variation, and Generalization: Learning a First Language*, pp. 35–51. Amsterdam/Philadelphia: Benjamins.

Bencini, G. M. L. and V. V. Valian. 2008. Abstract sentence representations in 3-year-olds: Evidence from language production and comprehension. *Journal of Memory and Language* 59: 97–113.

Berko, J. 1958. The child's learning of English morphology. *Word* 14: 150–177.

Bloom, L., M. Rispoli, B. Gartner, and J. Hafitz. 1989. Acquisition of complementation. *Journal of Child Language* 16(1): 101–120.

Bowerman, M. and S. Choi. 2001. Shaping meanings for language: Universal and language-specific in the acquisition of spatial semantic categories. In M. Bowerman and S. C. Levinson (eds.), *Language Acquisition and Conceptual Development*, pp. 475–511. Cambridge: Cambridge University Press.

Braine, M. D. S. 1963. The ontogeny of English phrase structure. *Language* 39: 1–14.

Braine, M. D. S. and P. J. Brooks. 1995. Verb argument structure and the problem of avoiding an overgeneral grammar. In M. Tomasello and W. E. Merriman (eds.), *Beyond Names for Things: Young Children's Acquisition of Verbs*, pp. 352–376. Hillsdale, NJ: Erlbaum.

Brandt, S., E. Kidd, E. Lieven, and M. Tomasello. 2009. The discourse bases of relativization: An investigation of young German and English-speaking children's comprehension of relative clauses. *Cognitive Linguistics* 20(3): 539–570.

Brandt, S., E. Lieven, and M. Tomasello. 2010. Development of word order in German complement-clause constructions: Effects of input frequencies, lexical items, and discourse function. *Language* 86(3): 583–610.

Brooks, P. J. and I. A. Sekerina. 2006. Shortcuts to quantifier interpretation in children and adults. *Language Acquisition* 13(3): 177–206.

Brooks, P. J. and M. Tomasello. 1999. Young children learn to produce passives with nonce verbs. *Developmental Psychology* 35(1): 29–44.

Brooks, P. J., M. Tomasello, K. Dodson, and L. B. Lewis. 1999. Young children's overgeneralizations with fixed transitivity verbs. *Child Development* 70(6): 1325–1337.

Bybee, J. 1995. Regular morphology and the lexicon. *Language and Cognitive Processes* 10(5): 425–455.

Bybee, J. 2001. *Phonology and Language Use*. Cambridge: Cambridge University Press.

Campbell, A. L. and M. Tomasello. 2001. The acquisition of English dative constructions. *Applied Psycholinguistics.* 22(2): 253–267.

Casenhiser, D. and A. E. Goldberg. 2005. Fast mapping between a phrasal form and meaning. *Developmental Science* 8(6): 500–508.

Chan, A., K. Meints, E. Lieven, and M. Tomasello. 2010. Young children's comprehension of English SVO word order revisited: Testing the same children in act-out and intermodal preferential looking tasks. *Cognitive Development* 25(1): 30–45.

Chandler, S. 2002. Skousen's analogical approach as an exemplar-based model of categorization. In R. Skousen, D. Lonsdale, and D. B. Parkinson (eds.), *Analogical Modeling: An Exemplar-based Approach to Language*, pp. 51–105. Amsterdam: John Benjamins.

Chang, F., G. S. Dell, and K. Bock. 2006. Becoming syntactic. *Psychological Review* 113(2): 234–272.

Childers, J. B. and M. Tomasello 2001. The role of pronouns in young children's acquisition of the English transitive construction. *Developmental Psychology* 37(6): 739–748.

Chomsky, N. 1957. *Syntactic Structures*. The Hague: Mouton.

Clark, R. 1976. A report on methods of longitudinal data collection. *Journal of Child Language* 3(3): 457–459.

Conwell, E. and K. Demuth. 2007. Early syntactic productivity: Evidence from dative shift. *Cognition* 103(2): 163–179.

Dąbrowska, Ewa. 2001. Learning a morphological system without a default: The Polish genitive. *Journal of Child Language* 28: 545–574.

Dąbrowska, E. 2004a. *Language, Mind, and Brain*. Edinburgh: Edinburgh University Press.

Dąbrowska, Ewa. 2004b. Rules or schemas? Evidence from Polish. *Language and Cognitive Processes* 19: 225–271.

Dąbrowska, Ewa. 2005. Productivity and beyond: Mastering the Polish genitive inflection. *Journal of Child Language* 32: 191–205.

Dąbrowska, Ewa. 2006. Low-level schemas or general rules? The role of diminutives in the acquisition of Polish case inflections. *Language Sciences* 28: 120–135.

Dąbrowska, Ewa. 2008a. The later development of an early-emerging system: The curious case of the Polish genitive. *Linguistics* 46:3: 629–650.

Dąbrowska, Ewa. 2008b. The effects of frequency and neighbourhood density on adult native speakers' productivity with Polish case inflections: An empirical test of usage-based approaches to morphology. *Journal of Memory and Language* 58: 931–951.

Dąbrowska, E. and E. Lieven. 2005. Towards a lexically specific grammar of children's question constructions. *Cognitive Linguistics* 16(3): 437–474.

Dąbrowska, E. and J. Street. 2006. Individual differences in language attainment: Comprehension of passive sentences by native and non-native English speakers. *Language Sciences* 28: 604–615.

Dąbrowska, E. and M. Szczerbiński. 2006. Polish children's productivity with case marking: The role of regularity, type frequency, and phonological diversity. *Journal of Child Language* 33: 559–597.

Dąbrowska, E. and M. Tomasello. 2008. Rapid learning of an abstract language-specific category: Polish children's acquisition of the instrumental construction. *Journal of Child Language* 35(3): 533–558.

Daelemans, W., J. Zavrel, K. van der Sloot, and A. van den Bosch. 2010. TiMBL: Tilburg Memory-Based Learner, version 6.3: Reference guide. ILK Technical Report – ILK 10–01. Tilburg Centre for Cognition and Communication, Tilburg University.

Diessel, H. and M. Tomasello. 2000. The development of relative clauses in spontaneous child speech. *Cognitive Linguistics* 11(1–2): 131–151.

Diessel, H. and M. Tomasello, 2001. The acquisition of finite complement clauses in English: A corpus-based analysis. *Cognitive Linguistics* 12(2): 97–141.

Diessel, H. and M. Tomasello. 2005. A new look at the acquisition of relative clauses. *Language* 81(4): 882–906.

Dittmar, M., K. Abbot-Smith, E. Lieven, and M. Tomasello. 2008. Young German children's early syntactic competence: A preferential looking study. *Developmental Science* 11(4): 575–582.

Dittmar, M., K. Abbot-Smith, E. Lieven, and M. Tomasello. 2013. Familiar verbs are not always easier than novel verbs: How German pre-school children comprehend active and passive sentences. *Cognitive Science* 38(1): 128–151.

Dixon, R. M. W. 2004. Adjective classes in typological perspective. In R. M. W. Dixon and Alexandra Y. Aikhenvald (eds.), pp. 1–49. *Adjective Classes: A Cross- Linguistic Typology*. Oxford: Oxford University Press.

Dodson, K. and M. Tomasello. 1998. Acquiring the transitive construction in English: The role of animacy and pronouns. *Journal of Child Language* 25: 555–574.

Ebbinghaus, H. 1913 [1885]. *Memory: A Contribution to Experimental Psychology* (trans. Henry A. Ruger and Clara E. Bussenius). New York: Teachers College, Columbia University.

Evans, N. and S. C. Levinson. 2009. With diversity in mind: Freeing the language sciences from Universal Grammar. *Behavioral and Brain Sciences* 32(5): 472–492.

Fernandes, K. J., G. F. Marcus, J. A. Di Nubila, and A. Vouloumanos. 2006. From semantics to syntax and back again: Argument structure in the third year of life. *Cognition* 100(2): B10–20.

Fisher, C. 1996. Structural limits on verb mapping: The role of analogy in children's interpretations of sentences. *Cognitive Psychology* 31(1): 41–81.

Fisher, C. 2002. The role of abstract syntactic knowledge in language acquisition: A reply to Tomasello 2000. *Cognition* 82(3): 259–278.

Forrester, N. and K. Plunkett. 1994. Learning the Arabic plural: The case for minority default mappings in connectionist networks. In A. Ram and K. Eiselt (eds.), *Proceedings of the Sixteenth Annual Conference of the Cognitive Science Society*, pp. 319–323. Hillsdale, NJ: Erlbaum

Fox, D. and Y. Grodzinsky. 1998. Children's passive: A view from the by-phrase. *Linguistic Inquiry* 29: 311–332.

Freudenthal, D., J. M. Pine, J. Aguado-Orea, and F. Gobet. 2007. Modeling the developmental patterning of finiteness marking in English, Dutch, German, and Spanish using MOSAIC. *Cognitive Science* 31(2): 311–341.

Freudenthal, D., J. Pine, and F. Gobet. 2010. Explaining quantitative variation in the rate of Optional Infinitive errors across languages: A comparison of MOSAIC and the Variational Learning Model. *Journal of Child Language* 37(3): 643–669.

Gathercole, V. C. M., E. Sebastián, and P. Soto. 1999. The early acquisition of Spanish verbal morphology: Across-the-board or piecemeal knowledge? *International Journal of Bilingualism* 3(2–3): 133–182.

Gentner, D. and J. Medina. 1998. Similarity and the development of rules. *Cognition* 65: 263–297.

Gertner, Y., C. Fisher, and J. Eisengart. 2006. Learning words and rules: Abstract knowledge of word order in early sentence comprehension. *Psychological Science* 17(8): 684–691.

Gini, C. 1921. Measurement of inequality and incomes. *Economic Journal* 31: 124–126.

Goldberg, A. E. 1995. *Constructions: A Construction Grammar Approach to Argument Structure*. Chicago: Chicago University Press.

Goldberg, A. E. 2006. *Constructions at Work: The Nature of Generalization in Language*. New York: Oxford University Press.

Goldberg, A., D. Casenhiser, and N. Sethuraman. 2004. Learning argument structure generalizations. *Cognitive Linguistics* 14: 289–316.

Goldberg, A., D. Casenhiser, and T. White. 2007. Constructions as categories of language. *New Ideas in Psychology* 25: 70–86.

Gordon, P. and J. Chafetz. 1990. Verb-based versus class-based accounts of actionality effects in children's comprehension of passives. *Cognition* 36(3): 227–254.

Hahn, U. and R. C. Nakisa. 2000. German inflection: Single route or dual route? *Cognitive Psychology* 47(4): 313–360.

Hare, M., J. L. Elman, and K. G. Daugherty. 1995. Default generalization in connectionist networks. *Language and Cognitive Processes* 10(6): 601–630.

Haspelmath, M. 2007. Pre-established categories don't exist: Consequences for language description and typology. *Linguistic Typology* 11(1): 119–132.

Hirsch, C. and K. Wexler. 2006. Children's passives and their resulting interpretation. In K. U. Deen, J. Nomura, B. Schulz, and B. D. Schwartz (eds.), *Proceedings of the inaugural Conference on Generative Approaches to Language Acquisition – North America*, pp. 125–136. University of Connecticut Occasional Papers in Linguistics 4.

Hirsh-Pasek, K. and R. M. Golinkoff. 1996. *The Origins of Grammar: Evidence from Early Language Comprehension*. Cambridge, MA: MIT Press.

Horgan, D. 1978. Development of full passive. *Journal of Child Language* 5(1): 65–80.

Huttenlocher, J., M. Vasilyeva, and P. Shimpi. 2004. Syntactic priming in young children. *Journal of Memory and Language* 50(2): 182–195.

Ibbotson, P., A. L. Theakston, E. V. Lieven, and M. Tomasello. 2012. Semantics of the transitive construction: Prototype effects and developmental comparisons. *Cognitive Science* 36(7): 1268–1288.

Israel, M., C. Johnson, and P. J. Brooks. 2000. From states to events: The acquisition of English passive participles. *Cognitive Linguistics* 11: 1–2.

Janda, R. D. 1990. Frequency, markedness and morphological change: On predicting the spread of noun-plural *–s* in Modern High German and West Germanic. *ESCOL* 7: 136–153.

Kauschke, C., A. Kurth, and U. Domahs. 2011. Acquisition of German noun plurals in typically developing children and children with specific language impairment. *Child Development Research 2011*: 17 pp.

Kidd, E., E. L. Bavin, and B. Rhodes. 2001. Two-year-olds' knowledge of verbs and argument structure. In M. Almgren, A. Barreña, M.-J. Ezeizabarrena, I. Idiazabal, and B. MacWhinney (eds.), *Research on Child Language Acquisition: Proceedings of the 8th Conference of the International Association for the Study of Child Language*, pp. 1368–1382. Somerville, MA: Cascadilla Press.

Kidd, E., S. Brandt, E. Lieven, and M. Tomasello. 2007. Object relatives made easy: A cross-linguistic comparison of the constraints influencing young children's processing of relative clauses. *Language and Cognitive Processes* 22(6): 860–897.

Kidd, E., E. Lieven, and M. Tomasello. 2006. Examining the role of lexical frequency in the acquisition of sentential complements. *Cognitive Development* 21: 93–107.

Kidd, E., E. V. M. Lieven, and M. Tomasello. 2010. Lexical frequency and exemplar-based learning effects in language acquisition: Evidence from sentential complements. *Language Sciences* 32(1): 132–142.

Kirjavainen, M., A. Nikolaev, and E. Kidd. 2012. The effect of frequency and phonological neighbourhood density on the acquisition of past tense verbs by Finnish children. *Cognitive Linguistics* 23(2): 273–315.

Kirjavainen, M., A. Theakston, and E. Lieven. 2009. Can input explain children's me-for-I errors? *Journal of Child Language* 36(5): 1091–1114.

Köpcke, K. M. 1998. The acquisition of plural marking in English and German revisited: Schemata versus rules. *Journal of Child Language* 25(2): 293–319.

Kotovsky, L. and D. Gentner. 1996. Comparison and categorization in the development of relational similarity. *Child Development* 67(6): 2797–2822.

Krajewski, G. 2008. A constructivist investigation into the development of Polish noun inflections in children between two- and three-and-a-half years of age. PhD thesis, University of Manchester.

Krajewski, G., E. V. M. Lieven, and A. L. Theakston. 2012. Productivity of a Polish child's inflectional noun morphology: A naturalistic study. *Morphology* 22(1): 9–34.

Krajewski, G., A. L. Theakston, E. V. Lieven, and M. Tomasello. 2011. How Polish children switch from one case to another when using novel nouns: Challenges for models of inflectional morphology. *Language and Cognitive Processes* 26(4–6): 830–861.

Kuczaj, S. and N. Brannick. 1979. Children's use of the wh-question modal auxiliary placement rule. *Journal of Experimental Child Psychology* 28: 43–67.

Labov, W. and T. Labov. 1978. Learning the syntax of questions. In R. Campbell and P. Smith (eds.), *Recent Advances in the Psychology of Language*, pp. 1–44. New York: Plenum Press.

Langacker, R. W. 2000. A dynamic usage-based model. In M. Barlow and S. Kemmer (eds.), *Usage-Based Models of Language*, pp. 1–63. Stanford, CA: CSLI Publications.

Legate, J. A. and C. Yang. 2007. Morphosyntactic learning and the development of tense. *Language Acquisition* 14: 315–344.

Leonard, L. B., M. C. Caselli, and A. Devescovi. 2002. Italian children's use of verb and noun morphology during the preschool years. *First Language* 3(66): 287–304.

Lieven, E. V. M., H. Behrens, J. Speares, and M. Tomasello. 2003. Early syntactic creativity: A usage-based approach. *Journal of Child Language* 30(2): 333–370.

Lieven, E. V. M., J. M. Pine, and G. Baldwin. 1997. Lexically-based learning and early grammatical development. *Journal of Child Language* 24(1): 187–219.

Lieven, E. V. M., J. M. Pine, and H. Dresner-Barnes. 1992. Individual differences in early vocabulary development: Redefining the referential–expressive distinction. *Journal of Child Language* 19(2): 287–310.

Lieven, E. V. M., D. Salomo, and M. Tomasello. 2009. Two-year-old children's production of multiword utterances: A usage-based analysis. *Cognitive Linguistics* 20(3): 481–507.

Limber, J. 1973. The genesis of complex sentences. In T. E. Moore (ed.), *Cognitive Development and the Acquisition of Language*, pp. 169–185. New York: Academic Press.

MacWhinney, B. 1975. Rules, rote, and analogy in morphological formations by Hungarian children. *Journal of Child Language* 2: 65–77.

MacWhinney, B. 1982. Basic syntactic processes. In S. Kuczaj (ed.), *Language Development. Volume 1: Syntax and Semantics*, pp. 73–136. Hillsdale, NJ: Lawrence Erlbaum.

MacWhinney, B. 2004. A multiple process solution to the logical problem of language acquisition. *Journal of Child Language* 31(4): 883–914.

MacWhinney, B. In press. Item-based patterns in early syntactic development. In Thomas Herbst (ed.), *Patterns, Collocations, and Constructions*. Berlin: De Gruyter Mouton.

Maratsos, M. P., D. E. Fox, J. A. Becker, and M. A. Chalkley. 1985. Semantic restrictions on children's passives. *Cognition* 19(2): 167–191.

Marchman, V. A. 1997. Children's productivity in the English past tense: The role of frequency, phonology and neighborhood structure. *Cognitive Science* 21(3): 283–304.

Marchman, V. A., B. Wulfeck, and S. E. Weismer. 1999. Morphological productivity in children with normal language and SLI: A study of the English past tense. *Journal of Speech, Language and Hearing Research* 42: 206–219.

Markman, A. B. and D. Gentner. 1993. Structural alignment during similarity comparisons. *Cognitive Psychology* 25(4): 431–467.

Matthews, D. and C. Bannard. 2010. Children's production of unfamiliar word sequences is predicted by positional variability and latent classes in a large sample of child-directed speech. *Cognitive Science* 34(3): 465–488.

Matthews, D., E. Lieven, A. L. Theakston, and M. Tomasello. 2004. The role of frequency in the acquisition of English word order. *Cognitive Development* 20: 121–136.

Matthews, D., E. Lieven, A. Theakston, and M. Tomasello. 2007. French children's use and correction of weird word orders: A constructivist account. *Journal of Child Language* 34(2): 381–409.

McCawley, J. D. 1992. Justifying part-of-speech distinctions in Mandarin Chinese. *Journal of Chinese Linguistics* 20: 211–246.

McClure, K., J. M. Pine, and E. V. M. Lieven. 2006. Investigating the abstractness of children's early knowledge of argument structure. *Journal of Child Language* 33: 693–720.

Meints, K. 1999. Protoypes and the acquisition of passives. In B. Kokinov (ed.), *Perspectives on Cognitive Science*, vol. 4, pp. 67–77. Sofia: NBU Press.

Messenger, K., H. P. Branigan, and J. F. McLean. 2011. Evidence for (shared) abstract structure underlying children's short and full passives. *Cognition* 121(2): 268–274.

Messenger, K., H. P. Branigan, and J. F. McLean. 2012. Is children's acquisition of the passive a staged process? Evidence from six- and nine-year-olds' production of passives. *Journal of Child Language* 39(5): 991–1016.

Messenger, K., H. P. Branigan, J. F. McLean, and A. Sorace. 2012. Is young children's passive syntax semantically constrained? Evidence from syntactic priming. *Journal of Memory and Language* 66(4): 568–587.

Moon, C., R. P. Cooper, and W. P. Fifer. 1993. Two-day-olds prefer their native language. *Infant Behavior and Development*,16: 495–500.

Ninio, A. 1993. On the fringes of the system: Children's acquisition of syntactically isolated forms at the onset of speech. *First Language* 13(39): 291–312.

Noble, C. H., C. F. Rowland, J. M. Pine. 2011. Comprehension of argument structure and semantic roles: Evidence from infants and the forced-choice pointing paradigm. *Cognitive Science* 35(5): 963–982.

Nosofsky, R. M. 1992. Similarity scaling and cognitive process models. *Annual Review of Psychology* 4: 25–53.

Peters, A. M. 1983. *The Units of Language Acquisition*. Cambridge: Cambridge University Press.

Pine, J. M., G. Conti-Ramsden, K. L. Joseph, E. V. M. Lieven, and L. Serratrice. 2008. Tense over time: Testing the agreement/tense omission model as an account of the pattern of tense-marking provision in early child English. *Journal of Child Language* 35(1): 55–75.

Pine, J. M., D. Freudenthal, G. Krajewski, and F. Gobet. 2013. Do young children have adult-like syntactic categories? Zipf's law and the case of the determiner. *Cognition* 127(3): 345–360.

Pine, J. M. and E. V. M. Lieven. 1993. Reanalysing rote-learned phrases: Individual differences in the transition to multi-word speech. *Journal of Child Language* 20(3): 551–571.

Pine, J. M. and E. V. M. Lieven. 1997. Slot and frame patterns and the development of the determiner category. *Applied Psycholinguistics* 18(2): 123–138.

Pine, J. M., E. V. M. Lieven, and C. F. Rowland. 1998. Comparing different models of the development of the English verb category. *Linguistics* 36(4): 807–830.

Pine, J. M. and H. Martindale. 1996. Syntactic categories in the speech of young children: The case of the determiner. *Journal of Child Language* 23(2): 369–395.

Pinker, S. 1989. *Learnability and Cognition: The Acquisition of Argument Structure*. Cambridge, MA: MIT Press.

Pinker, S., D. S. Lebeaux, and L. A. Frost. 1987. Productivity and constraints in the acquisition of the passive. *Cognition* 26(3): 195–267.

Pizutto, E. and C. Caselli. 1994. The acquisition of Italian verb morphology in a cross-linguistic perspective. In Y. Levy (ed.), *Other Children, Other Languages: Issues in the Theory of Language Acquisition*, pp. 137–188. Hillsdale, NJ: Lawrence Erlbaum.

Plunkett, K. and R. C. Nakisa. 1997. A connectionist model of the Arabic plural system. *Language and Cognitive Processes* 12(5–6): 807–836.

Radford, A. 1996. Towards a structure building model of acquisition. In H. Clahsen (ed.), *Generative perspectives on language acquisition*. Amsterdam: John Benjamins

Räsänen, S. H. M., B. Ambridge, and J. M. Pine. 2014. Infinitives or bare stems? Are English-speaking children defaulting to the highest-frequency form? *Journal of Child Language* 41(4): 756–777.

Räsänen, S. H. M., B. Ambridge, and J. M. Pine. 2014. An elicited production study of inflectional morphology in child Finnish. *Journal of Child Language* 41(4): 756–779.

Rizzi, L. 1994. Some notes on linguistic theory and language development: The case of root infinitives. *Language Acquisition* 3: 371–393.

Rowland, C. F. 2007. Explaining errors in children's questions. *Cognition* 104(1): 106–134.

Rowland, C. F., F. Chang, B. Ambridge, J. M. Pine, and E. V. Lieven. 2012. The development of abstract syntax: Evidence from structural priming and the lexical boost. *Cognition* 125(1): 49–63.

Rowland, C. F. and C. L. Noble. 2010. The role of syntactic structure in children's sentence comprehension: Evidence from the dative. *Language Learning and Development* 7(1): 55–75.

Rowland, C. F. and J. M. Pine. 2000. Subject–auxiliary inversion errors and wh-question acquisition: "What children do know?" *Journal of Child Language* 27(1): 157–181.

Rowland, C. F. and A. L. Theakston. 2009. The acquisition of auxiliary syntax: A longitudinal elicitation study. Part 2: The modals and auxiliary DO. *Journal of Speech, Language, and Hearing Research* 52(6): 1471–1492.

Rubino, R. B. and J. M. Pine. 1998. Subject–verb agreement in Brazilian Portuguese: What low error rates hide. *Journal of Child Language* 25(1): 35–59.

Savage, C., E. Lieven, A. Theakston, and M. Tomasello. 2003. Testing the abstractness of children's linguistic representations: Lexical and structural priming of syntactic constructions in young children. *Developmental Science* 6(5): 557–567.

Savage, C., E. Lieven, A. Theakston, and M. Tomasello. 2006. Structural priming as implicit learning in language acquisition: The persistence of lexical and structural priming in 4-year-olds. *Language Learning and Development* 2: 27–50.

Shimpi, P. M., P. B. Gámez, J. Huttenlocher, and M. Vasilyeva. 2007. Syntactic priming in 3- and 4-year-old children: Evidence for abstract representations of transitive and dative forms. *Developmental Psychology* 43(6): 1334–1346.

Skousen, R. 1992. *Analogy and Structure*. Dordrecht: Kluwer.

Solan, Z., E. Ruppin, D. Horn, and S. Edelman. 2003. Automatic acquisition and efficient representation of syntactic structures. In S. Becker, S. Thrun and K. Obermayer Ghahramani (eds.), *Advances in Neural Information Processing Systems*, pp. 107–116. Cambridge, MA: MIT Press.

Stoll, S., K. Abbot-Smith, and E. Lieven 2009. Lexically restricted utterances in Russian, German, and English Child-Directed Speech. *Cognitive Science* 33(1): 75–103.

Sudhalter, V. and M. D. S. Braine. 1985. How does comprehension of passives develop: A comparison of actional and experiential verbs. *Journal of Child Language* 12(2): 455–470.

Suttle, L. and A. E. Goldberg. 2011. The partial productivity of constructions as induction. *Linguistics* 49(6): 1237–1269.

Theakston, A., G. Krajewski, S. Keeble, and A. Woollams. 2013. Frequency, phonological and semantic factors in the development of the English past tense. Poster presented at 35th Cognitive Science Society Conference, Berlin.

Theakston, A. L. and E. V. M. Lieven. 2005. The acquisition of auxiliaries BE and HAVE: An elicitation study. *Journal of Child Language* 32(3): 587–616.

Theakston, A. L., E. V. M. Lieven, J. M. Pine, and C. F. Rowland. 2005. The acquisition of auxiliary syntax: BE and HAVE. *Cognitive Linguistics* 16(1): 247–277.

Theakston, A. L., E. V. M. Lieven, and M. Tomasello. 2003. The role of the input in the acquisition of third person singular verbs in English. *Journal of Speech, Language and Hearing Research* 46(4): 863–877.

Theakston, A. L. and C. F. Rowland. 2009. The acquisition of auxiliary syntax: A longitudinal elicitation study. Part 1: Auxiliary BE. *Journal of Speech, Language and Hearing Research* 52(6): 1449–1470.

Thothathiri, M. and J. Snedeker. 2008. Syntactic priming during language comprehension in three- and four-year-old children. *Journal of Memory and Language* 58(2): 188–213.

Tomasello, M. 2000. Do young children have adult syntactic competence? *Cognition* 74(3): 209–253.

Tomasello, M. 2003. *Constructing a Language: A Usage-Based Theory of Language Acquisition*. Cambridge, MA: Harvard University Press.

Twomey, K. E., F. Chang, and B. Ambridge. 2014. Do as I say, not as I do: A lexical distributional account of English locative verb class acquisition. *Cognitive Psychology* 73: 41–71.

Valian, V. 1986. Syntactic categories in the speech of young children. *Developmental Psychology* 22(4): 562–579.

Valian, V., S. Solt, and J. Stewart. 2009. Abstract categories or limited-scope formulae? The case of children's determiners. *Journal of Child Language* 36(4): 743–778.

Wexler, K. 1998. Very early parameter setting and the unique checking constraint: A new explanation of the optional infinitive stage. *Lingua* 106(1–4): 23–79.

Wilson, S. 2003. Lexically specific constructions in the acquisition of inflection in English. *Journal of Child Language* 30: 1–41.

Yang, C. 2013. Who's afraid of George Kingsley Zipf? Or: Do children and chimps have language? *Significance* 10(6) (published on-line).