Testing Generativist and Constructivist Accounts of Morphological Development Using Complex Noun Morphology

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By

Eglė Savičiūtė

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Abstract

How children learn grammar has been one of the most long-standing questions in cognitive psychology. After decades of both naturalistic and experimental child language study, two dominant approaches have emerged: generativist and constructivist. The generativist approach argues children reach adult-like productivity with the help of innate Universal Grammar, while the constructivist approach argues that children's grammar learning is incremental and input-based. However, the research field has been dominated by research on verbs and/or morphologically poor languages, such as English. The current thesis addresses these gaps in research by testing children's knowledge of the full noun morphology system in Lithuanian, a highly morphologically complex language.

Three studies are reported in this thesis. The naturalistic speech study found that the child's overall low error rate hid "pockets" of high error rates in medium-frequency contexts, and that the child was likely to use a high frequency surface form when she produced an erroneous form. There was also some evidence that the child was significantly less flexible in her use of noun cases than her mother.

The second study was an elicited production study testing children's ability to produce different cases of familiar nouns. In addition to a relatively high error rate and a tendency to "default" to a high frequency morpheme, significant surface form and phonological neighbourhood density effects were found.

Finally, the third study, an elicited production study using novel nouns, tested children's productions of novel noun forms. The results echoed the findings of the familiar noun elicitation experiment. The significant effects of age and phonological neighbourhood density provided evidence for an incremental analogy forming process based on similar, previously acquired items.

Together, the multi-methodological group of studies offer a coherent argument against the idea of early full productivity favoured by the generativist approach and support the input-based constructivist approach. However, certain findings, such as the relatively good performance with low frequency cases in the naturalistic speech study, and inconsistent age effects across the elicited production experiments, also challenge current constructivist theories of complex morphology acquisition.

Dissemination

Conferences

The contents of experimental data reported in this thesis have been presented in a talk at:

Alston Hall Child Language Workshop, UK (2014)

Studying Language Learning: From the Laboratory to the Classroom, Germany (2015)

The contents of experimental data reported in this thesis have been presented in a poster at:

2nd LuCiD Language and Communicative Development Conference, UK (2015)

16BCCCD – Budapest, Hungary (2016)

Peer Reviewed Publication

The contents of experimental data reported in this thesis have been published in a peer-reviewed journal article:

Savičiūtė, E., Ambridge, B., & Pine, J. M. (2018). The roles of word-form frequency and phonological neighbourhood density in the acquisition of Lithuanian noun morphology. *Journal of Child Language, 45*(3), 641-672.

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Introduction

The rate at which children learn their first language has fascinated researchers for decades. It has been shown that, even by six-month mark, infants have already learnt how to extract separate words from the continuous speech they are surrounded by, and can identify various nouns (Bergelson & Swingley, 2012). They are competent enough to start producing words themselves around the one-year mark and reach almost adult-like understanding of their native language syntax by the age of five (Guasti, 2004). However, there is, at present, no unified explanation yet of how children become competent users of morphology – the process by which words are inflected to reflect their properties, such as tense in verbs or number in nouns. The theories can be broadly divided into two contrasting approaches: generativist and constructivist. According to the generativist approach, abstract knowledge of grammatical morphology is innate; children quickly rule in or out pre-existing grammatical options, such as whether their language marks the past tense or not, that are not compatible with the language around them, and arrive at a full set of morphological rules relatively easily. Constructivist accounts argue that children begin by rote-learning frequent words and phrases they encounter and only then start constructing grammar based on multiple exemplars. This thesis investigates the predictions of these two approaches to morphological acquisition using Lithuanian, a highly inflected language.

The first part of Chapter 1 provides a more detailed overview of grammar acquisition from the generativist perspective in general, while the second part focuses on morphology. Theoretical explanations are illustrated with studies which both support and provide challenges to the approach. The constructivist approach is reviewed in a similar manner in Chapter 2. Chapter 3 summarises Lithuanian language grammar and relevant research. Its complex noun morphology is discussed in detail, and theories of its acquisition are tested in the following chapters.

Chapter 4 presents a naturalistic speech study, which tested the predictions of the two approaches. Recordings of a two-year-old Lithuanian girl's and her mother's speech were examined to test whether the child's productivity with noun morphology was similar (as predicted by generativist accounts) or significantly different (as predicted by constructivist accounts) to that of her mother. The findings

were mixed, possibly due to the lack of low-frequency data, suggesting that a more direct method of eliciting certain morphemes is required to fully test the Lithuanian noun morphology system. Furthermore, error data were examined in detail: the large differences in correct response rates across different noun case + number + declension contexts supported constructivist assumptions that input frequency plays a significant role in grammar acquisition. Examination of which inflections the child tended to use when she used an erroneous form also broadly supported the constructivist account, whilst also presenting some challenges.

Chapters 5 and 6 present familiar (real) and novel Lithuanian noun elicitation studies. The results generally followed constructivist predictions: children were better at producing high frequency inflected forms than the lower frequency ones; if they made an error they tended to substitute a low frequency target with a higher frequency surface form.

Chapter 7 discusses the findings of the naturalistic and empirical studies in Chapters 4, 5 and 6, and the support and challenges they provide to the differing morphological acquisition theories.

1. The generativist approach

1.1 Introduction

The generativist approach to language began partly as a reaction to a proposal put forward by Skinner (1957), who attempted to explain language learning in much the same terms as other well-established learning behaviours directly based on rewards and punishments. Just like mice in Skinner's box learning how to perform increasingly complex tasks in the hope of reward (and conversely stop producing undesired behaviours to avoid punishment), children were argued to learn language by attempting to repeat sounds they heard around them, in exchange for desired rewards, such as food or attention. When a child begins babbling in the early months of his or her life, parents are likely to reward only sounds that (remotely) resemble real words. This would make the child try to repeat those particular sounds more accurately and frequently in the hope of receiving a desired response from the parents. This push towards more accurate production of sounds would continue until they arrive at adult-like language.

However, as noted by Chomsky (1957), this theory could not explain people's ability to understand and produce novel utterances. A classic example used to illustrate the problem came from Chomsky (1957): *Colorless green ideas sleep furiously* is nonsensical semantically, and unlikely to have been used in the history of human language before then, but nonetheless people coming across it for the first time have no difficulty understanding that it is grammatically correct (c.f., **Green sleep curiously ideas furiously*). Chomsky therefore argued that language learning is different from other learned behaviours and demands a more complex explanation. Furthermore, theories based on simple behaviourism principles could not explain errors children sometimes make, such as **She goed there* or **Cat chase mouse*. It is unlikely that they would hear incorrect utterances like these in the environment around them, so a simple mechanism based on the repetition of the input could not explain language learning.

Chomsky (1957, 1959) therefore argued that grammar is based on a set of innate abstract linguistic categories, such as NOUN and VERB. These categories (or phrases such as NOUN PHRASE and VERB PHRASE) can be moved, or

transformed, using innate abstract grammatical rules, which generate new sentences. As this knowledge is innate, it means that all children are born with the same Universal Grammar (UG). However, different languages clearly have numerous differences in their grammars. The system through which children arrive at their particular language is called Principles and Parameters (Chomsky, 1981). Principles are the shared aspects of different syntaxes (e.g., the structure dependence principle – the assumption that children possess the understanding that grammar rules can apply to separate clauses within a sentence; Chomsky, 1971), while parameters (e.g., the null subject parameter, which determines whether the subject can be omitted or not, Hyams, 1986) dictate whether particular grammatical options are applicable to a particular language. This underlying system helps to explain why children are capable of becoming productive and creative with their language at a very quick rate, despite the relatively low amount of linguistic evidence they receive, compared to an infinite number of hypotheses they would have to consider when generating new syntactic structures.

1.1.1 Universal Grammar

The current section briefly explains the Chomskyan phrase-structure grammar, which has been one of the most successful linguistic category-based grammars in explaining the production of all major sentence types from the generativist point of view.

The fact that languages are constantly updated with new words, and that we usually do not need an explanation of what grammatical category a new word belongs to (e.g., *Google it*; *she Whatsapped him*), shows that the language system – at its most basic level - relies on assigning grammatical categories to the words and phrases we hear.

Basic linguistic categories such as NOUN, VERB and ADVERB are enough to produce a simple sentence based on abstract rules. For example, *Cats purr loudly* could potentially be constructed using the following rules:

NOUN goes before VERB

VERB goes before ADVERB

If one needs to construct a question based on this sentence, one could apply the rule ‘auxiliary DO goes before noun’:

Do cats purr loudly?

However, natural languages are a lot more complex than this, and such basic abstract rules are not enough. For example, if one tried to apply the same rule to *The black cats like milk*, the outcome would be **The black do cats like milk?*. To solve this problem, separate words are combined or merged into different units that can be moved together. For example, *The cats meow* can be split into a NOUN PHRASE (NP), consisting of a DETERMINER (D) *the* and a NOUN (N) *cats* and a VERB PHRASE (VP) containing *meow* (Figure 1).

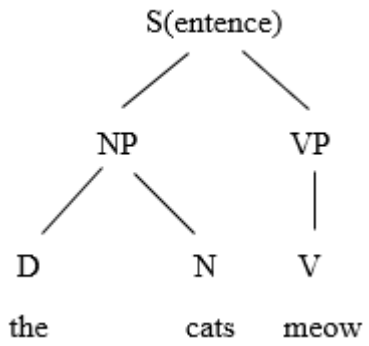


Figure 1. Phrase structure tree for *the cats meow*.

Now, a question may be formed by applying the rule that ‘auxiliary DO goes before the NOUN PHRASE’, which gives *Do the cats meow?*. Of course, the actual question formation rules posited under Chomskyan accounts are considerably more complicated; the aim of this example is simply to illustrate the necessity of positing rules that act on phrases (e.g., NP), rather than categories (e.g., NOUN) or individual words (*cats*).

More complex sentences can be accommodated by combining phrases into larger phrases and can potentially expand indefinitely (at least in principle) through the process of recursion, where additional COMPLEMENT PHRASES are added to HEAD PHRASES. As a further example, consider how VPs can accommodate a PREPOSITIONAL PHRASE (PP) in *the cats meow in the garden* (Figure 2).

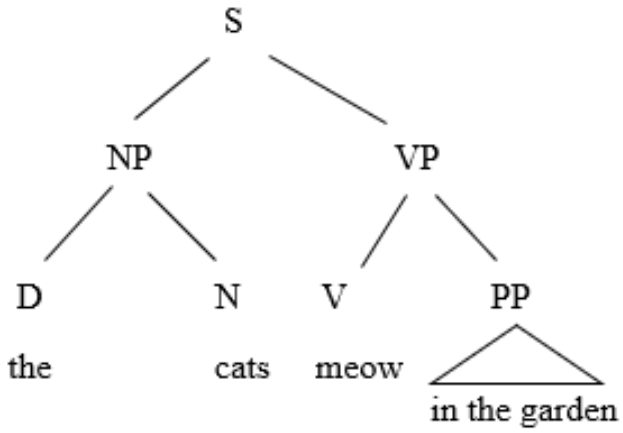


Figure 2. Phrase structure tree for the cats meow in the garden.

A major distinction between natural languages is whether the language is head-initial or head-final. Head-initial languages, like English, normally have the HEAD PHRASE preceding the COMPLEMENT PHRASE (e.g., VP = [V *kick*] [DP *the ball*]), while in head-final languages, like Korean or Japanese, the complement comes before the head (e.g., VP = [DP *the ball*] [V *kick*]).

Rules of phrase structure apply not only to content words, like NOUNS, VERBS, ADJECTIVES and ADVERBS, which make up lexical categories, but also to function category words, which play a (mainly) grammatical role within a sentence. They include whole-word categories (e.g., DETERMINERS and QUANTIFIERS) and also abstract categories like INFLECTION, which governs inflectional morphemes marking grammatical features (e.g., NOUN plural *-s*; VERB past-tense *-ed*).

Under many approaches, INFLECTION (INFL) is split into two further categories – TENSE (TNS) and AGREEMENT (AGR). Tense, as the name suggests, governs inflections denoting the tense of a verb (e.g., *–ed* for past tense in English), while agreement deals with the verb's agreement with person (e.g., *–s* for third person singular present tense in English). Most importantly for the present thesis, NOUN case marking is also governed by AGR.

While these, and many other lexical and grammatical categories, are held to be innate, the actual language-specific stems and inflectional morphemes are stored in the mental lexicon (these, of course, cannot be innate, since they vary from language to language). When the speaker formulates a sentence, the VERB projects

the necessary argument structure. For example, an intransitive sentence, such as *The cat is sleeping* requires a subject NP (*the cat*) and a VP (*is sleeping*): i.e., *sleep* projects a SUBJECT, but no OBJECT. Transitive utterances, such as *the cat is chasing the mouse,* require a subject NP (*the cat*), VP (*is chasing*), and an object NP (*the mouse*) embedded within VP. The utterance also undergoes tense, agreement, or any other relevant inflectional checking to ensure it is grammatically correct.

1.1.2. Poverty of the stimulus

An important goal of the Chomskyan Principles and Parameters framework is to solve the poverty of the stimulus (POS) problem. The POS argument states that if there were no pre-existing principles governing what kinds of grammatical rules are possible, a child learning his or her language would be faced with an infinite number of grammatical hypotheses to consider, and not enough input data to test them all. A frequent example used to illustrate the POS argument is the formulation of complex *yes/no* questions in English. Consider, first, simple *yes/no* questions:

1. *The cat is on the chair.*

2. *Is the cat on the chair?*

One could formulate the rule that *is* needs to move to the front of the sentence to form a question. However, the rule no longer works when it is applied to a sentence with multiple auxiliaries:

1. *The cat that is purring is fluffy*.

2. **Is the cat that purring is fluffy?*

The rule no longer works because the first auxiliary was moved instead of the last one. However, "move the last auxiliary to the front" rule would also work only with some sentences:

1. *The cat is trying to catch a bird that is tweeting*.

2. **Is the cat is trying to catch a bird that tweeting?*

In theory, the child could continue trying out various hypotheses (e.g., move the auxiliary before the adjective to the start of the sentence; move the auxiliary after the verb to the front of the sentence, etc.). Furthermore, without a constraining

starting point, these hypotheses could extend to extra-linguistic features of speech, such as pitch or volume. Considering the near-infinite number of possible linguistic and sonic features, it seems unlikely that all typically developing children receive enough input to test out all of the possible hypotheses and stumble into a full and correct set of hypotheses for auxiliaries, as well as other parts of the speech, by the age of five without any prior assumptions. Generativist accounts, therefore, posit the principle of structure dependence, which states that grammatical rules refer to linguistic structures (e.g., "main clause") rather than linear order. If the principle is applied to the example above, the rule states "move the auxiliary from the main clause" and the correct form is produced:

3. *Is the cat is trying to catch a bird that is tweeting?*

Furthermore, children not only arrive at the same linguistic endpoint, they also tend to follow similar development patterns irrespective of language (e.g., Braginsky, Yurovsky, Marchman & Frank, 2015), as well as making similar errors (e.g., Gertner & Fisher, 2012; Smith, 1933). For example, using non-finite verbs instead of a finite form has been observed in English, Dutch, German, French, Swedish, Danish and Russian (Wexler, 1994). This is taken as evidence of innate knowledge of sentence structure.

1.1.3 Principles and parameters

The generativist assumption of Universal Grammar suggests that children are born with an almost adult-like set of categories and rules, which make learning any grammar a relatively quick and easy process. However, different languages often have completely opposing rules, such as HEAD PHRASE position relative to its COMPLEMENT PHRASE location in English (head-initial) and Japanese (head-final). Therefore, in addition to the common features across all languages (principles; discussed above), different grammars also have a set of language-specific set of parameters, which lead to these diverse rules.

Although there is no definitive list of linguistic principles, some of the most prominent include lexical and functional categories such as NOUN PHRASE and INFLECTIONAL PHRASE; rules relating to the structure of a sentence and possible movement operations; direct links between semantic and syntactic roles (e.g.,

AGENT = subject); and binding principles governing interpretation of pronouns (e.g., *The cat licked her* is interpreted as the cat licking someone else, not itself [Chomsky 1980, 1981, 1982]).

The exact number and nature of parameters has also been somewhat unclear, although the trend has been to increase the number from "a few" (Pinker, 1994, p. 112) to potentially thousands (Shlonsky, 2010); this is likely due to an ever-increasing number of languages being studied in greater detail, with many new language-specific idiosyncrasies requiring a new parameter. Examples of proposed parameters include head direction (head-initial English or head-final Japanese) and null-subject (which determines whether or not a language requires an explicit subject). For example, pronouns in Italian are often optional, as the subject can be inferred from the verb inflection used:

- *I eat* → *(Io) mang**io***

- *You eat* → *(Tu) mang**i***

1.2 Morphosyntax acquisition

The previous section of the chapter provided an outline of how a competent adult speaker produces sentences under the generativist approach. The following section describes how word order rules (syntax) develop in children (before focusing on inflectional morphology). As there is no single generativist account which attempts to explain word-order acquisition in particular, two particularly influential accounts that illustrate the basic principles of generativist approaches are presented; principles that also apply to generativist theories of morphological acquisition. Both of these accounts focus on the acquisition of basic canonical word order (in English, SUBJECT VERB OBJECT).

1.2.1 Semantic bootstrapping

As discussed with regard to the poverty of the stimulus argument, children are equipped with all of the required syntactic rules and categories from birth. However, they still need to find the 'break-in' point in order to map the input to the syntactic categories. According to Pinker (1989), the help comes in the form of innate knowledge of:

- Syntactic categories (VERB and NOUN) and associated phrases (e.g., NOUN, VERB, NOUN PHRASE, VERB PHRASE)

- Semantic roles which determine the roles of each word in the sentence (e.g., AGENT and PATIENT)

- Rules linking semantic and syntactic categories

These linking rules specify the relationship between the semantic and grammatical roles, such as mapping AGENT with subject, as well as providing a blueprint for what lexical categories might be (e.g., a noun may be a living thing or a physical object, while a verb usually denotes an action).

When children encounter concrete, highly descriptive, sentences such as *The cat is chasing the mouse*, the AGENT (*cat* = subject) and the PATIENT (*mouse* = object) are easily identified and, by means of the linking rules, assigned to their respective syntactic categories. Similarly, the child concludes that according to the linking rules, *chasing* (the ACTION) must be the verb, and therefore their language must use the SUBJECT – VERB – OBJECT order. Once the word order is established, the child can then use the learned word order to parse more abstract utterances, which do not necessarily conform to these linking rules, e.g., *The cat hates the rain*. Although the verb here does not denote an action, the pre-established word order allows the sentence to be parsed as SVO.

Although it is difficult to see how one could test Pinker's (1989) proposal directly, several studies found evidence for very early canonical sentence structure comprehension. For example, Gertner, Fisher and Eisengart (2006) conducted a series of experiments with 21- and 25-month-olds to see whether toddlers would interpret novel verb sentences using the canonical English SVO word order. First, they showed the older children side-by-side videos of a duck performing an action on a bunny, or a bunny performing an action on the duck, with an audio description matching one of the videos (e.g., *The duck is gorping the bunny! / The bunny is gorping the duck!*) and found that children preferred to look at the video matching the audio description. The second experiment used the same method, only the subject was replaced by a pronoun (e.g., *He is gorping the bunny! / He is gorping the duck!*). Again, the participants looked longer at the matching video. When the experiments were repeated with the younger age group (21 months) and the animals in the videos

replaced by a boy and a girl, the pattern of results was repeated, with children showing preference for the video embodying the SVO word order.

A potential problem for Pinker's account is that learners are likely to come across input that violates the linking rules (e.g., *fast* in *The cat is fast* may be interpreted as a VERB, since it seems to denote an action; i.e., moving quickly). Pinker (1987) proposed that instead of applying the linking rules in a one-shot fashion, the child also considers distributional information. For example, *fast* is often found in the same location as words previously classed as ADJECTIVES, like slow or sleepy. This distributional analysis process results in the child correctly labelling fast as an ADJECTIVE.

1.2.2 Parameter Setting

Another popular theory of how grammar, in particular, basic word order, is learnt using innate knowledge of Universal Grammar, is parameter setting. Crain (1991) described a parameter as "a limited, ordered set of hypotheses (or values) that may be entertained for some linguistic phenomenon" (p. 601). Once a child encounters evidence that a pre-existing hypothesis is wrong (e.g., that the verb comes before the subject in an SVO order language, such as English), the pronoun parameter is set to the correct value and the child is considered as having acquired the rule. Alternatively, a child may choose to not set parameters until they come across an unambiguous 'trigger', which can be used to set a parameter (Fodor, 1998; Fodor & Sakas, 2005).

While the process is supposed to take a while, possibly years, depending on the language (Roeper, 1986), it is assumed that the time is used to encounter all the necessary lexical items. The sentences needed to test out all of the hypotheses can come in any order, but all children learning a particular language eventually arrive at the same point. Furthermore, setting of the individual parameters is not slow (Hyams 1989; Lasnik & Crain 1985).

As discussed previously, there is no definitive list of parameters, but there is general agreement across generativist parameter setting accounts that, in order to acquire basic word order, the child needs to set the complement-head, specifier-head and V2 (verb second) parameters (e.g., Crain, 1991, Hyams, 1986).

The complement-head parameter determines whether the complement (e.g., the OBJECT) is placed before or after the head (e.g., the VERB). Comparing English and Japanese illustrates how the complement-head parameter may be set:

English is a head-initial language, with the VERB (head) placed before the OBJECT (complement):

Drive (V) the car (O)

Japanese is a head-final language, with the VERB (head) placed after the OBJECT (complement):

Kuruma (O) o unten suru (V)
The car drive

If an English-speaking child begins with the hypothesis that English is a head-final language, they will quickly encounter sentences that violate this rule and therefore they will switch the head-complement parameter to head-initial setting. Conversely, a Japanese-speaking child who tests out the head-final option will not encounter parsing failure and will select the head-final option early on.

Similarly, the specifier-head parameter determines whether the specifier (e.g., the SUBJECT) is placed before or after the head (e.g., the VERB). Comparing English and Welsh illustrates how the specifier-head parameter may be set:

English is a SV language, with the SUBJECT (specifier) placed before the VERB (head):

The man (S) ran (V)

Welsh is a VS language, with the SUBJECT (specifier) placed after the VERB (head):

Rhedodd (V) y dyn (S)
Ran the man

Finally, the V2 parameter determines whether or not the finite verb must come in the second position of the clause or not. For example, German is a V2 language and the marked verb (whether it is the main verb or an auxiliary) appears in the second position:

Der Mann (S) fuhr (V) das Auto (O)
The man drove the car

Heute(PP) hat (AUX) der Mann (S) das Auto(O) gefahren (V)
Today has the man the car drive

In some cases (e.g., Legate & Yang, 2005) parameter setting offers a potential explanation as to why a child's language changes as they grow older, despite the assumption that underlying grammatical structures remain the same from birth to adulthood. More commonly, however, parameter-setting is invoked to explain rapid and largely error-free acquisition (e.g., Hoekstra & Hyams, 1998; Wexler, 1998). The fact that most posited parameters are binary makes hypothesis testing a quick process for the child, often requiring minimal input to arrive at the correct parameter setting (Hyams, 2008). For example, if the child begins with the assumption that their language uses VO order and they hear a sentence confirming it, the parameter is set to the correct head-initial option. Furthermore, multiple parameters may be set, in principle, on the basis of a single utterance. For example, as both the complement-head and specifier-head parameters are dependent on the location of the object, the child hearing *The man kicked the ball* should not only be able to determine the object-verb order, but also the subject-verb order.

The goal of this section has been to outline two generativist accounts of basic-word-order acquisition - semantic bootstrapping and parameter setting - with the aim of using these accounts to illustrate the general principles and assumptions of generativist approaches. As should be evident from the discussion above, a key defining feature of these (and all generativist) approaches is that rules are formulated in terms of categories (e.g., VERB NOUN) and phrases (e.g., VERB PHRASE, NOUN PHRASE), rather than individual lexical items. A second defining assumption is that these categories (including functional categories such as INFL or TNS and AGR) are innate and so available from the beginning of language acquisition. The following section outlines how these two principles are incorporated into generativist accounts of the acquisition of inflectional morphology, the topic of this thesis.

1.3 Adult knowledge of morphology according to generativist accounts

The first part of this chapter provided an overview of the process of basic word order acquisition in adult and young speakers according to the generativist approach. The focus of the second part of the chapter is instead on the generativist explanation of inflectional morphology – the changes of word forms within a sentence.

Word order syntax has been one of the main areas of research in child language acquisition, which is a major question in language development, especially in Western European languages. However, it is less of a challenge for languages which have free or semi-free word order. While English requires certain words to be in a certain word order for the correct meaning to be inferred, other languages do not. For example:

The cat	*is chasing*	*the mouse*
SUBJECT	VERB	OBJECT

If the word order is changed, a completely different message is conveyed:

The mouse	*is chasing*	*the cat*
SUBJECT	VERB	OBJECT

Such a switch would not lead to a different meaning in languages which allow free word order. For example, Lithuanian has a dominant SVO word order (just like English) but other orders are also allowed, without changing the meaning (although reordering can sometimes be used for pragmatic purposes, such as foregrounding the OBJECT). For example, *Mergaitė valgo obuolį* (= The girl is eating an apple) could be expressed in six different constructions:

SVO	*mergaitė valgo obuolį*
SOV	*mergaitė obuolį valgo*
VSO	*valgo mergaitė obuolį*
VOS	*valgo obuolį mergaitė*
OSV	*obuolį mergaitė valgo*
OVS	*obuolį valgo mergaitė*

Indication that the sentence needs to be interpreted in the OVS order instead of SVO comes from the morphemes at the end of the two nouns: *mergait-ė* (= girl NOM) and *obuol-į* (= apple ACC). The morphemes determine the roles the nouns play in the sentence (girl = AGENT/apple = PATIENT), which leads to the correct interpretation of the utterance.

Inflectional morphology can be used to indicate a wide range of grammatical features, not just of nouns, but other parts of speech too. The most frequently marked features include case (corresponding to the function of a noun in a sentence), grammatical gender (usually masculine and feminine gender marker applied to both animate and inanimate nouns; gender marking also applies to adjectives), number (normally differing between singular and plural), person (referring to the perspective of the participants in the action: *I/you/he* or *she*), tense (referring to the time an action is taking place: present, past or future) and aspect (specifying the action's duration in time, e.g., *I walked* vs *I was walking*). English, a morphologically impoverished language, uses few morphemes (e.g., *–s* to indicate noun plurality or *–ed* to mark past tense), while some other languages have a highly complex morphological system. For example, many indigenous Australian languages have ten or more grammatical cases (The World Atlas of Language Structures Online); Lithuanian has seven.

According to the generativist approach, these morphemes belong to the grammatical (functional) category of INFLECTION (I), which operates in a very similar way to lexical categories (e.g., NOUN and VERB). In phrase-structure trees, morphological suffixes are inserted or checked at INFLECTION (I), within the INFLECTIONAL PHRASE (IP). IP governs both inflectional morphemes and auxiliaries. When a particular inflected form is required, the verb moves to I to (depending on the particular variant of the theory) either pick up or check the relevant inflectional morpheme. For example, the phrase structure tree for *cats chased mice* is depicted in Figure 3.

Some generativist accounts (e.g., Hoekstra & Hyams, 1998; Wexler, 1998) further split the INFLECTIONAL PHRASE into tense and agreement. For example, *chase**s*** marks both present tense and 3sng agreement. In order for the system to arrive at the correct inflectional form, the verb is first checked against the tense category and then

the agreement category. Grammatical noun cases, which do not carry information about tense, are only checked against the agreement category. For example, the phrase structure tree for *cat chases mice* is depicted in Figure 4.

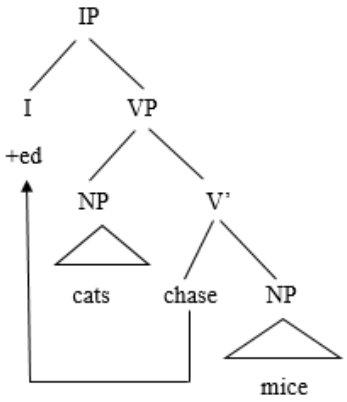


Figure 3. *Phrase structure tree for* cats chased mice.

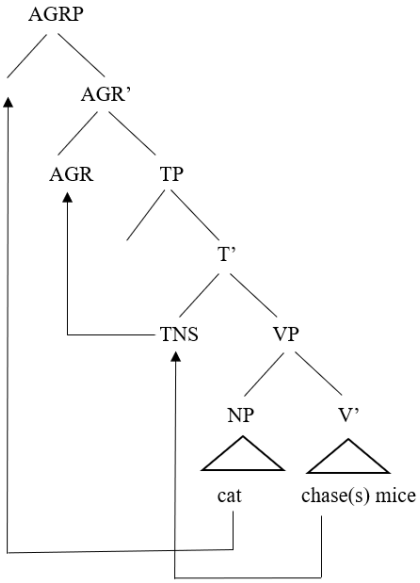


Figure 4. *Phrase structure tree for* cat chases mice.

Several different generativist proposals seek to explain how children can learn inflectional morphology; perhaps the most successful of which are the ATOM (Agreement/Tense Omission Model; Schütze & Wexler, 1996; Wexler, 1998), the VLM (Variational learning model; Legate & Yang, 2007, Yang, 2002) and the dual-route model (Prasada & Pinker, 1993). Although these models are, in principle, applicable to all types of inflectional systems, the most detailed presentations tend to focus on verb morphology, particularly root infinitive and subject case-marking

agreement errors. Root infinitive (RI) errors refer to the tendency for children to use the infinitive form of the verb when a tense is required. The most commonly researched language here is English (e.g., **The cat chase mice* instead of *The cat chase**s** mice*). Although this error could be interpreted as an omission error (*chase+s*), similar findings in other languages, in which finite forms require a substitution instead of an addition of the suffix to the finite form (e.g., **John Fußball spielen* [= *John football play INF] instead of *John spielt Fußball* [= John plays football] in German [Ambridge & Lieven, p. 144]), suggest that a more complex process might be behind this type of error. However, another, though less frequent, cross-linguistic error is using the wrong noun or pronoun case, particularly for SUBJECTs; for example, **Her* (for *She*) *chases mice.*

The predictions of generativist accounts regarding children's noun case marking will be set out in detail in the chapters that outline the empirical studies. For now, the aim is to illustrate the general principles of generativist accounts of inflectional morphology; in particular the claim that rules apply at the levels of variables (e.g., VERB, INFLECTION), not of individual verb or noun forms.

1.3.1 Agreement/Tense Omission Model (ATOM)

Schütze and Wexler (1996) examined naturalistic English speech data of three children between the ages of 1;11 - 3;1 and found that, in the majority of the erroneous utterances, children either made a subject case-marking error but used the correct verb form (e.g., **my had a tape recorder*, p. 675), or used the correct subject form but a non-tensed verb form (e.g., **she drink apple juice*, p. 674). However, children used the different subject and verb forms correctly during the same stages of development and appeared to know that accusative forms mark the OBJECT and that generative forms the possessive. Therefore, the errors could not be simply explained by assuming that the child has not learned the correct rules. Importantly, when children did supply tense marking, it was almost always (95%) correct.

Schütze and Wexler's findings led to the proposal of an Optional Infinitive stage, during which children are subject to the Unique Checking Constraint (UCC), which dictates that only one functional category can be checked at a time. This results in the child being unable to check verb forms for both subject agreement and tense. If the child checks against subject agreement only, he or she will produce

sentences like **she chase mice*. Conversely, if only tense is checked, the same utterance could be **her chased mice*. However, the majority of the utterances children make are grammatically correct, even during the OI stage. This is because children may violate the UCC and instead obey a competing pragmatic constraint requiring checking against both agreement and tense. The UCC is said to disappear with maturation, leaving the child with the correct 'check for tense and agreement' constraint only.

The ATOM also offers an explanation of why such errors are mostly seen in languages in which the subject is compulsory (e.g., English and German), but are a lot rarer in languages which permit subject omission (e.g., Italian and Polish): the latter type of languages tend to have verb suffixes which encode both tense and person. Children learning such languages only need to check against one functional category, and therefore do not need to violate the UCC.

1.3.1.1 Challenges to ATOM

The clear YES/NO checking approach to tense and agreement in the ATOM leads to a clear error pattern prediction: if TNS is checked, the error appears in the subject; if AGR is checked, the error is linked to the verb. However, children sometimes make errors which should not occur according to the ATOM model, e.g., **the cats is playing* or **him runs*. Hoekstra and Hyams (1998) found that errors that are predicted by the model not to occur can be found in both compulsory subject languages (e.g., English), as well as the null subject languages (Spanish). Although Wexler (1998) and Schütze (2001) acknowledged that errors that should be impossible according to ATOM can be found in child language (possibly due to the child not yet knowing the correct surface form/suffix), instances of such errors should be extremely infrequent.

Despite the qualification, Pine, Rowland, Lieven and Theakston (2005) pointed out that the data used to support the ATOM often lacked enough 3sng and 3plr contexts to directly test the predictions of the model. In order to address the problem, markedly larger spontaneous speech samples of three English speaking children between the ages of 1;10 and 3;0 were analysed. All analysed children produced at least ten 3sng non-nominative subjects. The results showed that although the overall rate of agreeing verbs with non-nominative subjects (e.g., **Her*

isn't; not predicted by ATOM) was below 10% and could be considered as noise in the data, the rates increased to 33-39% for feminine subjects when the data were split by gender. Neither the high error rate, nor the subject gender difference was predicted by ATOM.

A further problem with the ATOM is that it struggles to explain the gradient nature of error rates across different languages. The prediction of the account is that RI errors should be observed in compulsory subject languages, but not in null subject languages. While this appears to be true for some languages (e.g., they are frequent in English but not Italian), other languages, such as Dutch and French, seem to fall in the middle (Freudenthal, Pine, Aguado-Orea & Gobet, 2007; Phillips, 1995).

Most of the evidence contradicting the ATOM is linked to its binary checking process, which suggests a more flexible model is required to explain acquisition of morphology.

1.3.2 Variational Learning Model (VLM)

In addition to the findings of children using correct and incorrect forms simultaneously, which the ATOM attempted to address, another major question facing generativist accounts is that optional infinitive (OI) error type is not either applicable or not applicable in different languages, but instead is on a gradient, in languages such as Dutch and French. The Variational Learning Model (Legate & Yang, 2007; Yang, 2002) has been more successful at explaining the gradient across different languages.

The Variational Learning Model attempts to address the issue of gradience by suggesting that instead of testing one possible grammar at a time, several different grammars compete simultaneously. When an utterance is processed, grammars which can accommodate the structure are reinforced, while the grammars which do not are weakened. The process continues until a clear 'winner' emerges which can accommodate the language in the child's surroundings, based on the parameter which determines whether a language marks for tense in this case.

According to the VLM, differences in how long children tend to erroneously use the infinitive form in different languages is linked to how much evidence of tense marking is encountered in the input.

Spanish has an extensive conjugation system in which most person+tense combinations receive a unique ending specific to that particular combination (e.g., *jugar = to sing; I play = yo juego, you (singular informal) play = tú juegas, he/she/one plays = él/ella/ello/uno juega*; *I will play = yo jugaré* etc.); therefore, sentences which contain a non-finite form (or a form that may be mistaken for one) are relatively rare, leading the child to punish –TNS/AGR grammars and settle on the +TNS/AGR setting quickly (Rowland, 2013). English, on the other hand, marks relatively few person+tense combinations, which results in an extended RI period. French falls in between Spanish and English for unambiguously tense-marked verb frequency (in terms of pronunciation, rather than spelling) and has a medium-length RI period (Legate & Yang, 2007).

As well as explaining cross-linguistic differences, the VLM's focus on frequency also helps to account for individual differences. It has often been noted that a child's language reflects properties of the frequency distribution found in the input (e.g., see Ambridge et al., 2015, for a review), which includes error production. Hadley, Rispoli, Fitzgerald and Bahnsen (2011) found that children are more likely to produce errors if their caregivers used more sentences which did not overtly mark for tense (e.g., *you want help?* p. 566) compared with those who did (e.g., *Elmo is being towed away;* p. 566). In summary, the VLM's rewarding and punishing of various grammars accommodates children's simultaneous use of correct and incorrect grammars (as well as correctly predicting how long they are likely to do so) and allows for different grammars not to strictly be 'on' or 'off' with regard to certain other grammatical features, such as pronoun drop.

1.3.2.1 Challenges to VLM

Although the VLM is more successful at explaining tense-marking errors cross-linguistically than the ATOM, one of its major challenges is explaining the differences in word-specific performance. According to the VLM, the input sensitivity operates at the level of possible grammars, rather than individual forms. Therefore, a child's ability to construct a grammatically correct sentence should not be influenced by word types. However, studies have shown significantly varying performance based on the frequency of individual ready-inflected surface forms.

For example, Räsänen et al. (2016) found that in an elicited production task, two- to four-year-old Finnish speaking children's ability to produce a correctly person/number marked form were predicted by the token frequency of the noun and phonological neighbourhood density, even when the children showed evidence of having acquired the target morpheme with other verbs.

Differences in error rates in different types of nouns were also found in a naturalistic speech study. Freudenthal, Pine and Gobet (2010) analysed English, Dutch, German, French and Spanish child speech corpora, and found that the frequency of optional infinitive errors was significantly correlated to the frequency of that verb occurring as infinitives in sentences requiring non-finite forms. The evidence of word-specific frequency effects on error rates is not predicted by the VLM.

1.4 Dual-route model

Both the VLM and ATOM have received a considerable amount of attention and have shown the capability to address some of the linguistic development questions. However, they both focus on tense/agreement marking at an abstract level. The most prominent account which tries to explain how children learn to produce the appropriate phonological form of each inflection is the dual-route model, originally proposed for the English past-tense.

Prasada and Pinker (1993) suggested that irregular forms are rote-learned and stored as whole-word items. Within this store, individually learned forms are stored in separate phonological neighbourhoods made up of similar sounding words (for example, *wear* → *wore*, *tear* → *tore*; *ring* → *rang*, *sing* → *sang*). Regular forms, on the other hand, are stored separately as stems and inflections.

When the system needs to produce an inflected form, it first checks if it is already stored as a whole form or if there are enough similar-sounding examples which can be used to generate the required form (e.g., if *ring* → *rang* and *sing* → *sang*, then *zling* → *zlang*). If it is, the application of the regular/default ending is blocked and the stored form is used form is used; otherwise, the regular/default ending is used (e.g., *zling-ed*; Marcus et al., 1992).

The process is the same for adults and children. However, adults' whole-item and phonological neighbourhood store is much more extensive, as it increases over time. Therefore, adults are more likely to be able to produce a correctly inflected form, especially if it requires a "non-default" inflection.

Support for the dual-route model has mainly come from research into the English past tense. For example, Marcus et al. (1992) found that children sometimes applied the regular/default *–ed* inflection to irregular verbs (e.g., *feel* → **feel-ed*) at the same time as using the –ed ending correctly. The overall error rate was only 2.5%, which Marcus and colleagues interpreted as evidence for the dual-route model. As predicted by the model, the errors tended to occur with the low frequency irregular verbs, as they were least likely to have a whole-form entry or a phonological neighbourhood dense enough to generate an inflected form.

A corpus study by Xu and Pinker (1995) analysed 20 000 past tense and participle verb forms across nine children between the ages of 0;7 – 8;0. They found that both overregularisations and overregularisations errors (e.g., **swing* → *swang*) were made only with about 0.2% of the analysed verbs, with no evidence for age effects or other clear patterns, with the exception that overregularisations were often based on other similar irregular verbs (e.g., *swim* → *swam*, so **swing* → *swang*). Certain error types predicted by connectionist models (e.g., **mail-membled*; Rumelhart & McClelland, 1986) were not recorded either. The authors argued that the findings suggested the existence of a separate morphology forming route for irregular verbs, where the forms are generated based on their similarity to other irregular forms.

Van der Lely and Ullman (2001) tested 5;5 – 8;9-year-old children's ability to produce past tense forms of verbs in a sentence completion task. The overall error rate was under 3% for real verbs, while the error rate for novel verbs ranged from 11.45% for the youngest group to 5.10% for the middle group and 5.85% for the oldest group. Frequency did not appear to play a part in correct regular form production for 6;5– 8;9-year-old children; only by-subject significant frequency effects found in the 5;5-6;4-year-old group. Analysis based on children's familiarity ratings of the stimulus verb stems conducted prior to the main study task did not reveal a significant frequency effect. However, significant frequency effects were

found in irregular verb production, with the more frequent verbs receiving more correct responses. The results suggested the presence of two separate routes for past tense formation, a default-rule regular route and a whole-word form store susceptible to input effects.

1.4.1 Challenges to the dual-route model

One of the main challenges to the dual-route model comes from languages with no clear "default" inflection. In English, an overwhelming majority of plural noun forms end in *–s* and past tense forms end in *–ed,* making the potential regular/default form easy to identify. However, many languages have several competing endings with similar frequencies. Studies in languages as diverse as German, Arabic and Polish have shown that children's "defaulting" patterns often do not point to a default form.

Szagun (2001) analysed spontaneous speech recordings of 22 German-speaking children between the ages of 1;4 to 3;8. Plural form error analysis revealed that children "defaulted" to a wide range of endings when they produced an incorrect plural, with no one form of ending dominating the defaulting behaviour. Similar results were also found in a German plural elicitation study, in which 60 3- to 6-year-old children were asked to complete a sentence using a plural noun form. The errors were classed as either "no marking" (repetition of the singular form), "partial marking" (no stem change where required), "substitution" (using a plural marking morpheme from a different noun class) or "addition" (using a plural morpheme for nouns which are not marked in their plural form). The proportions of error types were approximately equal for the youngest group. The proportion of "partial marking" appeared to decrease in the oldest group (approximately 10%) in favour of "no marking" (about 50%). However, both "substitution" and "addition" error types remained generally stable, at about 20% each (Kauschke, Kurth & Domahs, 2011).

Another elicited production task investigated Arabic-speaking 3- to 8- year-old children's ability to pluralise real and novel nouns. While the younger groups showed a tendency to use feminine sound plural morphemes, the older children showed a tendency to "default" to both a feminine sound plural as well as broken plural morphemes (Albirini, 2015).

Dąbrowska found no evidence of a default ending in the Polish genitive case in either 1;4 – 4;11-year-old children's spontaneous speech analysis (2001), or novel genitive form production in an elicited production task in both children and adults (2004).

Even for English, "regular" past tense *-ed* forms are rated as more acceptable when they are phonologically similar to existing regular forms (Albright & Hayes, 2003; Ambridge, 2010); suggesting that phonological analogy, rather than a default rule, is used to generate these forms.

1.5 Challenges to generativist accounts of inflectional morphology

Although different generativist/nativist models offer varying details on specific grammar production processes, such as past tense marking, all argue that once a rule is acquired, the child will show (near) full productivity with items following the particular rule. However, in addition to the specific challenges to each account, some errors in child language constitute difficulties for generativist approach in general.

Most studies which report high productivity rate (e.g., Harris & Wexler, 1996; Hoekstra & Hyams, 1998; Hyams, 1986; Marcus et al., 1992; Poeppel & Wexler, 1993; Stemberger, 1989) come from naturalistic speech data, which is time-consuming to collect, leading to sporadic recordings. The lack of whole-day child recordings can make it difficult to establish if the child is non-productive with a certain inflection (especially if it is infrequent), or whether the recording did not capture it. Aguado-Orea and Pine (2015) attempted to address the question by collecting a dense sample and a) matching adult and child sample sizes and b) only including the child data from the point in which the child has demonstrated previous uses of a particular inflection. The analysis of the closely matched data suggested that the children used significantly fewer inflections per verb than adults, even when the children had learned the relevant inflections, challenging the generativist notion that children and adults have the same grammar, only the children need to learn the morphemes first.

Furthermore, elicitation studies have demonstrated word-specific effects on productivity, which again challenges the generativist proposition of children using

abstract rules from the beginning. For example, Räsänen et al. have shown that token frequency and phonological neighbourhood density significantly predict correct verb form production in English (2014) and Finnish (2016). Studies which ask children to produce a correctly inflected word form based on a novel word tend to show much lower correct production rates than those predicted by generativist theories (e.g., Dąbrowska, 2005; Dąbrowska & Szczerbiński, 2006; Kirjavainen, Nikolaev & Kidd, 2012).

1.6 Summary

A number of generativist theories have tried to address the issue of how children attempt to learn inflectional morphology of their language. Although they all have clear differences, such as how many items/grammars can be checked at once, they also share the assumption that Universal Grammar governs these processes. While some do not assign frequency a major rule in their explanations, theories which have been more successful at addressing morphological development at least partly base their predictions on how often the child hears a particular item. Frequency is especially important when trying to explain findings from more morphologically-complex languages, although child language data still presents a large number of challenges to generativist theories. Additionally, frequency has been shown to play a significant role when predicting the types of errors children are likely to make when they produce an erroneous utterance, making the default rule redundant.

Furthermore, despite the extensive amount of research into root infinitives and past tense inflection application, most of the evidence comes from morphologically impoverished languages, such as English and German, and there has not been a satisfactory explanation on how children learn complex inflectional systems, such as Polish or Finnish, based on innate rules and categories. Therefore, it is important to consider explanations which do not presume the existence of universal rules, and instead focus on properties of the input such as frequency and phonological neighbourhood density. These types of accounts are considered in the next chapter.

2. The constructivist approach

2.1 Introduction

Generativist approach accounts argue that children learn grammar by sifting through their innate knowledge of linguistic universals and setting parameters, which allows them to narrow down or arrive at their native language grammar remarkably quickly and in way that is largely error-free. However, as discussed in the previous chapter, the explanation has its shortcomings. One of the ways research has tried to address findings that cannot be explained by the generativist approach is to explain language development in a wholly different way: children begin to learn language by rote-learning words and phrases they hear around them and only subsequently start constructing grammatical categories and rules. Children's motivation to rote-learn and to create abstractions comes from the need to communicate with others around them. Concrete phrases, such as *want teddy/juice/sleep*, are generalised into more abstract templates (*want X*, in this case). The more frequent and prominent a construction, the quicker the child is likely to amass enough examples to create these schemas and start applying them to new items. These schemas apply to both sentence constructions (e.g., [SUBJECT] [VERB] [OBJECT] for basic transitive sentences; [WH-WORD] [AUX] [THING] [PROCESS] for *wh*-questions) and word-level inflection (e.g., [VERB]s, [VERB]ed).

The current chapter provides an overview of constructivist approaches. To facilitate comparison with generativist approaches (Chapter 1), this chapter follows a similar structure. First, constructivist explanations of the development of syntax, with a focus on English SVO order, are detailed. The second part of the chapter describes how inflectional morphology is acquired under this approach.

The constructivist account emerged in the 1960's with Braine's (1963) study of children's spontaneous utterances. Braine concluded that children begin constructing multi-word utterances by learning a small number of words and their position in a phrase, which he termed *pivots*, for example *want X*, *there X*. The pivots are used with other items in their vocabulary, referred to the X-class, to create utterances, such as *want car, want more, want up*.

The basic idea that grammar can be learned by replacing previously learned words in a phrase based on their similarity (in terms of semantics, phonology, location in an utterance etc.) in a gradual manner has been expanded upon by various constructivist accounts (e.g., Bates & Macwhinney, 1982; Brown 1973; Dąbrowska, 2000; Pine & Lieven, 1993), with Tomasello's (2003) approach being particularly influential in recent years.

2.2 Comparing constructivist and generativist accounts

In terms of the adult endpoint, the approaches may at first appear to be similar, as both often refer to grammatical categories and phrases such as NOUN, VERB and VERB PHRASE. However, the explanations of how these categories are formed and interact with each other are very different, with the main areas of disagreement relating to the degree of abstraction used by adults and children, and the amount of innate knowledge required for successful grammar learning.

First, early levels of abstraction are lower according to constructivist than generativist accounts. While proficient speakers may be able to construct a sentence using formal rules such as SUBJECT VERB OBJECT, usage-based accounts also allow for early sentences to be created based on more concrete semantically-based schemas (e.g., *the cat is chasing CHASEE* → *the cat is chasing the mouse/fly/laser*). Unlike generativist accounts, constructivist accounts suggest that more abstract rules develop later, while children still learning the language rely on the exemplar-based templates (although very high frequency schemas can also be used by adults, e.g., *D'you wanna ACTION*). The incremental increase of abstract knowledge throughout a child's development means that constructivist accounts treat children's early grammar as different from adult grammar. In contrast, generativist accounts assume that both use the same basic categories and rules (e.g., Pinker's *continuity hypothesis* [1984]).

Second, constructivist accounts eschew functional categories such as INFL(ECTION). Instead, constructions and forms which would require the use of functional categories (e.g., for verb inflection) are abstracted from previously learned phrases (e.g., *the cat/the dog walked/chased/played* → the THING VERBed). Furthermore, unlike under generativist accounts, different sentence constructions are assumed to be learned independently and are not based on movement rules. For

example, the *yes/no* question schema, *Did [AGENT] [ACTION] [PATIENT]* is abstracted from previously encountered *yes/no* questions such as *did the bird/dog/girl chase/find/grab/ the worm/bone/toy*, rather than reflecting the use of abstract movement rules (e.g., Ambridge & Rowland, 2009; Ambridge, Rowland, Theakston & Tomasello, 2006; Pine & Rowland, 2000).

Third, the approaches disagree on the origin of grammatical categories, such as NOUN or VERB. Generativist, or nativist, accounts argue that the categories are innate and that every child is born with all of the categories he or she may need to use with their native language. As the native grammar is only identified through the parameter-setting process, the child therefore is presumed to possess grammatical categories for any possible natural language. Constructivist accounts argue that these categories are learned from the input via functional distributional learning (e.g., Redington, Chater & Finch, 1998; Tomasello, 2003). Constructivist accounts agree that a small number of categories, such as NOUN and possibly VERB may be universal (e.g., Evans & Levinson, 2009), but that they are likely to arise through pragmatic need to identify object and actions. Indeed, the search for further possible universal categories has proved to be relatively fruitless (Dąbrowska, 2015).

2.3 Adult knowledge of syntax under the constructivist account

Constructivist accounts disagree with the generativist view on how adults produce syntax, as well as the process children use to become competent speakers. The following section of this chapter outlines how syntax is formed in adults, and how it differs from rule-based accounts, before focusing on acquisition.

Constructivist approaches accounts argue that, despite each person's unique linguistic input experience, all speakers of the same language develop the same abstract constructions required for communication, such as the SUBJECT VERB OBJECT construction in English. However, unlike the generativist theories, the explanation of how the constructions are created relies on exemplars and frequency, rather than formal rules. Furthermore, sentences may be produced using different types of constructions, for example:

- Abstract construction*: SUBJECT VERB OBJECT*

- Lexically specific construction: *the cat + X/ X + chasing the mouse/ CHASER chasing CHASEE /etc*.

- Frozen phrase: *the cat is chasing the mouse*

The level of abstraction will vary across different items and individuals, with the relative frequency of individual strings likely playing a part (e.g., Ambridge, Kidd, Rowland & Theakston, 2015); certain frequent phrases (e.g., *Idunno*) may be stored as readily-accessible frozen phrases (Bybee & Schiebman, 1999), while less frequent words and utterances may require more abstract processing. The different levels of abstraction (*the cat is chasing the mouse* → *the cat X* → SUBJECT – VERB – OBJECT) are not stored as separate clusters but instead are mapped in a taxonomic hierarchy of constructions.

2.4 Syntax development according to constructivist approach

Different constructivist accounts explain how children learn grammar in slightly different ways, but one of the most popular accounts was proposed by Tomasello (2003). Once the child knows how to separate continuous speech into different words and phrases and develops sufficient social understanding to detect what object and action the speaker is talking about, they are then ready to start understanding and producing syntax themselves.

The child begins by rote learning frozen phrases which they often hear spoken around them. The phrases tend to be linked to activities occurring regularly in a child's life, such as meal or bedtime. Emerging socio-cognitive skills allow the child to assume that adult speech is likely to be linked to events and objects in their immediate surroundings, for example if a parent says *Get your pyjamas on* while holding pyjamas, the utterance and the action/object are likely to be linked. Repetition of these routines and utterances, even with slight variations on different occurrences, help the child to solidify the link between the sound and the action.

After a number of frozen phrases are learned, the child begins to develop lexically specific schemas built on similarly constructed phrases they often hear around them. For example, when a child hears *I'm drinking it, I'm putting it, I'm cutting it, etc.*, they are likely to form an *I'm ACTIONing it* schema, in which the *ACTIONing* part is a frame, into which can be slotted a particular action. They can

then use the schema (or *slot-and-frame* pattern) to produce utterances, by inserting other action words they have learned previously into the construction, especially if they appear to describe a semantically similar action. Although the process is assumed to be similar for all constructions, the transitive verb schema based on an AGENT-ACTION-PATIENT scenario seems to emerge particularly early in English speaking children (e.g., Gertner, et al., 2006; Noble, Rowland & Pine, 2011).

The notion of lexically-specific items aiding construction formation is supported by studies showing children's better performance with pronouns compared to nouns. Childers and Tomasello (2001) found that two-and-a-half-year-olds were significantly better at producing transitive sentences using both real and novel verbs when the experimenter described puppet actions using pronouns instead of nouns in the training phase (e.g., *she* vs *dog*). Additionally, they found that children were significantly better at demonstrating comprehension by enacting a scenario if it was presented by the experimenter using pronouns compared to nouns. However, a significant difference was found only when the subject was animate (e.g., *he/horse*) and the object was inanimate (e.g., *it/bus*), with animate-animate and inanimate-inanimate combinations not showing any significant differences. Childers and Tomasello (2001) suggested that children were better with the *he-it* pairing due to it being more frequent in the input compared to the other combinations. The pronoun benefit in constructing transitive sentences was also found by Abbot-Smith, Lieven and Tomasello (2004), who repeated the study using a wider range of noun types.

The next step to fully productive syntax is to move from lexically-specific schemas to abstract constructions. The abstraction can be done in a number of ways. Utterances such as *I'm washing it* and *He's washing it* could lead to the *slot-and-frame* patterns *I'm ACTIONing it, He's ACTIONing it* and *WASHER wash WASHEE*, which could then themselves be analogised across to yield more abstract AGENT-ACTION-PATIENT construction schema via structure mapping (e.g., Gentner & Medina, 1998).

According to Tomasello (2003), children also use functionally-based distributional analysis to create different syntactic categories, such as NOUN and VERB. The categories are created by children noticing patterns that particular words appear in the same position in similar sentences, and they seem to perform a similar

function. For example, *I'm eating the apple* and *She's cutting the apple* while observing the actions can lead to the assumption that *apple* refers to the item that is acted upon in the different scenarios. *I'm cleaning the table* and *The cat's scratching the toy* can lead to the assumption that *apple, table* and *toy* all belong to the same syntactic category because of their position in the sentence and relationship to the action.

The speed and rate with which children learn different constructions depend on many factors, including, but not limited to, complexity, phonological similarity, object and action salience and social factors. However, the frequency of individual lexical items and constructions is one of the most important predictors according to the constructivist approach (Ambridge et al., 2015). All else being equal, the higher the frequency of a word or construction, the quicker the child learns and/or abstracts it. Therefore, children may incorrectly use a more frequent form or construction when a less common one is required. For example, Matthews and Theakston (2006) found that children sometimes produced utterances such as **two mouse*, likely because *mouse* is a lot more frequent than *mice*.

2.4.1 Evidence for the constructivist account of syntax acquisition

Naturalistic language studies which show support for constructivist accounts of syntactic development have mostly focused on the rates at which children produce utterances, which are, at least in part, a repetition of a previously uttered sentence. For example, Tomasello (1992) noted in a case study of an English-speaking child that certain verbs were only used with certain types of (pro)nouns (e.g., *draw* only appeared in a *PERSON draw* construction, while *cut* was only used in a *cut THING* construction). Although the study has been criticized for not conducting any statistical analyses (Yang, 2002), the tendency to use different verbs with only certain types of (pro)nouns agrees more with constructivist slot-and-frame proposals than the generativist approaches, under which semantically- or lexically-specific differences are not expected.

More controlled naturalistic child speech studies found that the tendency to rely on a small number of slot-and-frame constructions, such as *The+X* or *Daddy+X*, extended beyond verbs, and in some cases accounted for the majority of a child's language (e.g., 77% in Pine & Lieven, 1993; 60% in Lieven, Pine & Baldwin, 1997).

Dąbrowska and Lieven (2005) found that such slot-and-frame constructions also play an important part in children's question construction. After analysing the speech of two English-speaking children between two and three years, they found that around 90% of their questions could be traced back to previously used constructions (e.g., *Shall we X?*).

However, as is often the case with naturalistic research, data in these studies often lacked variability of contexts, and it can be difficult to distinguish between utterances which are based on (a) fully-abstract constructions, (b) lexically-specific constructions and (c) rote-learned phrases. Frozen phrases seem to appear often in adult speech (e.g., *I+dunno*; Bybee & Scheibman, 1999), so it can be difficult to distinguish between rote-learned and constructed utterances.

Evidence for early schemas comes from Pine, Freudenthal, Krajewski and Gobet (2013), who found that the overlap between the same nouns used in the *a/an+X* construction and the *+X* construction (e.g., a *cat*, *the cat*) was significantly lower in child language compared to adult speech. As the results show that two- to three-year-old children have already learned both determiners and a range of nouns, but are less likely to use them interchangeably, the study supports the gradual abstraction view. If the formal determiner phrase rules were being employed, children would be expected to use different nouns in the *a/an+X* and *the+X* constructions at a similar level to adults.

Further evidence that children employ lexically specific schemas during their language development comes from Lieven, Salomo and Tomasello (2009). Recordings of densely sampled naturalistic speech of four two-year-olds were divided into the main part and the test corpus, with the latter spanning the last two days of recordings. Potential schemas were then identified by looking for construction/lexical items with a single change between them which could be assigned to the same semantic category. For example, *More choc choc* ***on there*** and *Bow's food* ***on there*** are both examples of the *REFERENT* ***on there*** schema; ***going*** *under bridge* and ***going*** *down* are both examples of the ***going*** *DIRECTION* schema. The analysis of the target corpus revealed that a third of multi-word utterances could be linked to previously produced phrases in the main corpus. Despite the high rate of single-change trace-back utterances, this study could not, of course, rule out the

possibility that both main corpus and target corpus utterances followed the same construction based on adult-like abstract knowledge, or - alternatively - rote-learned.

Another complication with naturalistic language studies is that even densely sampled corpora can miss previous instances of a particular utterance or construction, or the influence of parental speech, when the children's aural experiences are not recorded (Rowland, Pine, Lieven & Theakston, 2005; Tomasello & Stahl, 2004). A way to address this problem is to ask children to judge or produce utterances which are not likely to occur naturally – either by introducing novel words or using unusual word orders.

Ambridge and Lieven (2011) summarised the results of 14 elicitation studies in which children were presented with a novel verb in either a no argument construction (e.g., *Oh look! Gaffing!* [Olguin & Tomasello, 1993]), or a non-SVO transitive construction, such as passive construction (e.g., *The elephant is being pelled by the dog* [Pinker, Lebeaux & Frost, 1987]) or agent-only construction (e.g., *Barney's chamming!* [Akhtar & Tomasello, 1997]). The children were then asked to describe a scene in which two characters were involved in performing the novel action. The percentage of children able to use the novel verb in an SVO order ranged from 100% of seven- to eight-year-olds in Pinker et al. (1987), down to 10% of 2;9-3;8 year-olds in Akhtar and Tomasello (1997). At first glance, the results may appear to support the generativist prediction of early productivity, as even some one- and two-year-olds were able to produce a novel utterance with the SVO transitive construction. However, on closer inspection, over 90% of the productive SVO constructions included at least one pronoun (Tomasello & Brooks, 1998), suggesting that lexically-specific schemas based on pronouns (e.g., *He's ACTIONing it*) were largely responsible for SVO production. Childers and Tomasello (2001) further supported this claim by showing that two-and-a-half-year-old children were more likely to produce an SVO transitive construction when they were exposed to a verb + pronoun construction (e.g., *Look! The Bear's striking the three. See? He's striking it*; around 85% of the children were classed as productive), compared to a verb + noun construction (e.g., *Look! The dog's hurling the chair. See? The dog's hurling the chair*; approximately 45% of children were classed as productive), suggesting that children were using a *He's ACTIONing it* schema, instead of mapping the lexical items to an SVO word order paradigm.

However, Fisher (2002) argued that such findings can be unreliable, as the stimuli sometimes included verbs which were not grammatical in all tested constructions (e.g., *Ernie fell/jumped/went/disappeared vs *Bert fell/jumped/went/ disappeared Ernie*), and that children may have misinterpreted some of the novel actions and mistakenly classed them as a transitive/non-transitive action. Tomasello and Abbot-Smith (2002) refuted the criticism by noting that children did not show any evidence of misinterpretation in control conditions with the same verbs and constructions.

Weird-word-order studies have also provided support for lexical schemas. When children were presented with novel verb scenarios with an unusual non-SVO word order (e.g., SOV *Elmo the car gopping;* Akhtar, 1999), the likelihood of them using a typical SVO/SV word order when later asked to describe an event in which novel characters performs the action increased with age from approximately 50% at the age of two to approximately 90% at the age of four, supporting gradual-construction development accounts (Akhtar, 1999). Similar results were found by Abbot-Smith, Lieven and Tomasello (2001), who found that weird to typical word order corrections increased from 21% of productions at 2;4 to 66% at 3;9. Patterns in line with constructivist predictions were also observed in a study by Matthews, Lieven, Theakston and Tomasello (2005), who found that children were most likely to switch to a familiar SVO word order when the weird word order set up used a high frequency verb (e.g., *Look! XY pushing/pulling;* 100% at 2;9), as opposed to a lower frequency one (e.g., *Look! XY ramming/tugging*; 53% at 2;9).

The findings showing children's ability to switch from weird word order to canonical word order even at the earliest stages of testing may present as a challenge to the constructivist accounts. However, the significant age and word frequency effects also suggest that some frequent schemas, such as *I'm ACTIONing it* may appear early and account for the canonical word order structures at an early age in certain conditions.

Furthermore, Fisher (2002) criticised elicitation studies for using production evidence to support claims about children's grammatical comprehension, as production and comprehension might require somewhat different cognitive skills. Experiments which tried to circumvent this problem also provided support for

constructivist accounts but did not completely rule out generativist accounts. For example, Noble et al. (2011) presented two- to four-year-old children with pairs of videos differing in transitivity using novel verbs (e.g., *The duck and the bunny are blicking* vs *The duck is daxing the bunny*) and asked them to point to the picture matching the audio description of the video. The results showed that while transitive structures were correctly identified even by the youngest children, intransitive structures were correctly identified from 3;4 years, suggesting the independent development of the syntax structures. However, a preferential looking task with 21- and 25-month-old children found that even the younger group looked longer at the matching video (e.g., *X is gorping Y* vs *Y is gorping X*) when presented with an audio description of a transitive action. As the tested verbs were novel, the authors concluded that the results demonstrated children's early ability to abstract sentence structures (Gertner, et al., 2006).

Nonetheless, Ambridge and Rowland (2013) reviewed the most frequent types of methodologies used in child language research and concluded that elicited production tasks can be useful, as long as care is taken when designing them. The main points of considerations for such studies were a) whether the study makes sense to children (i.e. they are less likely to cooperate if they think the task is nonsensical); b) the age is appropriate (the authors suggested that simple elicited production methods could be used for children over two years of age); c) if children are motivated (e.g., stickers could be used as a motivational tool); d) whether fillers are necessary (i.e. is it detrimental to the study if the child can guess what they are expected to produce); e) whether to use familiar or novel words. The authors also suggested that it is important to look beyond overall correct response rates and that analysing the types of responses children produced could be insightful (e.g., whether they tended to use one type of production when they responded incorrectly), which is difficult to measure using comprehension methods. Additionally, elicited production responses are less ambiguous than data from many popular comprehension methodologies such as head-turn preference or EEG.

Another important area of research into grammatical comprehension has stemmed from Bates and MacWhinney's Competition Model (1987, 1989). According to the model, syntax comprehension was strongly influenced by cue

validity and the competition between them, with the strongest cues with the least competition leading to easier comprehension. Cue validity is based on availability and reliability. Availability refers to how often a cue occurs compared to its competitors; reliability refers to how often the cue leads to the expected outcome. The values assigned to each item vary depending on language. For example, word order in fixed-word-order languages, such as English, has a higher reliability rating than in free word-order-languages, such as Korean. Furthermore, availability and reliability may have different values. For example, in German, case marking is not always present (low availability) but certain case markers have high subject-object prediction values (high reliability). Animacy, agreement and stress cues have all been shown to play a part in sentence comprehension, but word order and case are often the most important (Tomasello, 2003).

Additionally, the level of their influence can change over time. For example, Ibbotson, Theakston, Lieven and Tomasello (2010) found that in a pointing comprehension task, three-year-olds relied on case-marked pronouns when interpreting ungrammatical sentences more than the two-year olds. Dittmar, Abbot-Smith, Lieven and Tomasello (2008) used an act-out task to investigate two- to seven-year-old German children's syntax comprehension. The youngest children required both word order and case cues to interpret the stimulus sentences, such as *the cat is weefing the goat* correctly. The five-year-olds still relied on word order and only the seven-year-olds showed adult-like performance and could use case cues alone to interpret the findings. Interestingly, Krajewski, Lieven and Tomasello (2010) found a similar pattern with two- to eight-year-old Polish speakers, despite Polish having a more overt case marking system than German. In Italian, animacy appears to be a stronger cue than word order for both adults and children when interpreting sentences such as *the pencil kicked the cow* but children rely more on word order and less on animacy than adults (Bates, MacWhinney, Caselli, Devescovi, Natale & Venza, 1984). The general findings that the effects of different types of cues change across languages and that their effect can change throughout childhood support the constructivist idea of a gradual grammatical development and complement the findings of production studies well.

Moving beyond the specific example of the SVO transitive construction, support for the constructivist approach comes from the fact that frequency effects are "ubiquitous" in child language acquisition (Ambridge et al., 2015). In this paper, studies investigating single word, inflectional morphology and syntax acquisition were reviewed with a focus on the role of frequency in grammar development. The paper pointed out that children make fewer errors with frequent multi-word utterances (for example, they cited Bannard and Matthews' 2008 study, in which children made fewer errors repeating frequent multiword strings, such as *a cup of tea* compared to lower frequency ones, such as *a cup of milk*). However, when children encounter more unusual contexts, high frequency strings may, in fact, interfere with correct production and lead the children to incorrectly apply the high frequency construction onto the target context. For example, Cameron-Faulkner, Lieven and Theakston (2007) concluded that children's early erroneous negation structures (e.g., *no move, no drop it*) were produced as a result of children applying the most frequent and salient negation marker *no* to an otherwise correct structure (e.g., *drop it*).

Evidence that high frequency strings prevent children from making errors comes from studies that show that children may form word chunks from frequent word strings. For example, Bannard and Matthews (2008) identified word strings that occur frequently in child-directed speech, such as *Back in the box* and non-frequent phrases, with only the last word in the utterance being different (e.g., *Back in the car*) and asked two- and three-year-old children to repeat the sentences. Children were significantly more likely to correctly repeat the high frequency string than the low frequency string. In the second experiment, they found that three-year-olds were significantly quicker at repeating the higher frequency utterances than the low frequency ones, suggesting that the whole phrase forms a single, lexically-specific chunk. A follow-up study by Matthews and Bannard (2010) using similar stimuli also showed that two- and three-year-olds were quicker at repeating higher frequency strings, even if the final word on its own had similar frequency in the input (e.g., *What a funny noise* vs *What a funny cup*).

Further evidence of string frequency effect was presented by Arnon and Snider (2010), who showed 4;6-year-old children various pictures and either asked them a lexically non-constricted question (*What are these called?*) or a lexically-

specific sentence completion prompt (e.g., *Brush your [teeth]; On your [feet]*). The target nouns were all irregular plural forms. The children were significantly more likely to produce a correct answer in the lexically specific condition, especially if the construction was highly predictive of the target noun (e.g., *Three blind [mice]*) than not (e.g., *Lots of [fish]*) and if the frequency of the noun was higher (e.g., *teeth* compared to *geese*).

Evidence of high frequency constructions leading to errors in lower frequency targets was shown in a naturalistic speech study by Cameron-Faulkner et al. (2007). Speech of a boy aged 2;3-3;4 and his mother was analysed with a focus on negation phrases. Findings suggested that the boy constructed a *no+VERB* frame at the early stages of the recordings (e.g., *no work*; *no move*), which did not reflect adult input. Towards the end of the recording period, *no* was replaced by *not*, which was possibly due to the high frequency use of *not* as the initial word in multiple-word utterances in the mother's speech. Full and correct uses of negation (e.g., *I can't see anymore; I don't like it*) tended to be linked to particular negation forms (e.g., prohibition and not non-existence) and particular negation lexical form (e.g., *don't* and not *won't*).

While not all generativist accounts reject the role of frequency in grammar acquisition (e.g., Legate & Yang, 2007), all nativist theories are based on the assumption that language production is primarily governed by abstract lexical categories and rules. However, studies showing that more frequent lexical items or strings are easier to comprehend and produce than lower-frequency ones, despite the utterances appearing to be the same on the abstract level (e.g., Arnon & Snider, 2010; Bannard & Matthews, 2008; Matthews & Bannard, 2010), suggest that frequency-based accounts might be more accurate when explaining grammatical knowledge development.

2.4.2 Challenges for the constructivist account of syntax acquisition

Despite numerous studies supporting the input-based accounts of syntax acquisition, a number of challenges remain for the constructivist approach. The studies outlined above mostly focus on early-stage development of lexically-specific schemas, with a

particular attention on the development of the verb slot in the SUBJECT VERB OBJECT (or, indeed, AGENT-ACTION-PATIENT) construction. Research investigating how the semi-abstract schemas are converted to adult-like, abstract schemas has been limited, and the findings have not always supported constructivist predictions. Abbot-Smith et al. (2004) attempted to address this question by testing two-and–a-half–year–olds' ability to use a novel-verb witnessed in a non-SVO construction in a transitive construction. The findings showed that semantic similarity between stimulus and target verbs (e.g., light emitting actions vs noise emitting actions) did not affect performance, suggesting that, at least at this stage, children had not yet developed abstract schemas based on different semantic verb classes.

Another study, attempting to investigate the maturation of schemas, taught 24 4;9 – 6;1 year-old children novel OSV and VOS *enabling* and *preventing* constructions (e.g., *tiger fox fall* or *fall tiger fox* accompanied a *preventing* video where a fox stops a tiger from falling off a cliff). In the test stage, children heard a new sentence and were shown two similar videos with reversed actions. For example, *climb king queen* was accompanied by a video of the king throwing down the ladder to the queen, which she then climbs up, or a video of the queen throwing down a ladder to the king, which he then climbs up. The children were asked to point to the matching video. The characters and actions were different across the training and trial stages and the word orders used were not typical for English, in order to prevent the children from forming abstractions based on surface forms. Unlike adult controls, children did not show a significant preference for the correct video. Although the results did not support Tomasello's (2003) claim that older children can extract underlying sentence structures without relying on surface forms, such as *I'm X-ing it*, the authors highlighted the lack of research in this area and could not rule out methodological flaws leading to the null result (Ambridge, Goldwater & Lieven, 2018).

Recently, Ambridge (2019) drew attention to another concern affecting constructivist accounts – the lack of concreteness and detail in defining the contents of an abstraction. While more open and flexible than generativistic categories, abstractions, such as [AGENT] or [SUBJECT] are central to the constructivist

approach, as it is assumed that children eventually develop such categories based on the input they receive. However, it was highlighted that the accounts struggle to explain how sentences such as *John feared Bill* vs *John frightened Bill* can be interpreted correctly relying only on abstractions, without referring to verb-specific semantic information. Similar problems can be identified in other areas of grammatical development, including morphology, phonetics and word meanings. For example, it is difficult to explain why one would produce the past tense of *fleep* as *flept* and not *fleeped*, or define a category or a prototype that would include a *(river) bank* and a *(financial) bank* without including a large variety of other irrelevant concepts and without heavily relying on previously stored exemplars. Instead, it was proposed that analogies are not based on stored abstractions but are formed 'on the fly' based on previously stored exemplars linked to the target utterance at hand. However, as with its predecessors, the account needs to provide more details on a number of factors, including the processes involved in analogy forming (Lieven, Ferry, Theakston & Twomey, 2020), how different types of memory and perception known to influence language are incorporated (Brooks & Kempe, 2020), and the competition between different kinds of frequencies (MacWhinney, 2020).

2.5 Summary

Despite some results not directly supporting constructivist accounts, such as finding evidence that children display some syntactic productivity at an earlier-than-expected age (e.g., Gertner et al., 2006), the pervasive frequency and lexical effects summarised so far in this chapter would appear to be more consistent with a constructivist than a generativist account of syntactic development. According to the constructivist approach, children gradually build up their syntactic knowledge on the basis of previously-acquired phonetically and semantically similar constructions. The process is gradual, and the rate of acquisition is in part dependent on the input frequency of the particular item or construction.

Having summarised the general principles of, and evidence for, constructivist accounts, the second half of this chapter focusses on constructivist accounts of the phenomenon investigated in this thesis: children's acquisition of systems of inflectional morphology.

2.6 Morphology development under the constructivist approach

The constructivist principle of learning from the input applies to morphology, as well as syntax. The child begins by rote-learning whole items (e.g., *toys, dolls, balls*), along with their contextual information (e.g., the caregiver is pointing at a number of similar objects when saying those words). Over time, the regularities between the words and the contextual information begin to link up and the abstraction process begins with partially productive constructions linked to similar items (e.g., multiple items = [ITEMS]s). Following this, the constructions become more abstract until they reach a fully abstract [NOUN]s construction, which can be applied to new nouns. The more often a particular word is encountered the quicker the child is likely to learn it.

Frequency therefore plays a significant part in the account. Studies measuring the effect of frequency in morphological development usually distinguish between two major kinds of frequency: phonological neighbourhood density and token frequency. In the domain of inflectional morphology, phonological neighbourhood density (PND; or *type frequency*, or *family size*) often refers simply to the number of different items that take a particular inflection, for example, past tense *–ed* in English or Italian verbs ending in *-ire* in their infinitive form, as opposed to those ending in *-are*. In other studies, however, these terms are used to refer to smaller clusters of similar-sounding items (or "islands of reliability"; Albright & Hayes, 2003, p. 11) which pattern similarly with regard to inflection (e.g., the English past-tense forms *hissed, missed* and *wished*). Studies investigating highly inflected languages often use conjugation or declension classes as a proxy for PND (e.g., Dąbrowska, 2008; Amore, 2012; Räsänen, Ambridge & Pine, 2016), although more flexible PND measurements have also been proposed more recently (Engelmann, et al., 2019; Granlund et al., 2019).

Token (or *word-form*) frequency refers to how often a particular word form is used in a language. The PND and token frequency are independent of each other. For example, some words, such as *gave*, do not use the frequent past tense inflection *-ed* and therefore have a low phonological neighbourhood density, but because they occur frequently, have high token frequency. Furthermore, frequency can often be used to predict the kinds of *errors* speakers are likely to make when they cannot

produce a correct form - input-based accounts often predict that children default to a more frequent surface form (e.g., Aguado-Orea and Pine, 2015; Räsänen, Ambridge & Pine, 2014).

It has been suggested that token frequency and phonological neighbourhood density can help inflectional morphological development in different ways. Bybee (1995, 2001) argues that phonological neighbourhood density, rather than token frequency, is more important in schema development. High token frequency, on the other hand, helps to ensure storage of individual forms, which is especially beneficial for learning irregular forms. Below, studies that have investigated the effects of token frequency and phonological neighbourhood density on children's acquisition of morphology are reviewed.

2.6.1 Token (word-form) frequency

A number of studies have observed that children are more productive with word forms they encountered more frequently in the input. For example, Kuczaj (1977) interpreted findings from spontaneous speech samples that children appear to learn high frequency irregular past tense forms in English early and around the same time as the unmarked forms as evidence for chunk or rote-learning based on token frequency. A longitudinal study of 2-3-year olds (Theakston, Lieven, Pine & Rowland, 2004) found that input frequency was more important in predicting early verb use than semantic generality in English. Similarly, Naigles and Hoff-Ginsberg (1998) videotaped 57 mother-child interactions at home at the stage when children were starting to combine words, and compared mothers' and children's speech at another, naturalistic, home setting session 10 weeks later. They found that the input frequency from the mother successfully predicted the frequency and flexibility with which the verb would be used by the child. Maslen, Theakston, Lieven and Tomasello (2004) conducted a dense sampling spontaneous speech study of a 2-3-year-old, which captured up to 10% of the child's speech input and output. The overregularisation rates for both irregular verbs (in past-tense form) and nouns (in plural form) decreased with increasing token frequency. For example, *went* (high token frequency) was produced as **goed* only 5% of the time, while *ran* (low token frequency) was produced as **runed* 71% of the time. Similarly, *feet* (high token

frequency) were produced as either **feets* or *foots* 2% of the time, while *postmen* (low token frequency) were produced **postmans* 40% of the time.

Elicited production studies conducted in English also saw similar results. Marchman (1997) tested 74 children between 3;8 and 15;5 years old in a picture-book past-tense elicited production task. As expected, the error rate reduced with age, but the overall rate was 20%. Most errors were erroneous choice of a suffix (e.g., **catched*) and zero-marking (e.g., **eat* in a past tense context). Vowel changes and blends were also observed (e.g., *flow* → **flew*). In line with token frequency and phonological neighbourhood density data, most suffixation errors were produced with low frequency, irregular verbs, while phonological features of the stem appeared to be the main influence in incorrect use of bare stems. Both regularisation and irregularisation errors were observed, suggesting incorrect responses were constructed based on phonological neighbourhood contents.

A similar study was conducted by Matthews and Theakston (2006). In addition to regular/irregular noun and verb conditions, they also tested sibilant nouns (which resemble plurals in their singular form, e.g., *horse¸ cross*) and verbs that end in *–t/d* in their present form (e.g., *want, spit*) and found that surface form frequency predicted inflection rates in in children aged 3;11 – 9;9.

Surface form frequency effects have been observed in other languages too. Orsolini, Fanari and Bowles (1998) tested several groups of Italian- speaking children between the ages of four and ten. The children were asked to produce a story based on a picture book and to participate in a sentence completion task, which required them to produce either a past participle or past definitive form. In both experiments, children performed better with high surface form frequency verbs, as well as verbs which did not require stem changes. Moreover, Pizzuto and Caselli (1992) found that high frequency forms emerged early in Italian spontaneous speech.

Research into the Icelandic and Norwegian past tense has provided similar results. Four- to eight-year olds were tested using an elicitation task with 60 different verbs varying in token frequency and phonological neighbourhood density, both of which turned out to be significant factors in children's production. Furthermore, when children were productive, they tended to use an ending belonging to a more frequent class incorrectly (Ragnarsdóttir, Simonsen & Plunkett, 1999).

Similarly, when 82 two- to four-year-old Finnish children were asked to produce different person+number present tense forms to describe presented actions, it was found that both token frequency and phonological neighbourhood density were good predictors of error rates, with the low frequency contexts producing most errors. In line with input-based accounts, children tended to use a higher frequency number + person inflection when they made an erroneous response (Räsänen et al., 2016).

Form frequency was also found to be significant in Japanese verb production (Tatsumi, Ambridge & Pine, 2018) and noun case marking in Polish (Dąbrowska, 2008; Dąbrowska & Szczerbinski, 2006) and Serbian (Mirković, Seidenberg & Joanisse, 2011). A recent study by Granlund et al. (2019) used elicited production methods to test three- to five-year-old children's noun morphology knowledge in three highly inflected languages: Finnish, Polish and Estonian. Pooled data across the three languages showed that age, token frequency and phonological neighbourhood density were all significant predictors for correct inflection production.

2.6.2 Phonological neighbourhood density:

Another form of frequency playing an important role in the constructivist explanation of child morphological development is the phonological neighbourhood density. The PND refers to a group of words that share certain phonological similarities in the lexicon. According to the input-based accounts, the previously learned forms may be used to form an analogy when encountering a new item (e.g., *blow/blew, know/knew, throw/threw*, so *smow* → *smew*). The larger the PND, the greater effect it is expected to have on new form production. As generativist accounts operate on category, rather than lexical item level, phonological similarities between words should not be important in word formation. Therefore, findings of PND effects are interpreted as evidence for the constructivist approach and against the generativist approach.

One of the most wide-spread methods of investigating PND effects has been studying what types of forms children produce, or "default" to when faced with unfamiliar lexical items. For example, Marchman (1997) tested 74 children between the ages of three and thirteen on their ability to produce past tense regular and

irregular verb forms when presented with their present form. In addition to age and form frequency, phonologically-sensitive verb type frequency was found to be a significant predictor of error types.

In a follow-up study, Marchman, Wulfeck and Weismer (1999) found a similar pattern of results. They found that 31 6;3 – 12;2-year-old typically developing children were most likely to produce suffixation errors (e.g., **falled*, **felled*), followed by zero-marking errors (e.g., **bring* instead of *brought*). Some vowel change (e.g., *flow* → **flew*) and miscellaneous (e.g., *spill* → **spilt*) responses were also recorded. Once again, phonological neighbourhood densities were deemed to be a significant predictor of the produced form. The influence of token frequency and phonological neighbourhood density on correct production of irregular verbs and nouns was also echoed in a dense sampling naturalistic English speech study by Maslen et al. (2004).

Ambridge (2010) tested the differences in proposed analogy creation processes by assessing children's (aged 6;4 -7;2 and 9;9 – 10;8) acceptability of various novel verbs carrying regular and irregular past tense suffixes. The novel words varied in their similarity to existing regular and irregular verbs and were classified as being similar to a) an existing class of regular and irregular verbs (e.g., *dize*), b) an existing class of regular verbs (e.g., *nace*), c) an existing class of irregular verbs (e.g., *fleep*), or d) neither an existing regular or irregular class (e.g., *nung*). The effect of similarity to regular existing forms in rating scores provided evidence for single route accounts and evidence against the dual route approach. The effect was found only in the older group, suggesting that irregular form analogies may precede regular forms. Similar results were also found by Blything, Ambridge and Lieven (2018) in an elicited-production task completed by three- to ten-year-olds.

In addition to the previously discussed Finnish present tense elicitation study by Räsänen et al. (2016), which found significant effects of both token frequency and phonological neighbourhood density, Finnish verbs were also investigated by Kirjavainen, et al. (2012), who conducted a sentence completion task with three- to six-year-old children to test their knowledge of parts of the Finnish past tense system. They found that both token frequency and phonological neighbourhood

density were significant factors with productive (i.e., highly regular) verbs. Interestingly, token frequency showed an inverse trend with (semi-)productive verbs, as children seemed to perform better with low frequency than high frequency verbs. The authors suggested that the inhibitory effect may be due to the competition between stored forms and the analogy-forming process. Similar findings have been used to support the dual-route model previously by suggesting that high frequency word forms activate both routes, therefore increasing the cognitive load (e.g., Clahsen, Hadler & Weyerts, 2004). However, the authors stated that negative token frequency effect could be similarly explained under constructivist accounts as an increased cognitive load due to the competition between rote-learned token storage and slot-and-frame exemplar storage.

Ševa et al. (2007) tested two- to four-year-old Serbian and Russian speaking children on their ability to produce adjectives with correct gender agreement with simplex and diminutive noun forms in Russian and Serbian. Despite Russian child-directed speech containing markedly more diminutive forms than Serbian (approximately 50% and 5% respectively), results showed that children found it easier to produce correctly matched diminutive forms compared to their simplex counterparts. Another elicited production study in Russian and Serbian asked children to inflect real and novel nouns, which were either in their simplex or diminutive form. More correct responses were seen with familiar nouns and diminutive forms (Kempe, Ševa, Brooks, Mironova, Pershukova & Fedorova, 2009). The diminutive advantage may occur due to diminutive suffixes usually belonging to more frequent declension groups/denser phonological neighbourhoods (even if the simplex form belongs to a lower frequency declension), and the tendency of diminutive forms to standardise stress patterns (Kempe et al., 2009; Savickienė, Kempe & Brooks, 2009).

Despite strong evidence of phonological neighbourhood density effects in morphological production in a number of languages, it can sometimes be difficult to definitively state if the results support a single or a dual route model, as some dual-route accounts allow analogy creation based on previously stored forms (e.g., Alegre & Gordon, 1999; Hartshorne and Ullman, 1999; Pinker & Ullman, 2002). However, it does present a challenge to more classical accounts, such as Prasada and Pinker (1993), which state that only irregular forms are stored as fully inflected forms.

Findings from a study testing Dutch children's productivity with the past tense provided further evidence that phonological neighbourhood density effects may depend on the speaker's age. Five-year-old (younger group) and seven- to eight-year-old (older group) children were asked to complete a story about a familiar object using an existing verb or a novel creature using a novel verb. Despite the prediction that children would perform better with verbs requiring the more frequent *-de* suffix, only older children in the familiar verb group followed this pattern. Younger children produced more correct responses with the less frequent *-te* suffix in the familiar verb condition, and both age groups did better with *-te* verbs in the novel verb group. It was suggested that in addition to token and suffix frequency, a frequency metric based on both the stem frequency, as well as the frequency of a particular suffix, could be helpful in predicting children's production. Token frequency showed a more predictable results pattern: older children found it easier to produce the correct form of both regular and irregular verbs if they had a high token frequency; word form effect was also observed with irregular verbs in the younger group. The authors suggested that token frequency effects may be observed only once a sufficiently-sized vocabulary has been amassed (Rispens & de Bree, 2014). However, an opposite effect has been found by Dąbrowska and Szczerbinski (2006), who investigated Polish nouns.

Phonological neighbourhood density effects have also been found in Polish noun inflection productions. For example, Dąbrowska (2004) found that both adults' and children's performance was the best with irregular but phonologically dense genitive and dative forms, as opposed to regular contexts with few phonological neighbours, suggesting that the forms were based on phonological analogies rather than formal rule application. To further explore Polish-speaking children's productivity, Dąbrowska and Szczerbinski (2006) tested children's productivity with the genitive, dative and accusative cases. Fifty-seven two-to-four-year-old children were presented with a selection of toys, which the experimenter labelled with either a real or a novel noun in a variety of contexts. The children were then asked to describe an action involving the toy where a different noun case was required. The results showed a pattern of steadily increasing productivity: two-year-olds performed the worst, while four-year-olds' performance was comparable to adults. Analysis also showed that both token frequency and phonological neighbourhood density

were good performance predictors. However, token frequency was a better predictor for younger children, while phonological neighbourhood density appeared to be more important in older children's and adults' performances, which the authors interpreted as evidence for low-level schemas being surpassed by higher-level schemas as children get older, challenging the findings of Rispens and de Bree (2014). Finally, regularity was not a significant predictor, providing evidence against the dual-route model.

Krajewski, Theakston, Lieven and Tomasello (2011), however, found challenges to both single and dual route accounts when they conducted an elicited production task with two- to three-year-old Polish children. Unlike other elicited studies, they varied the starting point – the stimulus word forms were presented in different inflections, which appeared to have an effect on production. The effect provides evidence against generativist proposition that once the child has acquired a particular inflection, they should have no trouble applying it to new words. However, frequency of either the stimulus or the target nouns did not influence the correct response rates, which is not predicted under input-based accounts.

2.6.3 Phonological neighbourhood density x surface form frequency interaction

The relationship between frequency and regularity has been explored over the years in psycholinguistics, with the general finding that the processing of irregular items is more susceptible to frequency effects than that of regular items. The effect has been observed in both syntax (e.g., Hutton & Kidd, 2011), and morphology (e.g., Ellis & Schmidt, 1998; see Ellis, 2002 for review). However, once again, the studies have tended to focus on English and/or verbs.

More recently, research has turned to the investigation of phonological neighbourhood density and surface form frequency interaction in more inflectionally complex languages. For example, Räsänen et al. (2016) tested 93 Finnish children in an elicited inflected verb production task and found a negative phonological class size by surface form frequency interaction, suggesting that children relied on phonological neighbourhood density more with lower frequency surface forms.

Granlund et al. (2019) tested 120 Polish, Finnish and Estonian 3;0-5;0 year-old children (40 speakers of each language) in a sentence completion task testing their ability to produce different case forms. The pooled data analysis also revealed a negative phonological neighbourhood density and surface form frequency interaction. In a follow-up study, Engelmann et al. (2019) conducted a child speech elicitation and a computer modelling study using Polish and Finnish verb inflections. Although the elicited production study did not reveal a significant interaction, the model showed that the effects of phonological neighbourhood density decrease with increasing surface form frequency. The authors suggested that the inconsistency between the findings may have been due to different frequency/density measurements used and called for more detailed analyses in the future.

2.6.4 Error frequency and defaulting

Many studies investigating children's inflectional development have focused on children's ability to produce correct forms and the age they begin using them, while little attention has been paid to erroneous responses. However, when error data has been analysed, systematic patterns in error rates, as well as the types of inflections children default to when producing an incorrect utterance, have been identified. Studies investigating error data (discussed in more detail below) often find high error rates in low frequency contexts and vice versa, and children's tendency to use a high frequency surface form when they produce an unexpected utterance. Such findings support the constructivist account better compared to the generativist account, as frequency is integral to the approach. Conversely, as rule-based theories discount the influence of individual lexical item properties, varying error rates across inflectional systems are difficult to account for without invoking frequency. Furthermore, children's tendency to replace a less frequent form with a more frequent form when producing an error (without necessarily showing a preference for only one type of inflection) also provides support for input-based accounts over abstract rule models.

Rubino and Pine (1998) challenged the long-standing generativist claim that children make few errors in early speech development by analysing each subject-verb agreement context in Portuguese. They found that the error rate of subject-verb agreement in a Brazilian child's (3;02 - 3;04 years) speech ranged from 0% in high frequency 2sng contexts to 43.5% in low frequency 3plr contexts. The most frequent

context was 3sng, which was used 929 times out of the 1464 analysed utterances, with only 5 instances (0.5%) coded as incorrect. The authors concluded that input frequency appeared to have a significant role in correct utterance rates.

Aguado-Orea and Pine (2015) extended the findings of vast differences between error rates from Brazilian Portuguese to Spanish. Verb inflection use recorded in over 55 hours of naturalistic speech of two Spanish speaking children between the ages of 2;0 and 2;6 and their caregivers was analysed. The results showed that although there were large differences in the use of high and low frequency verb person + number contexts in adult speech, it was significantly more varied than children's use. The overall error rate of 3.9% was in line with previous studies looking at children's error rates (e.g., Hoekstra & Hyams, 1998). However, they also found 'pockets' of errors of up to 46% in low frequency contexts (e.g., 3plr), suggesting that children were not yet productive with some of the low frequency combinations. Furthermore, when children did produce an erroneous verb form, they tended to use a more frequent surface form (e.g., 3sng forms in 3plr contexts).

Data from elicited production studies have also contradicted the assumption that children show productivity from an early age. For example, Marchman (1997) found an overall error rate of 20% in a picture-book elicited production task. Another elicitation study investigating children's tendency to use bare stems in English 3sng contexts found that the likelihood of a child producing a zero-marked form increased with an increased bare-stem to 3sng form ratio, even though the bare forms of the verbs included were more common than the 3sng form in the input. The findings suggested that (apparent) OI errors, previously used as evidence for a developmental stage in a generativistic process, may be due to frequency effects instead (Räsänen et al., 2014). Räsänen et al. (2016) also found that Finnish-speaking children tended to use a higher frequency number + person inflection when they made an erroneous response.

Most of the research into frequency effects on inflectional morphology has been carried using Western European languages with limited morphological systems and/or focused on verbs. However, as both approaches aim to explain all languages, it is important to test their predictions in both non-Western and non-verb language

environments. Dąbrowska and colleagues have attempted to extend the body of evidence by researching the Polish noun system. The Polish language has a complex noun case system comprising of seven cases belonging to neither feminine, masculine or neuter genders.

Dąbrowska (2001) analysed spontaneous speech of three Polish-speaking children between the ages of 1;4 and 4;11 with a focus on their genitive use. While there were very few errors in singular genitive use, error analysis revealed that when children overgeneralised genitive plurals, they used a frequent surface form more often (*-a* 1.28% of tokens on average) than a less frequent one (*-u* 0.24% or *-y/i* 0.11% of tokens on average). An elicited production of novel genitive, dative and accusative Polish noun forms study by Dąbrowska and Szczerbinski (2006) found that while overgeneralisation errors (defined as using an ending belonging to a different grammatical gender/case context) were low across all age groups with real words, there was a slight increase in the novel word condition.

2.7 Summary and rationale

Recent years have seen an increase in studies of the development of inflectional morphology on languages other than English and have expanded the focus of the research beyond the past tense (e.g., Aguado-Orea & Pine, 2015; Dąbrowska, 2008; Dąbrowska & Szczerbiński, 2006; Engelmann et al., 2019; Granlund, et al., 2019; Kirjavainen et al., 2012; Räsänen et al., 2016; Stephany & Voeikova, 2009), with support generally shown for input-based language development accounts, in the form of effects of both token frequency and phonological neighbourhood density. However, very few studies to date have attempted to test an entire inflectional system in a morphologically complex language. The studies reported in this thesis attempt to address this gap in research by testing children's productivity with the full noun case system in Lithuanian, a morphologically complex language. They also include work with novel nouns, which is crucial for establishing productivity.

In addition to adding to the knowledge of morphological development of different parts of language, studying nouns has several benefits. First, nouns have been shown to emerge early in language development, often preceding verbs (e.g., Bird, Franklin & Howard, 2001). As some languages, such as Lithuanian, do not allow unmarked forms, nouns are often the first morphologically marked words used

by children. As the two grammatical development explanation approaches have very contrasting predictions of the rate of acquisition – early for generativist and gradual for constructivist – studying nouns can help to distinguish between them.

Also, unlike verbs, the range of produced noun forms should be less influenced by motivational factors. Verb usage in children is often dominated by first singular and second singular inflections, reflecting children's wishes for themselves or their caregivers (e.g., Aguado-Orea & Pine, 2015). Although usually there are notable differences in the use of different case+number combinations, the noun forms are not influenced by the speaker's position.

As discussed in the following chapter, both Lithuanian nouns and verbs are morphologically highly complex. However, unlike verbs, nouns are less susceptible to affixes which change the meaning of the word (e.g., *einu* = (I) go/walk; ***neper****einu* = (I) do no go/walk through). Furthermore, spoken Lithuanian often uses the imperative mood (e.g., *duok man* = (you) give (it) to me) in addition to indicative mood (e.g., *duodi man* = (you) give (it) to me), with both moods following different ending paradigms. These aspects of verb morphology would have to be carefully incorporated into the research of Lithuanian verb usage either in adults or children. However, data detailed or dense enough to allow the calculations of meaningful frequency counts was not available at the time. Furthermore, studies in other languages looking at whole verb inflection systems, such as Rubino and Pine (1998), Aguado-Orea and Pine (2015) and Räsänen et al. (2016) focused on indicative mood verbs only, making the comparative value of conducting a similar study in Lithuanian limited.

Finally, nouns can be easily depicted using two-dimensional pictures, unlike verbs, which often require more complex materials and/or equipment. Therefore, the study set-up can be more mobile and adaptable.

The second most notable part of the presented research is the use of Lithuanian. Aside from its remarkably high inflectional complexity, Lithuanian is a suitable language to use when testing various linguistic theories for several reasons, one of them being its similarity to a more widely studied language – Polish. Both languages share a number of important inflectional features, including the number and nature of noun cases and the use of declensions, which can be used to

corroborate or challenge the findings using Polish. However, differences also exist. For example, aside from biological gender, few links exist between grammatical endings and other properties of noun in Lithuanian, compared to Polish, as described in Dabrowska (2001). For example, borrowings, place names and abstract nouns do not show any regularity in their declension class in Lithuanian, whereas they do in Polish. This lack of connection between grammatical and non-grammatical properties of nouns in Lithuanian can help to reduce any non-grammatical noun property effects compared to Polish.

Furthermore, all Lithuanian nouns are inflected. Polish, on the other hand, allows null endings in some contexts, such as masculine singular forms. Therefore, studying Lithuanian can help to separate any potential conflation between omission and commission errors. Moreover, Lithuanian has a more complex inflectional system than Polish, with less syncretism. For example, in Polish, plural dative, locative and instrumental all have one ending each, irrespective of the noun's gender, whereas almost all declensions have unique plural dative, locative and instrumental endings in Lithuanian. Therefore, the production of these contexts is not influenced by the frequency or other linguistic aspects of the other contexts.

Before moving on to the empirical chapters, however, it is necessary to introduce some basic linguistic properties of Lithuanian, with a focus on inflectional morphology and – in particular – the noun system.

3. The Lithuanian language

3.1 The Lithuanian language introduction

The current chapter provides an overview of the Lithuanian language. The first part briefly summarises the basic properties of its phonology. Then, its morphology, with a focus on noun (and relatedly, adjective) case marking, is discussed. Finally, previous studies of Lithuanian morphology and acquisition are summarised.

Lithuanian, the closest living language to Proto-Indo-European (Ambrazas 1997; Mallory & Adams, 2006; Schmalstieg, 1982), is a highly morphologically complex language belonging to the Baltic language family. In the present day, several dialects can be found, broadly divided into two groups: Aukštaičių (Highland) and Žemaičių (Lowland). Differences can be found in phonology, morphology, syntax and the lexicon between the dialects, especially in rural areas. For example, speakers of Eastern Highland dialect soften substitute *am, an, em, en* with *um, un, im, in* (e.g., *ranka* → *runka* [= arm/hand]); Western Lowland speakers often use a single vowel instead of a diphthong and remove vowels from the endings (e.g., *puodas* → *pods* [= pot]; *kiemas* = *kems* [yard]). Consonant changes can be found in Southern Highland areas. For example, *dž* changes to *dz* (*džiaugsmas* → *dzaugsmas* [= happiness]) and t to c (*tiltas* → *ciltas* [= bridge]). There are also inflectional differences between the dialects. Table 1 is the comparison of *dantis* (= tooth) in standard and North Lowland dialects (Girdenis & Rosinas, 1977). The Western Highland dialect (spanning the central regions of Lithuania) is considered to be the standard form and is taught in all schools and used in public speaking (Hogan-Brun, Ramonienė & Grumadienė, 2005) and was used in the studies reported in this thesis.

3.2 Phonology overview

The following section provides a brief overview of Lithuanian phonology.

Although the consonants in Lithuanian are largely similar to English, there are numerous differences in vowels. Lithuanian has six long and four short vowels, with some of them forming merging or compound diphthongs (Table 2).

Table 1

Standard and North Lowland Lithuanian dialect inflection of dantis *(= tooth)*

Case	Standard	North Lowland
NOM	dant-is	dont-es
GEN	dant-ies	dont-eis
DAT	danč-iui	dont-ei
ACC	dant-į	dunt-i
INST	dant-imi	donč-io
LOC	dant-yje	dunt-ie

Despite the differences between some of the vowels being subtle, they can change the grammatical meaning of the word. For example:

*Kalb**a*** - [ˈkalba] = language SNG:NOM

*Kalb**ą*** - [ˈkalba:] = language SNG:ACC

3.2.1 Stress

Stress in Lithuanian has no fixed position (Ambrazas, 1997; Zukienė, 2012) and plays an important role in syntax and morphology. Stress can help to segment words or change meaning; it may also shift across different forms of the same word.

Similarly to other tonic, or pitch, accent languages, such as Swedish, stress may sometimes change the meaning of a word or a combination of words. For example: *le**n**kė* = to pass 3sng/ 3plr past tense; *l**e**nkė* = Polishwoman SNG:NOM; *v**a**, t**o**s* = there, those; *vat**o**s* = cotton wool SNG:GEN. Stress may also change the word form, e.g., *neš**i*** = to carry 2sng present tense; *n**e**ši* = to carry 2sng future tense. Stress can also shift with the addition of affixes, as diminutive suffixes, which tends to standardise the stress. For example:

Simplex		Diminutive
akmuo (= stone SNG:NOM)	→	*akmenukas* (= stone SNG:NOM:DIM)
katinas (= tomcat SNG:NOM)	→	*katinukas* (= tomcat SNG:NOM:DIM)

Table 2

Lithuanian vowels

Vowel type	IPA	Example	English approximation
Long	i:	šun**į,** r**y**tas	m**ee**t
	e:	g**ėlė**	st**are** (some dialects, e.g., Geordie)
	æ:	m**e**las, gėl**ę**	c**a**t
	a:	stal**ą,** r**a**tas	f**ar**
	o:	p**o**vas	y**aw**n (some dialects, e.g., Australian)
	u:	stal**ų,** b**ū**ti	b**oo**t
Short	ɪ	g**i**l**i**	b**i**t
	a	dien**a**	m**u**m
	ʊ	stal**u**	b**oo**k
	ɛ	gėl**e,** skryn**ia**	p**e**t
Merging diphthongs	iɛ	p**ie**nas	prem**ie**re
	uɔ	p**uo**das	N/A
Compound diphthongs	aɪ	**ai**das	w**i**ld
	aʊ	K**au**nas	t**ow**n
	ɛɪ	p**ei**lis	n**a**me
	ʊɪ	p**ui**ku	N/A
	ɛʊ	k**iau**lė	n**ow** (some dialects, e.g., Southern Irish)
	ɔɪ	k**oji**nė	c**oy**

3.3 Morphology overview

Lithuanian is a highly inflected language with a wide range of affixes. Suffixes often express several linguistic features at once. For example, number, gender, and declension can be inferred from a noun suffix; a verb suffix contains information about person, tense, conjugation, number and mood. Different morphological rules are applied to all parts of speech – verbs, adverbs[1], nouns, adjectives, numerals, pronouns, participles, prepositions, conjunctions, interjections, and onomatopoeic words. A brief overview of the most morphologically complex parts, focussing particularly on noun case-marking morphology – the topic of this thesis – is presented here.

[1] Adverbs in Lithuanian are rarely inflected and therefore are not discussed in this chapter.

3.3.1 Verbs

Non-finite forms in Lithuanian are morphologically rigid (and usually denoted by the ending *–ti*), while finite forms are morphologically complex. The latter can be categorised by:

- Person: 1st, 2nd and 3rd. 1st and 2nd person have different singular and plural endings; 3rd person uses the same ending for both;
- Number: singular and plural;
- Tense: present, past, past frequentative and future. Each can be used in its simple or compound form with the auxiliary *būti* (= to be);
- Mood: indicative, subjunctive, imperative and evidential/oblique;
- Voice: active and passive.

Many mood + tense combinations are further divided into different conjugations and sub-conjugations; the main combinations are listed in Tables 3 - 6.

3.3.1.1 Prefixes

Prefixes are also a rich source of morphology in verbs. Prefixes can take the role of a preposition (e.g., ***į****-bėgti* = to run **into**), express negation (e.g., ***ne****-mylėti* = to **not** love), spatial or temporal aspects of the verb, as well as the extent of the action (e.g., ***per****-važiuoti* = to drive **through**). Many verbs can take the reflexive marker *–si/-s*, which can be found either before or after the root, depending on the verb form (e.g., *at-**si**-kelti* = to raise oneself up [perfective aspect]; *kelt-**is*** = to raise oneself up [imperfective aspect]). *–(d)in-* and *–(d)y-* suffixes express causation (e.g., *didė-ti* = to make oneself bigger; *did-in-ti* = to make someone/thing bigger). Multiple affixes may be used with one word, for example:

Skaity-ti = to read

Man ši knyga <u>ne-per-si-skait-ė</u> lengvai = I did not find it easy to read this book (lit. to me this book did not through readSELF easily)

Table 3

Indicative mood endings

	Tense	Present			Past		Past frequentive	Future
	Conjugation*	-a	-i	-o	-o	-ė	N/A	N/A
	Verb	= to climb	= to be quiet	= to say	= to buy	= to say	= to climb	= to climb
Non-reflexive	1sng	lip-u	tyl-iu	sak-au	lip-au	sak-iau	lip-davau	lip-siu
	2sng	lip-i	tyl-i	sak-ai	lip-ai	sak-ei	lip-davai	lip-si
	3sng	lip-a	tyl-i	sak-o	lip-o	sak-ė	lip-davo	lip-s
	1plr	lip-ame	tyl-ime	sak-ome	lip-ome	sak-ėme	lip-davome	lip-sime
	2plr	lip-ate	tyl-ite	sak-ote	lip-ote	sak-ėte	lip-davote	lip-site
	3plr	lip-a	tyl-i	sak-o	lip-o	sak-ė	lip-davo	lip-s
Reflexive	1sng	lip-uosi	tyl-iuosi	sak-ausi	lip-ausi	sak-iausi	lip-davausi	lip-siuosiu
	2sng	lip-iesi	tyl-iesi	sak-aisi	lip-aisi	sak-eisi	lip-davaisi	lip-siesi
	3sng	lip-asi	tyl-isi	sak-osi	lip-osi	sak-ėsi	lip-davosi	lip-sis
	1plr	lip-amės	tyl-imės	sak-omės	lip-omės	sak-ėmės	lip-davomės	lip-simės
	2plr	lip-atės	tyl-itės	sak-otės	lip-otės	sak-ėtės	lip-davotės	lip-sitės
	3plr	lip-asi	tyl-isi	sak-osi	lip-osi	sak-ėsi	lip-davosi	lip-sis

* Based on indicative mood 3sng/plr ending

Table 4

Imperative and conditional mood endings

	Mood	Imperative	Conditional
	Stem	= to eat	= to climb
Non-reflexive	1sng	N/A	lip-čiau
	2sng	valg-yk	lip-tum
	3sng	(tegu) valg-o	lip-tų
	1plr	valg-ykime	lip-tume / lip-tumėme
	2plr	valg-ykite	lip-tute / lip-tumėte
	3plr	(tegu) valg-o	lip-tų
Reflexive	1sng	N/A	lip-čiausi
	2sng	valg-ykis	lip-tumeisi
	3sng	(tegu) valg-osi	lip-tųsi
	1plr	valg-ykimės	lip-tumės / lip-tumėmės
	2plr	valg-ykitės	lip-tutės / lip-tumėtės
	3plr	(tegu) valg-osi	lip-tųsi

Table 5

Evidential mood endings

Conjugation*		-a/-o		-i	
Gender		MASC	FEM	MASC	FEM
Stem		= to climb		= to be quiet	
Non-reflexive	SNG	lip-ąs/ lip-antis	lip-anti	tyl-–įs/ tyl-intis	tyl-inti
	PLR	lip-ą/ lip-antys	lip–ančios	tyl-į/ tyl-intys	tyl-inčios
Reflexive	SNG	besi-lip-ąs/ besi-lip-antis	besi-lip-anti	besi-tyl-įs/ besi-tyl-intis	besi-tyl-inti
	PLR	besi-lip-ą/ besi-lip-antys	besi-lip-ančios	besi-tyl-į/ besi-tyl-intys	besi-tyl-inčios

* Based on indicative mood 3sng/plr ending

Table 6

Passive verb form endings

Conjugation*	-a		-i		-o	
Gender	MASC	FEM	MASC	FEM	MASC	FEM
Stem	= to climb		= to be quiet		= to eat	
SNG	lip-tas	lip-ta	tyl-inamas	tyl-inama	valg-omas	valg-oma
PLR	lip-ti	lip–tos	tyl-inami	tyl-inamos	valg-omi	valg-omos

* Based on indicative mood 3sng/plr ending

NB Passive forms are used with the auxiliary *to be*; conjugations based on present tense 3sng.

3.3.2 Nouns

Lithuanian noun morphology is highly complex. A different ending is used depending on the noun's gender, number, case, and declension. The noun declension system is presented in Table 7.

3.3.2.1 Gender

The vast majority of nouns are assigned either a masculine or a feminine grammatical gender, with a small number of exceptions classed as a common gender noun. Most nouns have only one grammatical gender form; however, biological sex can lead to two forms (e.g., *mokytojas* – *mokytoja* [= teacher MASC – teacher FEM]; *liutas* – *liutė* [= lion – lioness]). Grammatical gender can almost always be inferred from the ending of the noun, as each declension contains nouns from only one grammatical gender (see Table 7).

3.3.2.2 Number

Two numbers – singular and plural – are distinguished in Lithuanian. An archaic form of dual number is sometimes used with certain quantitative phrases (e.g., *mudu abudu* [= us two]). Some nouns only occur in one number form, such as *drąsa* (= courage SNG) or *durys* (= door PLR).

3.3.2.3 Case

Case indicates the syntactic and semantic roles of a noun within a sentence (e.g., NOMINATIVE case marks the SUBJECT; ACCUSATIVE case marks the OBJECT). Traditionally, reference grammars assume that seven cases are used in standard Lithuanian. The vocative case has been disputed as it is only used as a form of address, rather than as an indication of a syntactic role (e.g., SUBJECT/OBJECT); however, like the other cases, it is indicated by a distinct pattern of endings across different declensions. The use of a particular case is determined by a number of syntactic and semantic factors; the main uses are summarised in Table 8. Some archaic forms of the illative, such as *lauk-an* (= into the outside), are also occasionally encountered, but they are restricted to a limited number of nouns.

3.3.2.4 Declension

Each noun belongs to a declension class, which determines the pattern of endings across the cases (see Table 7). Although several different classification systems have been proposed (based on similarities at the level of stem-endings and stress pattern), the standard system includes five declensions, with the first declension divided into three sub-declensions (1.1, 1.2, 1.3) and the second declension into two (2.1, 2.2). Each (sub)declension contains nouns of a particular gender; the system does not have different masculine and feminine endings within a particular subdeclension.

Descriptively speaking, the declension class of a particular noun is determined by the ending of the nominative singular form. Although complex in terms of the number of different endings, the system is highly regular. With very few exceptions, all that varies between different case and number marked forms of nouns within the same declension is the inflectional morpheme following the stem (e.g., *-as, -o, -ui, -ą, -u, -e, e/-ai*, for singular nouns in declension 1.1). The stem itself does not change, with the exception of a handful of stems ending in *–t* or *–d*, which change to *–č* and *–dž* respectively in some number + case combinations (e.g., *tėt-is* → *tėč-io* [= dad SNG:NOM → dad SNG:GEN]; *baland-is* → *balandž-iai* [= dove SNG:NOM → doves PLR:NOM])[2]. Of the 140 cells in the complete paradigm, 51 are filled by endings that are unique and 89 by endings that are repeated once or more elsewhere in the paradigm due to syncretism (though almost always marking the same case) and neutralisation (*-ei / -iai* and *-į/ -y*).

[2] Nouns requiring a stem change were not used in the elicitation studies.

Table 7

System of Lithuanian noun declension

	Declension	1.1	1.2	1.3	2.1	2.2	3.1	4.1	5.1
	Gender	MASC	MASC	MASC	FEM	FEM	FEM	MASC	MASC
	Noun	= table	= knife	= horse	= bread	= bee	= eye	= market	= shepherd
SNG	NOM	stal-as	peil-is	arkl-ys	duon-a	bit-ė	ak-is	turg-us	piem-uo
	GEN	stal-o	peil-io	arkl-io	duon-os	bit-ės	ak-ies	turg-aus	piem-en-s
	DAT	stal-ui	peil-iui	arkl-iui	duon-ai	bit-ei	ak-iai	turg-ui	piem-en-iui
	ACC	stal-ą	peil-į	arkl-į	duon-ą	bit-ę	ak-į	turg-ų	piem-en-į
	INST	stal-u	peil-iu	arkl-iu	=NOM	bit-e	ak-imi	turg-umi	piem-en-iu
	LOC	stal-e	peil-y(je)	arkl-y(je)	duon-oj(e)	bit-ėj(e)	ak-y(je)	turg-uj(e)	piem-en-y(je)
	VOC	stal-e/-ai	peil-i	arkl-y	=NOM	=INST	ak-ie	turg-au	piem-en-ie
PLR	NOM	stal-ai	peil-iai	arkl-iai	duon-os	bit-ės	ak-ys	turg-ūs	piem-en-ys
	GEN	stal-ų	peil-ių	arkl-ių	duon-ų	bit-ių	ak-ių	turg-ų	piem-en-ų
	DAT	stal-ams	peil-iams	arkl-iams	duon-oms	bit-ėms	ak-ims	turg-ums	piem-en-ims
	ACC	stal-us	peil-ius	arkl-ius	duon-as	bit-es	ak-is	turg-us	piem-en-ius
	INST	stal-ais	peil-iais	arkl-iais	duon-omis	bit-ėmis	ak-imis	turg-umis	piem-en-imis
	LOC	stal-uose	peil-iuose	arkl-iuose	duon-ose	bit-ėse	ak-yse	turg-uose	piem-en-yse
	VOC	=NOM	=NOM	=NOM	=NOM	=NOM	=NOM	=NOM	=NOM

Note. Endings for the singular locative case for declensions 1.2-5.1 formally include the phonemes shown in parentheses, but the contracted colloquial forms are widely used.

Table 8

Lithuanian cases and their main uses. Adapted from Babaev (n.d.)

Case	Use	Example
Nominative	Who?	*Jonas spardo kamuolį*
	What?	= John is kicking the ball
	Subject	*Tai yra Jonas*
		= This is John
Genitive	Whose?	*Jono kamuolys*
	Of what?	= John's ball
	Possessive	*Jonas neturi kamuolio*
	Negation	= John does not have a ball
Dative	To whom?	*Jonas spyrė kamuolį draugui*
	To what?	= John kicked the ball to a friend
	For what?	*Jonas spardė kamuolį dienai*
		= John kicked a ball for a day
Accusative	Whom?	*Jonas spardo kamuolį*
	What?	= John is kicking the ball
	When?	*Jonas spardo kamuolį sekmadieniais*
	Object	= John kicks a ball on Sundays
Instrumental	With what?	*Jonas spardo kamuolį su draugu*
	By what?	= John is kicking the ball with a friend
	How?	*Jonas spardo kamuolį savo batu*
		= John is kicking the ball with his shoe
Locative	Where?	*Jonas spardo kamuolį kieme*
		= John is kicking the ball in the backyard
Vocative	Address form	*Jonai!*
		= John!

3.3.2.5 Diminutives

Diminutive forms in Lithuanian are used to express smallness or cuteness and are marked with a suffix between the stem and the ending. The suffixes are listed in Table 9; they are not gender/declension specific and can be combined to stress the diminutiveness of the noun, e.g., *laš-as* (droplet SNG:NOM) → *laš-iuk-as / laš-el-is* (droplet SNG:NOM:DIM) → *laš-el-iuk-as* (droplet SNG:NOM:DIM:DIM). However, irrespective of the simplex form declension, each suffix can be used with only one masculine and one feminine ending. For example, diminutive forms using the suffix *-el-* always use the *-is* ending for masculine nouns and *-ė* for feminine nouns:

*arkl-**ys*** [horse MASC:SNG:NOM] → *arkl-el-**is*** [horse MASC:SNG:NOM:DIM], not **arkl-el-**ys;***

*bal-**a*** [puddle FEM:SNG:NOM] → *bal-ut-**ė*** [puddle FEM:SNG:NOM:DIM], not **bal-el-**a***

Additionally, unlike the free stress of the simplex forms, diminutives have a standard stress pattern, with the diminutive suffix receiving the emphasis.

Table 9

Diminutive suffixes in Lithuanian

Dim suffix	MASC ending	Masculine example	FEM ending	Feminine example
-el-	-is	laiv-as (= boat) → laiv-el-is	-ė	gėl-ė (= flower) → gėl-el-ė
-ėl-	-is	debes-ys (= cloud) → debes-ėl-is	-ė	ranken-a (= handle) → ranken-ėl-ė
-(i)uk-	-as	žmog-us (= person) → žmog-iuk-as	-ė	lap-ė (= fox) → lap-iuk-ė
-ut-	-is	lang-as (= window) → lang-ut-is	-ė	kėd-ė (= chair) → kėd-ut-ė
-yt-	-is	paukšt-is (= bird) → paukšt-yt-is	-ė	lov-a (= bed) → lov-yt-ė
-ul-	-is	sen-is (= old man) → sen-ul-is	-ė	tet-a (= aunt) → tet-ul-ė
-už-	-is	brol-is (= brother) → brol-už- is	-ė	egl-ė (= fir tree) → egl-už- ė
-(i)ūkšt-	-is	veln-ias (= devil) → veln-iūkšt-is	-ė	merg-a (= lass) → merg-iūkšt-ė
-okšn-	-is	kelm-as (= tree stump) → kelm-okšn-is	N/A	N/A

3.3.3 Adjectives

Adjectives in Lithuanian are highly inflected; the type of adjective determines the inflection pattern it follows. The main divisions between adjectives are concrete and general quality, and simple and definitive adjectives. Adjective inflection often follows the same pattern as noun inflection; therefore, it is possible that noun and

adjective inflection acquisition are intertwined and support one another. The adjectival inflectional system is displayed in Table 10.

3.3.3.1 Simple and definitive adjectives

Concrete adjectives can be further split into simple and definitive categories. The former are considered unmarked, while the latter are marked. Both types of adjectives follow a similar pattern of inflection, with the definitive adjectives often also carrying additional suffixes between the stem and the ending. Definitive articles roughly corresponded to adjectives used with *the* in English. For example:

Simple	Definitive
Ger-as šauktas = good spoon	*Ger-as-is šauktas* = the good spoon
Gelton-a mašina = yellow car	*Gelton-oj-i mašina* = the yellow car

Adjectival suffixes contain information about gender, number and case. The inflection pattern agrees with the gender and number of the relevant noun, but not necessarily the declension. Nonetheless, adjective and noun inflections frequently match (Table 11).

Traditionally, reference grammars posit three adjective declensions (Table 11) but other classifications of varying level of detail have also been proposed (e.g., Ambrazas, 1997; Kamandulytė - Merfeldienė, 2012).

Suffixes can also be used to form diminutive forms or denote degree:

Ger-as – *ger-esn-is* – *ger-iaus-ias* (= good – better – the best)

Did-el-ė – *did-esn-ė* – *didž-iaus-ia* (= big – bigger – the biggest)

Table 10

Adjective case endings

	Declension	1		2		3	
	Gender	MASC	FEM	MASC	FEM	MASC	FEM
	Stem	= good		= expensive		= big	
SNG	NOM	ger-(i)as	ger-(i)a	brang-us	brang-i	didel-is	didel-ė
	GEN	ger-(i)o	ger-(i)os	brang-aus	brang-ios	didel-io	didel-ės
	DAT	ger-(i)am	ger-(i)ai	brang-iam	brang-iai	didel-iui	didel-ei
	ACC	ger-(i)ą	ger-(i)ą	brang-ų	brang-ią	didel-į	didel-ę
	INST	ger-(i)u	ger-(i)a	brang-iu	brang-ia	didel-iu	didel-e
	LOC	ger-(i)ame	ger-(i)oje	brang-iame	brang-ioje	didel-iame	didel-ėje
PLR	NOM	ger-i	ger-(i)os	brang-ūs	brang-ios	didel-i	didel-ės
	GEN	ger-(i)ų	ger-(i)ų	brang-ių	brang-ių	didel-ių	didel-ių
	DAT	ger-iems	ger-(i)oms	brang-iems	brang-ioms	didel-iems	didel-ėms
	ACC	ger-(i)us	ger-(i)as	brang-ius	brang-ias	didel-ius	didel-es
	INST	ger-(i)ais	ger-(i)omis	brang-iais	brang-iomis	didel-iais	didel-ėmis
	LOC	ger-(i)uose	ger-(i)ose	brang-iuose	brang-iose	didel-iuose	didel-ėse

Table 11

Examples of adjective-noun ending agreement

	Gender	MASC				FEM			
	Number	SNG	PLR	SNG	PLR	SNG	PLR	SNG	PLR
	Noun	kirv-is (= ax)		laiv-as (= boat)		lov-a (= bed)		gėl-ė (= flower)	
didel-is (= big)	NOM	**didel-is kirv-is**	didel-i kirv-iai	didel-is laiv-as	didel-i laiv-ai	didel-ė lov-a	didel-ės lov-os	**didel-ė gėl-ė**	**didel-ės gėl-ės**
	GEN	**didel-io kirv-io**	**didel-ių kirv-ių**	**didel-io laiv-o**	**didel-ių laiv-ų**	didel-ės lov-os	**didel-ių lov-ų**	**didel-ės gėl-ės**	**didel-ių gėl-ių**
	DAT	**didel-iui kirv-iui**	didel-iems kirv-iams	**didel-iui laiv-ui**	didel-iems laiv-ams	didel-ei lov-ai	didel-ėms lov-oms	**didel-ei gėl-ei**	**didel-ėmis gėl-ėmis**
	ACC	**didel-į kirv-į**	**didel-ius kirv-ius**	didel-į laiv-ą	**didel-ius laiv-us**	didel-ę lov-ą	didel-es lov-as	**didel-ę gėl-ę**	**didel-es gėl-es**
	INST	**didel-iu kirv-iu**	**didel-iais kirv-iais**	**didel-iu laiv-u**	**didel-iais laiv-ais**	didel-e lov-a	**didel-iomis lov-omis**	**didel-e gėl-e**	**didel-ėmis gėl-ėmis**
	LOC	didel-iame kirv-yje	**didel-iuose kirv-iuose**	didel-iame laiv-e	**didel-iuose laiv-uose**	didel-ėje lov-oje	didel-ėse lov-ose	**didel-ėje gėl-ėje**	**didel-ėse gėl-ėse**
maž-as (= small)	NOM	maž-as kirv-is	maž-i kirv-iai	**maž-as laiv-as**	maž-i laiv-ai	**maž-a lov-a**	**maž-os lov-os**	maž-a gėl-ė	maž-os gėl-ės
	GEN	**maž-o kirv-io**	**maž-ų kirv-ių**	**maž-o laiv-o**	**maž-ų laiv-ų**	**maž-os lov-os**	**maž-ų lov-ų**	maž-os gėl-ė	**maž-ų gėl-ių**
	DAT	**maž-ui kirv-iui**	maž-ais kirv-iais	**maž-ui laiv-ui**	**maž-ais laiv-ais**	**maž-ai lov-ai**	**maž-oms lov-oms**	maž-ai gėl-ė	maž-omis gėl-ėmis
	ACC	maž-ą kirv-į	**maž-us kirv-ius**	**maž-ą laiv-ą**	**maž-us laiv-us**	**maž-ą lov-ą**	**maž-as lov-as**	maž-ą gėl-ė	maž-as gėl-es
	INST	**maž-u kirv-iu**	**maž-ais kirv-iais**	**maž-u kirv-iu**	**maž-ais laiv-ais**	**maž-a lov-a**	**maž-omis lov-omis**	maž-a gėl-ė	maž-omis gėl-ėmis
	LOC	maž-ame kirv-yje	**maž-uose kirv-iuose**	maž-ame laiv-e	**maž-uose laiv-uose**	**maž-oje lov-oje**	**maž-ose lov-ose**	maž-oje gėl-ėje	maž-ose gėl-ėse
graž-us (= pretty)	NOM	graž-us kirv-is	graž-ūs kirv-iai	graž-us laiv-as	graž-ūs kirv-iai	graž-i lov-a	**graž-ios lov-os**	graž-i gėl-ė	graž-ios gėl-ės
	GEN	graž-aus kirv-io	**graž-ių kirv-ių**	graž-aus laiv-o	**graž-ių kirv-ių**	**graž-ios lov-os**	**graž-ių lov-ų**	graž-ios gėl-ės	**graž-ių gėl-ių**
	DAT	**graž-iu kirv-iu**	**graž-iais kirv-iais**	**graž-iu laiv-u**	**graž-iais kirv-iais**	**graž-iai lov-ai**	**graž-iai lov-ai**	**graž-iai gėl-iai**	graž-ioms gėl- ėms
	ACC	graž-ų kirv-į	**graž-ius kirv-ius**	graž-ų laiv-ą	**graž-ius kirv-ius**	**graž-ią lov-ą**	**graž-ias lov-as**	graž-ią gėl-ę	graž-ias gėl-es
	INST	**graž-iu kirv-iu**	**graž-iais kirv-iais**	**graž-iu laiv-u**	**graž-iais kirv-iais**	**graž-ia lov-a**	**graž-iomis lov-omis**	graž-ia gėl-e	graž-iomis gėl-ėmis
	LOC	graž-iame kirv-yje	**graž-iuose kirv-iuose**	graž-iame laiv-e	**graž-iuose kirv-iuose**	**graž-ioje lov-oje**	**graž-iose lov-ose**	graž-ioje gėl-ėje	graž-iose gėl-ėse

* Instances of matching adjective and noun ending are in bold

3.3.3.2 Concrete and general quality adjectives

Concrete adjectives qualify a particular thing and agree with the grammatical gender of the noun, while general quality adjectives are used to qualify less concrete concepts and usually take the neuter gender. Furthermore, general quality adjectives do not follow case or declension inflection.

Examples of general quality adjectives:

- *Tai <u>blogai</u>* = it is bad

- *Rytoj bus <u>šilta</u>* = tomorrow it is going to be warm

- *Ruda – <u>nuobodu</u>* = brown is boring

3.4 Lithuanian language acquisition research

Research into child language acquisition in Lithuanian has been very limited (Dabašinskienė & Kalėdaitė, 2012), and has focused mainly on naturalistic speech, establishing rates of usage of different parts of the language, gender, adjectives and the use of diminutives. Research on morphological acquisition and production has been mostly led by Dabašinskienė (previously known as Savickienė) and colleagues. An overview of studies focusing on Lithuanian morphological acquisition is summarised in the next section.

3.4.1 Noun morphology acquisition

The most detailed study of Lithuanian noun acquisition is based on naturalistic speech recordings of a girl (1;7 – 2;5) and her mother. The analysis revealed that the distribution of various noun forms largely mirrored the mother's speech by the end of the recording period, though of course it is impossible to tell whether this reflects input-based learning, or simply the fact that the parent and child are speaking the same language. The main differences between the mother's and the child's speech included the girl's higher preference for the nominative case and the mother's more frequent use of the 2.2 declension. The 2.2 declension is the declension used with feminine diminutives (e.g.,*katyt-ė* [= cat FEM DIM]), so it is likely to reflect the mother's high use of diminutive forms. The summary of the number, case and declension form usage by the mother and the child are reproduced in Tables 12-14.

Table 12

Percentage of number and forms in the child's and mother's speech

Number	Child	Mother
Singular	87	83
Plural	13	17

Table 13

Percentage of case forms in the child's and mother's speech

Case	Child	Mother
NOM	59	48
GEN	15	19
DAT	4	5
ACC	19	21
INST	2	4
LOC	2	3

Table 14

Percentage of declension forms in the child's and mother's speech

Declension	Child	Mother
1.1	36	30
1.2/1.3	13	13
2.1	11	11
2.2	38	43
3.1	1	1
4.1	2	2
5.1	0	0

The analysis also suggested that case semantics is acquired before declension, as the child used the right case but the wrong declension on several occasions, such as substituting masculine *–as/-is* with feminine *–a* (e.g., **banana* [*bananas* = banana], **obuoliuka* [*obuoliukas* = apple DIM], **pauka* [*paukštis* = bird], **smėlia* [*smėlis* = sand]). Many such utterances co-occurred with correctly inflected forms, challenging the generativist claim that once a child learns a rule, they should be able to use it freely (e.g., Wexler, 1998). Additionally, the authors noted some instances of the girl using the feminine *–a* instead of another feminine *-ė* ending: **palelia* (*piniginė* = purse), **bulia* (*bulvė* = potato), *apa* (*lapė* = fox).

Although the numerical breakdown of the errors was not provided, the author reported that the latter type of errors was considerably less frequent than the masculine – feminine switch. It is also interesting to note that in erroneous productions, the child produced *–a* instead of *–ė*, although the latter is used in the singular nominative feminine diminutive forms, which are very frequent in the child's speech (as discussed in more detail below).

Dabašinskienė and Cubajevaitė (2009) researched case errors produced by second-language learners of Lithuanian students in their written assignments. Although detailed numerical data on error types was not presented, the most frequent types of reported errors included using the nominative instead of the accusative or the genitive, even with frequent verbs, such as *to like, to drink* and *to buy*, which are generally followed by an accusative form. The genitive was also used instead of the accusative or the nominative. Lithuanian affirmative sentences often use the accusative case, but their negative counterparts require the genitive (e.g., *valgau obuolius* [= I am eating the apples]; *nevalgau obuolių* [= I am not eating the apples]), which led to a number of erroneous uses of the accusative instead of the genitive form. There were also several instances of the dative being used instead of the accusative or the nominative. Incorrect use of the dative was presumed to be likely due to the students' native language or the complexity of the sentence. Some first-language Polish and Latvian speakers appeared to show carry-over effects of their native language use of the locative in (Lithuanian) accusative contexts, such as **Naktyje* [=*naktį*] *beveik visai nebijau miegoti tamsu kambaryje* (= At night I have almost no fear to sleep in the dark room).

3.4.2 Diminutives

A further analysis of the naturalistic speech data showed that use of diminutive noun forms appears early and closely matches the mother's use (Savickienė, 1998). Diminutive forms were recorded at the earliest point of recording and were prominent in the child's speech – only about 16% of the nouns she used in the first couple of months of observation were in the simplex (i.e., non-diminutive) form. The rates of diminutives decreased throughout the rest of the recording period and matched the mother's rates closely, with an average of 40%, which is considerably higher than the 5% diminutive rate seen in adult-directed speech (Dabašinskienė &

Voeikova, 2015). Similarity to the mother's speech was also observed in the types of diminutive suffixes the child produced. The most frequent suffixes were *-ytė* (FEM) and *-ukas* (MASC). Analysis also revealed that the child mostly used either the simplex or the diminutive form for most nouns, with only 10% used in both. Furthermore, the author noted that the simplex forms were immediate imitations of adult speech, while most self-produced forms were diminutives. The child also showed the ability to use up to three different types of diminutive suffixes with the same noun from the early stages of observation (e.g., *meški-iukas, mešk-utė, mešk-ytė* [= bear SNG:NOM:DIM]), although the possibility that the forms were rote-learned outside of the recording sessions remains. The analysis of the same recording by Kamandulytė (2007) also revealed that the mother tended to use a higher percentage of diminutives over simplex forms when talking to her child than with other adults.

Savickienė et al. (2009) suggested that the high rates of diminutive use observed in child-directed speech might aid morphological development. In an elicited production task, Savickienė et al. presented pictures of novel and familiar animals to three- and six-year-old children. The animals were labelled by the researchers using either a simplex or a diminutive form, and the children were asked to describe them, which they generally did using pronouns and adjectives. Results showed fewer pronoun and adjective gender agreement errors were produced if the animal was initially labelled with its diminutive form. The authors suggested that the diminutive advantage might be due to declension and lexical stress simplification. Despite Lithuanian possessing a number of diminutive suffixes, all end in *-as/-is* (MASC) or *-e* (FEM), which helps due to their high frequency. The diminutive suffix "buffer" between the stem and the ending may also help to highlight the phonological differences between the cases. For example:

*ak-**is*** (= eye SNG:NOM) → *ak-yt-**ė*** (= eye SNG:NOM:DIM)

*ak-**is*** (= eye PLR:ACC) → *ak-yt-**es*** (= eye PLR:ACC:DIM)

Furthermore, unlike simplex forms, diminutives have a fixed stress pattern, which may also help to reduce phonological complexity. The suggested benefits of diminutive suffixes on noun case acquisition was further reinforced by the re-analysis of the naturalistic speech data used in Savickienė's 1998 study, which found

that the child tended to use diminutive forms for nouns which belong to low frequency declensions in their simplex forms (Dabašinskienė, 2009).

3.4.3 Adjective morphology

Kamandulytė-Merfeldienė (2012) investigated the acquisition of Lithuanian adjective morphology. Naturalistic recordings of four children were analysed with a focus on adjective-noun agreement errors. The overall error rate was low (3-6%; no detailed error rate data were provided), with gender agreement errors being the most common (e.g.,**Lelytė mažas* [= doll **FEM**:SNG:NOM:DIM small **MASC**:SNG:NOM]). However, it was not clear if the error rate was stable, or if it varied across different contexts. It was noted that, for all types of agreement errors (gender, number and case), children appeared to be the least productive (i.e., showed higher error rates) with the less frequent forms (e.g., **Su raudoni popieriais buvo* [= with red MASC:PLR:**NOM** papers MASC:PLR:**INST** were]); adjective-noun inflection paradigm similarities appeared to facilitate early agreement acquisition.

Some of the main themes of research into Lithuanian morphological acquisition have been that the use of diminutives is extensive in child language and is likely to play a part in helping children to learn language by standardising the rhythm and declension use; the distribution of number, case and declension in child language largely reflects that of mother's speech. However, as summarised by Dabašinskienė and Kalėdaitė (2012), generalisations based on previous research must be drawn with considerable caution, as – on top of the general problems associated with making inferences about productivity from naturalistic data – the majority of naturalistic data studies were based on the recording of the same child, and there have been very few elicited production studies testing morphological development using a larger number of children (e.g., Dabašinskienė, 2010; Savickienė et al., 2009).

4. Naturalistic language study

4.1 Introduction

As discussed in the previous chapters, constructivist explanations of morphological development argue that the child needs to receive a significant amount of input to first acquire rote-learned words and phrases, along with the contextual information (e.g., *noriu pien-o* [= I want milk GEN], *noriu čips-o* [= I want a crisp GEN]; *lėlė su varl-e* [= the doll with the frog INST], *katė su pel-e* [= the cat with the mouse INST]) which then are slowly abstracted across to form slot-and-frame patterns (e.g., *noriu X-o* [= I want X-o]; *X with X-e* [= the X with the X-e]). The process is highly dependent on frequency – the higher the frequency of the slot-and-frame pattern, the quicker the child is likely to learn it (see Ambridge et al., 2015 for a review). The frequency effects also influence what errors the child is likely to make (or what they are likely to *default* to) – low frequency inflected forms are likely to be replaced by higher frequency ones (e.g., *rank-omis* [= hands PLR:INST] → *rankas* [= hands PLR:ACC]).

Generativist explanations, on the other hand, argue that morphology acquisition centres on innate linguistic and functional categories, such as NOUN, VERB and INFLECTION and the rules governing them. As the child develops, he or she learns the language-specific stems and inflections, which map onto these categories and eliminates non-target grammars (e.g., Crain, 1991; Legate & Yang, 2007). Once a particular parameter is set based on a handful of examples, the child is then able to apply this rule to other stems and generate new inflected forms correctly and easily. Due to the pre-existing rules and categories, the process is said to be relatively quick and the child is expected to make few errors. If they do make errors, they are expected to use a default rule, such as *add –ed to the past tense form* in English.

The current chapter presents a naturalistic data study, which aimed to test generativist and constructivist predictions, focusing on Lithuanian noun morphology. First, a brief review of other spontaneous speech studies testing generativist and constructivist accounts is presented.

4.2 Previous studies

One of the major sources of supporting evidence for the nativist position is the cross-linguistic finding that children begin using inflections at the earliest observable stage of their language development and appear to become (nearly) fully productive at an early stage, "despite ever present opportunity for error" (Cazden, 1968, p. 445). A number of spontaneous child speech studies (reviewed below) have concluded that children learn morphology quickly and make very few mistakes during the early stages of multi-word production period. Here, studies looking at this phenomenon in English, German and highly inflected languages, such Spanish, Polish and Lithuanian are reviewed.

4.2.1 English and German

Harris and Wexler (1996) analysed English spontaneous speech samples from the CHILDES database (MacWhinney, 2000) and found very few agreement errors. Only 0.02% of the 1352 1sng utterances incorrectly used a 3sng *–s* ending, supporting the rules and categories accounts. Another study looking at English focused on the past tense *–ed* ending overgeneralisation (Marcus et al., 1992). Using the CHILDES database (MacWhinney, 2000), the authors extracted 11521 irregular past tense form utterances from a sample of 83 children between the ages of 1;3 and 6;6. The overall overgeneralisation rate across all children was generally low, at 7.6%, but the median rate for the most densely sampled children was only 2.5%. Stemberger (1989) conducted a longitudinal diary study of two children's spontaneous speech between the ages of 1;0 – 5;11 and 1;0 – 3;4 and recorded only ten and two morphological errors respectively.

Poeppel and Wexler (1993) analysed 282 spontaneous declarative multi-word utterances of a 2;1-year-old German-speaking child and concluded that the child had already acquired much of the inflectional system. The data showed that the child used finite/non-finite forms in unexpected positions 7.8% of the time. Although the use of non-finite forms in finite contexts was predicted by the theory (15.9% of the errors), the use of finite forms in non-finite contexts was difficult to explain (6.9% of errors). The authors claimed that the result was "overwhelming" (p. 6) evidence of child's ability to use finite and non-finite forms correctly, the data provided also showed that the error rate rose to 31.8% for the less frequent non-finite contexts.

4.2.2 Romance languages

Acquisition of morphology in Romance languages has also received considerable attention. Hyams (1986) analysed the speech of 11 Italian children between the ages of 1;10 and 2;4 and concluded that subject-verb agreement errors were "rare exceptions" (p. 135) and that correct responses were not limited to only to a few contexts.

Similar findings were reported by Pizzuto and Caselli (1992), who analysed spontaneous speech of three Italian children between the ages of 1;10 and 3;9 recorded during one- or two-hour sessions every few weeks. Despite the relatively long period of recording and including several children in the analysis, the number of plural forms in the recordings (0-22%) was not enough to include them in the analysis. The overall error rate of for incorrect singular person/number agreement echoed English data and ranged from 1 - 4%, although copula and auxiliary omissions in compound tenses saw error rates as high as 30% and 39% respectively.

Hoekstra and Hyams (1998) analysed a total of 6634 utterances of 11 German**,** Italian, Catalan and Spanish speaking children between the ages of 1;4 and 3;0. The subject-verb agreement error rate ranged from 0.6% to 4%. French language learners appear to follow similar patterns. Analysis of three children between 1;8 and 2;9 years demonstrated that 92 – 100% verbal inflections were used correctly. Hoekstra and Hyams (1998), and also Rasetti (2003), concluded that the results can be taken as evidence for early morphological knowledge.

4.2.3 Other highly inflected languages

More highly inflected languages, such as Polish, have also shown apparent signs of early productivity. Weist, Wysocka, Witkowska-Stadnik, Buczowska and Konieczna (1984) recorded the spontaneous speech of six Polish children over four 45-minute sessions each taking place at least two weeks apart. Children were divided into a younger group (aged 1;7-1;9 at the beginning of the recordings) and an older group (aged 2;0 – 2;2 at the beginning of the recordings). Although detailed error data were not provided, the authors argued that the data showed that children were able to use correctly inflected past and future verb tenses with few errors.

Babyonyshev (1993) extended research into complex morphology acquisition by investigating noun case marking abilities in two Russian children. The first child was recorded over 26 sessions between the age of 2;1 and 2;7. The second child was recorded over 19 sessions between the age of 1;6 and 2;0. Both children showed a strong preference for the nominative case (428 out of 499 inflected nouns for the first child and 198/246 for the second child). The other cases (accusative, genitive, dative, possessive, prepositional and instrumental) were used between 0 and 35 times. Nominative forms were produced correctly 99.5% of the time. The nominative ending was also used 20% of the time when a different inflection was required, but the author suggested that this may have been due to children misanalysing sentence structures. The accusative was used correctly 86% of the time. There was only one occasion in which an accusative inflection was used erroneously. The remaining cases were used correctly 40-80% of the time. Babyonyshev concluded that "children acquiring Russian use morphological case-marking appropriately from the moment of the appearance of structures that demand it" (p. 41), which the author interpreted as evidence for early inflectional knowledge compatible with Universal Grammar.

Dąbrowska (2001) analysed genitive case use of three Polish children between the ages of 1;4 and 4;11. The mean overgeneralisation rate for each child varied between 0.53% and 2.02%. The results showed that the frequent *–a* suffix was more likely to be erroneously applied to nouns (1.28% of tokens) than the less frequent *–u* (0.24% of tokens) or *-y/i* (0.11% of tokens) suffix. The author concluded that the finding was not evidence for a default rule, as there were few cross-declensional errors and therefore the suffix was not applied equally across different stems. Instead, the differences in the suffix frequencies was taken as evidence for frequency effects.

Polish data were analysed by Krajewski, Lieven and Theakston (2012) who analysed a densely sampled speech corpus of a girl between 2;0.3 and 2;1.12. They found only 36 occurrences of the child using an incorrect ending, representing 0.64% of the token data. Although the overall error rate is very low, the mother also used a non-typical ending on a few occasions, and statistical analysis showed that the child's error rate was significantly greater than the mother's, challenging the

generativist assumption that child grammar is not essentially different from adult grammar.

4.2.4 Lithuanian

The most in-depth study of a Lithuanian child's morphological development was conducted by Savickienė and Dressler (2003). Thirty-five hours of naturalistic child speech recordings of a 1;7-2;6-year-old girl were analysed with a focus on noun morphology (11964 nouns in the mother's speech and 9379 nouns in the daughter's speech). The start of the analysis coincided with the onset of inflection use. Because of its clear relevance to the present study, this study is considered in more detail in the following sections.

4.2.4.1 Number

The girl showed the apparent ability to distinguish between number at the beginning stages of recording but her use of plural increased throughout the recording period – from 4% at 1;7 to 18% at 2;5. Despite the child's relatively low number of plural forms, this rate was not much lower than the mother's use of plural forms, which averaged 17% throughout the recording period. The child showed an apparent preference for plurals in the nominative case for the first few months, with other case plurals gradually beginning to emerge at around 1;9. Although the authors noted few number agreement errors, and that the child showed the ability to use plural forms correctly at the beginning stages of the recording, wrong inflections (e.g., *daug kengūriukas* [= many kangaroo SNG:NOM:DIM]) were still identified up to age 2;2. A detailed breakdown of the error data were not presented, making it difficult to draw conclusions about whether the data better support constructivist or the generativist accounts.

4.2.4.2 Case

The frequency of different noun cases varied significantly but both speakers (girl and mother) appeared to use them at a similar rate. The most frequent cases were the nominative, accusative and genitive cases. The rest of the cases (dative, instrumental and locative) ranged from 2-5%. The girl's choice of cases became more varied throughout the analysis period. At the beginning of the recording, 71% of her nouns were in the nominative singular form. The other cases she used at 1;7 were singular

accusative, genitive and vocative. There were also several uses of plural nominative. By 1;9 she had used at least one singular noun in every case, as well as plural accusative and genitive forms. The remaining plural cases appeared between 1;9 and 2;0. At the end of the recording period, the number of singular nominative forms was reduced to 47%. The difference was made up by an increase in all other cases, with the exception of singular locative (from 2.4% at 1;8 to 1.8% at 2;5). Although the mother's speech was generally more varied and stable over time than the daughter's, the overall pattern appeared to be repeated: singular nominative forms were the most frequent but saw a reduction from 43% at the beginning to 35% at the end of the recording. Most other cases saw a modest increase. The most sporadically used form was the locative plural, which began appearing in the mother's and child's speech only when the child was 1;9.

4.2.4.3 Declension

The declensional system used in the study was not a traditional one, and used additional subclasses. However, the subclasses used can largely be mapped onto the system set out in the previous chapter.

At the beginning of the recording period, the majority of the nouns produced by the girl belonged to the 2.2 declension (71.4% of tokens). The second most common declension in the girl's speech was 1.1 declension at 14.3%. The two declensions remained the most common in her speech throughout the recording period but their use became considerably more balanced: the average use of 1.1 throughout the recordings was 35.5% and for 2.2 it was 37.4%. 2.1 declension was used in 10.5% of utterances. The mother showed a similar pattern of declension use, with 2.2 used in 43.4% of tokens, and 1.1 appearing in 30.3% of tokens.

Detailed quantified declension error data were not provided but the authors highlighted that the most common type of declension error was the application of 1.1 ending to a noun belonging to a different declension (0.6% of tokens). The authors also observed a few instances of defaulting to 1.3, 2.1 or 2.2 declension and at least one instance to defaulting to a lower frequency declension from 2.1 to 4.0.

4.2.4.4 Diminutives

One of the stand-out aspects of the girl's speech was the use of diminutive forms. They appeared at the earliest stages of recording and made up 29-72% of noun tokens and 21-48% of noun types, peaking at around the two-year mark. The girl's rate closely followed that of her mother's diminutive use, with the exception of the first month of the recording, when diminutive forms appeared in adult speech markedly more often than the child's. The mirroring of the mother's speech pattern also appeared in the child's distribution of diminutive suffixes. Out of the six feminine suffixes, *-yt-ė* and *–ut-ė* appeared in 86% of diminutive forms in the child's speech and 76% of the mother's speech. However, all other suffixes appeared at least once. Similarly, masculine *–el-is* and *–uk-as* were used 87% of the time by the child and 80% by the mother. The rest of the suffixes were also used several times by both of the speakers, with the exception of *–ait-is,* which only appeared once in the mother's speech. The girl also demonstrated the ability to use several different diminutive suffixes (and gender/declension endings) with different stems from the beginning, although it is not clear if the same forms also appeared in the mother's speech. For example, teddy-bear SNG:NOM:DIM:

- *Mešk-iuk-as*
- *Mešk-ut-ė*
- *Mešk-yt-ė*

However, the child did not show the same flexibility in switching between diminutive and simplex forms; only 8% of the nouns appeared in both forms.

In summary, Savickienė and Dressler's (2003) study of naturalistic Lithuanian language speech showed that the child's use of morphology begins early. The child appeared to reflect the mother's use of inflection closely, although the early stages of the recordings were dominated by a small number of frequent contexts, with the child's morphology use becoming more diverse over time. The girl's use of declensions was somewhat restrictive, with the majority of her nouns classed as belonging to 1.1 or 2.2 declension. However, the lack of diversity in her declension use might be due to the high number of diminutive forms, which usually fall under 1.1 or 2.2 declension. Some more common types of errors, such as defaulting to a more common declension, were discussed. However, no detailed error

data were provided, making it difficult to test the speech data against the predictions of the generativist and constructivist accounts. In particular, the speech was not analysed in enough detail to allow for a tightly-controlled analysis to compare the (apparent) productivity in parent and child, as reported by Aguado-Orea and Pine (2015).

4.2.5 Frequency analyses

The naturalistic speech studies discussed above have generally concluded that children acquire morphology quickly and easily, and produce few errors. However, such conclusions are usually based on macro level analyses, which collapse across all target contexts. This is potentially misleading, as frequent contexts (e.g., 1sng VERB forms and NOMINATIVE noun forms), which constitute by far the majority of the data, are exactly those for which children are likely to have rote-learned the relevant forms, and hence to make few errors. Conversely, infrequent contexts (e.g., 3plr VERB forms and INSTRUMENTAL or DATIVE noun forms), which make very little contribution to overall error rates, are exactly those for which children are unlikely to have rote-learned the relevant forms, and hence likely to make errors. Indeed, studies which have analysed children's error rates in a more fine-grained manner, i.e., broken down across contexts, have generally found much higher error rates in low-frequency parts of the system.

One of the early studies which looked at error rates based on frequency was conducted by Rubino and Pine (1998), who analysed 300 minutes of recordings of a Brazilian child between the ages of 3;02 and 3;04 with a focus on subject-verb agreement. Out of the 1464 analysed verb forms produced by the child, only 3% were classed as erroneous, which falls in line with data from other languages, as reviewed above. However, when the results were broken down by number, it was found that the error rate rose to 28% for less frequent plural subjects. When the results were further broken down by person and number contexts, a wide-ranging pattern of erroneous productions was revealed. The error rate ranged from 0.0% in high frequency 2sng contexts to 43.5% in low frequency 3plr contexts. The most frequent context was 3sng, which was used 929 times out of the 1464 analysed utterances, with only 5 instances (0.5%) coded as incorrect. The correct production rate appeared to be linked to the number of forms produced, with the most frequent

person-number combinations seeing the lowest error rates, and the least frequent person-number combinations seeing the highest error rates. A notable exception to this trend was the 1plr – *nós* inflection – all ten forms produced by the child were correct. It was suggested that this might be due to the child repeating the form produced by the mother as part of discourse; this pattern of the most infrequent contexts produced correctly will be seen in the results section of this chapter. The findings also led to the suggestion that such 'frozen strings' may have been counted as correct productions in previous research, potentially artificially inflating correct production rates. To remedy this, the authors advised to check the data for independent occurrences of different forms within the utterance in preceding speech samples.

Aguado-Orea and Pine (2015) pointed out that it is often difficult to distinguish between the generativist and constructivist theories using traditional naturalistic speech analysis methods. Data showing children's tendency to use a narrow range of word forms (e.g., more than half of the verb stems produced by both of the children in the Aguado-Orea and Pine study were only in one inflection) has been used to support the constructivist assumption that different word forms are learnt independently of each other, based on the frequency of each item. However, Yang (2013) offered an alternative explanation, suggesting that the large differences between different form use in child language followed Zipf's law, which states that most of our speech is made up of very few word forms, and that most word forms occur very rarely (Zipf, 1949). On the other hand, low overall error rates (e.g., Marcus et al., 1992; Schütze & Wexler, 1996; Wexler, 1998) have been used as evidence for early productivity, as predicted by generativist theories, have also been challenged – low overall error rates may be hiding 'pockets' of high error rates in low frequency contexts (Rubino & Pine, 1998).

Aguado-Orea and Pine (2015) attempted to address these criticisms by a) gathering a dense speech corpus and b) using productivity and error data analysis on the dataset. They analysed naturalistic recordings of two Spanish-speaking children between the ages of 2;0 and 2;6. As the recordings were made more frequently, the amount of data (61 to 68 minutes per week on average for five to seven months) was significantly greater than other Spanish or other highly inflected language corpora (e.g., López Ornat, 1994). The dense sampling allowed the authors to collect enough

data to compare error rates in low frequency contexts and higher frequency contexts; productivity analysis was used to test whether the parents' and the children's chosen word forms simply followed Zipf's law, or whether children's use of morphology was significantly different from that of their parents, which would be evidenced by the findings of parents showing significantly greater flexibility with the number of inflections they use with the same verb stems compared to the children. Productivity was calculated by comparing the number of different inflections per verb used in child versus adult speech. The samples were controlled for vocabulary range, sample size and knowledge of individual inflections. Vocabulary range was established by only analysing verb stems if they appeared at least twice in both the children's and adults' language. Sample size was controlled by obtaining a random sample of adult verb tokens matched in number to the child data. As first-person plural (1plr) and second-person plural (2pl) only started appearing towards the end of the analysed recording period, these contexts were excluded from the analysis in order to control for inflectional knowledge.

Productivity analysis revealed that out of the six possible inflections, children mostly used only one inflection per verb (1.64 – 1.84 inflections on average). However, in an uncontrolled analysis, the averages were not significantly different from adults' speech (2.14 – 2.15 inflections on average), stressing the importance of establishing adult speech usage prior to drawing conclusions regarding children's morphological productivity. Once the data were controlled for vocabulary range and sample size, productivity analysis showed that children were significantly more restricted in their use of verb inflections compared to adults, contradicting suggestions that children's morphological production is fully productive, but appears lexically restricted simply due to Zipf's law. Furthermore, to check if the differences in productivity were due to children not yet having learnt all of the relevant inflections, a possibility which is consistent with some generativist accounts (e.g., Chomsky, 1981; Legate & Yang, 2007; Pinker, 1994), the final productivity analysis was restricted to the period of recording after children have demonstrated the ability to use all of the inflections. The re-analysis revealed that children (1.79 – 2.11 inflections on average) were still less productive compared to their caregivers (2.11 – 2.31 inflections on average) with the range of verbal inflections appearing in their speech.

Error analysis of the children's speech revealed an overall error rate of under 5%, in line with other studies suggesting early productivity (e.g., Hoekstra & Hyams, 1998; Marcus et al., 1992; Poeppel & Wexler, 1993). However, the error rate was not consistent throughout the inflectional system – error rates ranged from <1% for 3sng to 46% for 3plr. Correct production rates appeared to be linked to the context frequency, as the most frequent context (3sng) showed the highest rate of correct productions, while the least frequent context (3plr) showed the highest error rate. The large differences in error rates demonstrate the importance of breaking down error rates by different contexts, rather than focusing only on the overall rate. Furthermore, the large error rates in low frequency contexts challenge the generativist claim of largely error-free morphological development, while at the same time supporting constructivist view of frequency affecting acquisition.

Rubino and Pine (1998) and Aguado-Orea and Pine (2015) have demonstrated that a simple calculation of the overall error rate may mask a more complex pattern of productivity that challenges the long-standing idea that children are productive users of morphology form an early age. However, these studies investigated verb production; only one study (Krajewski et al., 2012) has applied similar methodology to nouns, in which the analysis of naturalistic Polish child speech found that the child's average number of inflections per type (number of nouns sharing the same inflectional endings) of 1.86 was significantly smaller than the adult's average number of inflections per type of 2.00. The results showed that, on average, the parent used the same stem with two different inflections (e.g., DAT:SNG and NOM PLR), while the child used most of the nouns in one form, with only some nouns being produced in two forms or more. The finding that the parent is more flexible with their use of inflections is difficult to explain under the generativist approach, as it assumes that adult and child grammar are essentially the same and therefore should not show major differences in production patterns. Nonetheless, the small number of studies investigating child and adult productivity rates show that further testing is needed to investigate whether this pattern of production is found in other highly inflected languages, and if it is applicable to other parts of the speech, beyond verbs.

4.3 Current study

To test generativist and constructivist predictions for morphology, focusing on nouns especially, a naturalistic data study was conducted. A female child's and her mother's speech were recorded, analysed and compared. Following Aguado-Orea and Pine (2015), two constructivist predictions were tested. First, it was predicted that the overall error rate will be low but large differences in error rates will be detected across different contexts, with the highest error rates seen in low-frequency case, declension and number contexts, and the lowest error rates seen in high-frequency contexts. Second, a significant difference between the number of inflections produced by the mother and child (in favour of the mother) was expected, even after controlling for corpus size, vocabulary and knowledge of the relevant inflection. Generativist accounts predict no such differences, since children and adults are assumed to be operating with the same underlying system of morphology.

4.3.1 Method

4.3.1.1 Participants

Kamilė[3] is a girl with no known language or other developmental disorders. She is the only child in a middle-class family from Kaunas, Lithuania. Kamilė participated in the study between the ages of 2;6 and 2;8. Both of her parents are monolingual Lithuanian speakers.

4.3.1.2 Recording

Eleven hours of naturalistic speech were recorded over 27 sessions using an audio recorder. Recording sessions took place three to four times a week and averaged 18 minutes per session. The recordings took place at home, in naturalistic but varied situations, such as mealtimes, morning routines or playtime. Although the sampling was less dense than the Aguado-Orea and Pine (2015) and studies using the data on CHILDES database (e.g., Harris & Wexler, 1996; Marcus et al., 1992), it compares positively against many of the other naturalistic speech studies discussed in the Introduction (e.g., Babyonyshev, 1993; Poeppel & Wexler, 1993; Weist et al., 1984).

[3] The name of the child was changed for privacy reasons, but the pseudonym used belongs to the same declension to allow correct speech analysis presentation.

4.3.1.3 Transcription and coding

Transcription was completed using CLAN software. Noun coding was based on CHAT transcription principles of the CHILDES system (MacWhinney, 2000). An additional tier was added to the system to accommodate Lithuanian noun morphology and allow easy comparison between the target and produced forms. The following template was used:

q:target case:target number:target declension:noun stem:produced case:produced number:produced declension:diminutive indicator (if present).

For example:

q:n:s:d11:stal:g:s:d11

The first part of the example above indicates that the target form was a noun (q:) in nominative (n:) singular (s:) form belonging to the 1.1 declension (d11:) and had the stem *stal* (stal:). The case + number + declension information indicates that the target ending was *-as*, meaning the target noun was *stalas* (= table SNG:NOM). The second part of the code (after "stal:") indicates what the speaker actually said. The only difference in the second part of the code compared to the first part is that the case marker changed from 'n:' to 'g:', indicating that the speaker used the genitive instead of the nominative case. This means that the utterance was **stalo* and was classed as a case error. The lack of the *:dim* marker at the end of the code indicated that the utterance was a simplex form. *q* was used as a noun indicator, as it is not a letter used in the Lithuanian alphabet.

4.3.2 Results

4.3.2.1 Mother's data overview

During the recording sessions, the mother used a total of 1778 noun tokens and 882 unique forms (548 different stems). As a number of previous spontaneous speech studies have shown the importance of considering the caretaker's speech when analysing child language (e.g., Aguagdo-Orea & Pine, 2015; Krajewski et al., 2012; Rubino & Pine 1998), a detailed overview of the mother's use of nouns is provided below.

4.3.2.1.1 Number

As expected, singular forms were used more frequently than plural forms (Table 15). The ratio of singular to plural tokens is very similar to the mother's usage in the Savickienė and Dressler's (2003) study at 2;5 – 79% SNG, 21% PLR.

Table 15

The distribution of singular and plural forms in mother's speech

Number	Tokens	Tokens (%)	Unique forms	Unique forms (%)
Singular	1453	81.72	655	74.26
Plural	325	18.28	227	25.74

4.3.2.1.2 Case

As outlined in Table 16, nominative, accusative and genitive cases appeared the most frequently in the mother's speech, making up 74.75% of noun tokens. Somewhat unexpectedly, the mother's use of vocatives was relatively frequent compared to adult-to-adult data (5.49%; Rimkutė, Kazlauskienė & Raškinis, 2011), as well as the data in the Savickienė and Dressler's (2003) study – 16.31% compared to 9.0% at 2;5. The high occurrence rate is likely to be due to frequent and various ways the mother addressed the daughter, for example, *Kamile* (= Kamilė VOC), *Kamilyte* (= Kamilė VOC:DIM), *beždžioniuke* (= monkey VOC:DIM).

Table 16

The distribution of noun cases in mother's speech

Case	Tokens	Tokens (%)	Unique forms	Unique forms (%)
NOM	553	31.10	270	32.57
GEN	293	16.48	175	21.11
DAT	44	2.47	23	2.77
ACC	483	27.17	242	29.19
INST	64	3.60	41	4.95
LOC	51	2.87	23	2.77
VOC	290	16.31	55	6.63

4.3.2.1.3 Case by number

When case usage is broken down by number (Table 17), the pattern remains largely the same – nominative, accusative and genitive were the most frequent cases; singular forms were more frequent than plurals. The exception was singular vocatives – they make up almost a fifth of the mother's singular noun forms. As discussed previously, the unexpectedly high number of vocative forms was due to the mother repeatedly calling the child by different pet names. Aside from the singular vocative, the distribution of cases was similar to the case distribution in the Savickienė and Dressler's (2003) corpus.

Table 17

The distribution of noun cases by number in mother's speech.

Number	SNG				PLR			
Case	Tokens	Tokens (%)	Unique forms	Unique forms (%)	Tokens	Tokens (%)	Unique forms	Unique forms (%)
NOM	457	31.45	226	34.50	96	29.54	67	29.52
GEN	192	13.21	112	17.10	101	31.08	75	33.04
DAT	41	2.82	20	3.05	3	0.92	3	1.32
ACC	371	25.53	190	29.01	112	34.46	70	30.84
INST	52	3.58	30	4.58	12	3.69	11	4.85
LOC	50	3.44	22	3.36	1	0.31	1	0.44
VOC	290	19.96	55	8.40	0	0.00	0	0.00

4.3.2.1.4 Declension

The most frequent masculine declensions were 1.1 (*-as*) and 1.2 (*-is*), making up 43.25% of the noun tokens. The two most frequent feminine declensions 2.1 (*-a*) and 2.2 (*-ė*) made up a further 49.15% of the noun tokens. The other declensions made up only 7.59% of the noun tokens; however, even the least frequent declension was used 15 times. The mother also used some brand names, such as *Kakadu*, which do not belong to any declension (Table 18).

The distribution of declension use is somewhat more skewed towards the more frequent declensions than in adult-to-adult speech data (Rimkutė et al., 2011; see Tables 33 and 34 in Chapter 5 for detailed breakdown). The difference is likely to be due to increased diminutive use in child-directed language (Kamandulytė,

2007; Savickienė, 1998), which tends to regularise declension pattern in Lithuanian (Savickienė et al., 2009).

Table 18

The distribution of noun declensions in mother's speech.

Declension	Tokens	Tokens (%)	Unique forms	Unique forms (%)
1.1	546	30.71	201	35.33
1.2	223	12.54	69	12.13
1.3	43	2.42	17	2.99
2.1	273	15.35	90	15.82
2.2	601	33.8	161	28.30
3.1	39	2.19	9	1.58
4.1	33	1.86	15	2.64
5.1	15	0.84	5	0.88
N/A	5	0.28	2	0.35

Note. The mother used several brand names, such as *Kakadu*, which do not follow any declension.

4.3.2.2 Child's data overview

During the recording period, the child produced 998 noun tokens and 427 unique forms (282 stems). When incorrect responses were removed, 936 tokens and 424 unique forms (276 stems) remained. The following breakdown of the data discusses correct data only.

4.3.2.2.1 Number

The majority of the nouns in the child's speech were singular forms (Table 19). The girl used a similar proportion of singular forms to the mother (83.65% vs 81.72%). The child's data at 2;5 in Savickienė and Dressler's (2003) study show a very similar singular form rate of 82%.

Table 19

The distribution of singular and plural forms in child's speech

Number	Tokens	Tokens (%)	Unique forms	Unique forms (%)
Singular	783	83.65	341	80.42
Plural	153	16.35	83	19.58

4.3.2.2.2 Case

Kamilė's case distribution followed her mother's speech closely, with the nominative, accusative, vocative and genitive cases appearing the most frequently (Table 20). The girl's use of the nominative case (35.79%) was similar to her mother's (31.10%). As in the mother's data, the vocative was somewhat more frequent than expected, which was due to her frequent calls for the mother. Despite the instrumental, dative and locative forms appearing with less than 5% of the noun tokens, each case was used over 10 times.

Table 20

The distribution of noun cases in child's speech

Case	Tokens	Tokens (%)	Unique forms	Unique forms (%)
NOM	335	35.79	164	40.69
GEN	122	13.03	65	16.13
DAT	13	1.39	13	3.23
ACC	281	30.02	123	30.52
INST	19	2.03	18	4.47
LOC	11	1.18	8	1.99
VOC	155	16.56	12	2.98

4.3.2.2.3 Case by number

The case pattern across the two different numbers generally remains the same, with two exceptions. Firstly, singular vocatives made up almost a fifth of the girl's singular forms, but none were used in the plural form. The difference was caused by the girl frequently addressing her mother. Secondly, the genitive made up 9.96% of the singular forms, but it made up 28.76% of the plural forms, which is also seen in the mother's speech. The high rates of the genitive may be due to frequent *What do you want (to eat)?/ What would you like (to eat)?* contexts, as the responses often required a plural form response, such as *čipsų* (= crisp PLR:GEN) or *uogų* (= berry PLR:GEN). Aside from plural vocative, all cases were used at least once in both number forms (Tables 21 and 22). The data are broadly similar to that seen in Savickienė and Dressler (2003).

Table 21

The distribution of noun cases (singular forms) in child's speech

Case	Tokens	Tokens (%)	Unique forms	Unique forms (%)
NOM	279	35.63	140	41.06
GEN	78	9.96	51	14.96
DAT	12	1.53	12	3.52
ACC	236	30.14	106	31.09
INST	16	2.04	15	4.40
LOC	7	0.89	5	1.47
VOC	155	19.80	12	3.52

Table 22

The distribution of noun cases (plural forms) in child's speech

Case	Tokens	Tokens (%)	Unique forms	Unique forms (%)
NOM	56	36.60	30	35.71
GEN	44	28.76	19	22.62
DAT	1	0.65	1	1.19
ACC	45	29.41	26	30.95
INST	3	1.96	4	4.76
LOC	4	2.61	4	4.76
VOC	0	0.00	0	0.00

4.3.2.2.4 Declension

Kamilė's use of declensions also closely mirrored mother's speech – the most frequent masculine declensions 1.1 and 1.2 made up 46.15% compared to 43.25% in the mother's data; the most frequent feminine declensions added up to 48.08% of declensions, which was only slightly lower than the 49.15% in the mother's data. The only noticeable difference between the girl's and the mother's use of declensions is the more equal use of 2.1 and 2.2 declensions in the daughter's speech (24.15% and 23.93% respectively) compared to the mother's data (15.35% and 33.80% respectively). The difference is in part due to the girl frequently calling out for the mother (*mama!* [= mum VOC]), which uses the 2.1 declension (Table 23).

Table 23

The distribution of noun declensions in child's speech

Dec	Tokens	Token (%)	Unique forms	Unique forms (%)
1.1	309	33.01	103	36.14
1.2	123	13.14	35	12.28
1.3	24	2.56	4	1.40
2.1	226	24.15	47	16.49
2.2	224	23.93	85	29.82
3.1	10	1.07	3	1.05
4.1	13	1.39	5	1.75
5.1	7	0.75	3	1.05

4.3.2.3 Speech data overview summary

In line with data reported in Savickienė and Dressler (2003), the mother and the child show very similar noun use patterns to each other. Singular forms were markedly more frequent than plural forms; nominative, accusative and genitive were the most frequent cases in both number forms; over 90% of the nouns used belonged to either 1.1, 1.2, 2.1 or 2.2 declension. The distribution also follows a similar pattern to Lithuanian adult speech data (discussed in Chapter 5), only the differences between higher and lower frequency contexts were more pronounced in the mother – child speech. The singular vocative was somewhat more frequent than in previous data, but both the mother and the child used it at very similar rates. However, the explanation of why the rates are similar are different under the different acquisition accounts. According to the constructivist approach, the child is learning directly from the input and therefore copying the mother's speech patterns (e.g., Braine, 1963). According to the generativist approach, the similarity is likely due to both the mother and the child demonstrating Zipf's Law effects (according to which speech is dominated by a small number of frequent words, such as *of, and, that* in English [Yang, 2013]). To distinguish between these two possibilities, productivity and error analyses were conducted.

4.3.2.4 Productivity analysis

Following the procedure[4] of Pine and Aguado-Orea (2015), the mother's and the daughter's productivity with nouns was compared. The aim of the analysis was to test the predictions of the two opposing approaches – generativist and constructivist. According to the generativist theories, children show early inflectional knowledge; once a child learns a language-specific inflection, he or she should be able to use it with ease in future contexts. Constructivist approach argues the opposite – children are expected to show only partial productivity. The young speaker is likely to begin with rote-learned word forms and phrases and then gradually build slot-and-frame templates which can be then used to insert new lexical items. The more frequently the child encounters a particular template, the more readily he or she is likely to learn it. Furthermore, when the child makes a mistake, they are more likely to use a more frequent target form erroneously.

The productivity analysis outlined below provides an additional layer of interpretation compared to traditional overall error rate analyses (e.g., Babyonyshev, 1993; Harris & Wexler, 1996; Hoekstra & Hyams, 1998), by controlling for a number of factors which might affect calculations of child's knowledge of different inflections: vocabulary range, sample size and knowledge of a particular inflection. As it was assumed that the mother would produce a higher number of lemmas, vocabulary range was controlled by only including noun stems which were used by both the mother and the child. This was done twice: first, all matching stems were used, while the second vocabulary control only included stems which appeared at least twice, to reduce the possibility that the child was just repeating a noun that the mother uttered once. Sample size was controlled by further reducing the sample to only include noun stems which were used by both the mother and the child and then randomly deleting produced nouns from the larger sample until both samples contained the same number of tokens. Finally, inflectional knowledge was controlled by limiting the analysis to the period after the child had produced all of the tested inflections.

[4] The terminology used in this section also closely follows the terminology used in Aguado-Orea & Pine (2015).

Productivity was assessed by calculating the number of different, correctly produced inflections per noun used by the girl and comparing it with the number of different inflections per noun in matched samples of the mother's speech using paired-sample t-tests. The results of the possible level of productivity ranged from 1 inflection per noun to the maximum of 14 (7 cases x 2 numbers) inflections per noun.

4.3.2.4.1 Uncontrolled samples

When the mother's and the child's speech was compared without any controls, the analysis showed that the mother produced almost twice as many nouns as the child. The average number of inflections used per noun was relatively small for both speakers. Surprisingly, the child used slightly more inflections on average than the adult with singular forms (1.46 and 1.44 respectively), but the pattern was reversed when both plural and singular forms were compared (1.54 for the child and 1.61 for the mother). However, as the mother used roughly twice as many nouns as the child, the differences may be simply due to the child using a relatively small number of tokens she knows well in a few cases repeatedly. The number of nouns used in one form only was also relatively high, with nearly a half of the nouns used by the child occurring in one form only (44.87% of singular forms and 42.92% of singular and plural forms). A detailed breakdown of the uncontrolled noun use comparison can be found in Table 24.

4.3.2.4.2 Controlled for vocabulary range (all lemmas)

The first analysis compared inflection use for each noun based on lemmas found in both the child's and the mother's speech. For example, the stem *kepur-* (= hat) appeared in the child's speech twice, both in the plural nominative form, whereas the mother used the noun four times – three times in its singular nominative form and once as a singular genitive. The average number of inflections per noun would be 1.00 for the child and 2.00 for the mother, suggesting that the mother was more flexible in her use of inflections for this particular noun.

When all nouns were analysed in this manner, the analysis showed that the mother used more tokens compared to the child. A paired-sample t-test revealed a significant difference between the mother's (M = 1.81, ±SD = 1.02) and the child's

(M = 1.52, ±SD = 0.83) singular noun inflection productivity levels (t(152) = -3.51, p = .001). Furthermore, a paired-sample t-test revealed a significant difference between the mother's (M = 2.16, ±SD = 1.31) and the child's (M = 1.62, ±SD = 0.95) singular and plural noun inflection productivity levels (t(182) = -5.49, p < .001), suggesting that the mother was significantly more productive in noun inflection use than the child. A detailed breakdown of the matched lemma noun use comparison can be found in Table 24.

4.3.2.4.3 Controlled for vocabulary range (two or more lemmas)

When the data were reduced to only include noun stems which were used at least twice in both the child and the adult (93 stems), the average number of inflections used by the child was 1.83 for singular forms and 1.94 for singular and plural forms. The average number of inflections used by the mother was 2.21 for singular forms and 2.52 for singular and plural forms. One inflection per noun occurred in 22.54% of singular forms and 18.18% of singular and plural forms in the child's speech and 13.87% of singular forms and 9.57% of singular and plural forms in the mother's speech. The low average number of inflections used by the child may be taken as evidence for the constructivist claim that children's use of grammar is less flexible than adults' use of grammar. However, as the adult's use of inflections was not considerably different, the idea that that both the adult's and the child's use of nouns follows Zipf's law cannot be discounted. Such results highlight the importance of analysing the caretakers' speech along the child's speech when analysing naturalistic data.

Nonetheless, a paired-sample t-test revealed a significant difference between the mother's (M = 2.21, ±SD = 1.12) and the child's (M = 1.83, ±SD = 0.89) singular noun inflection productivity levels (t(77) = -3.43, p < .001). Furthermore, a paired-sample t-test revealed a significant difference between the mother's (M = 2.52, ±SD = 4.92) and the child's (M = 1.94, ±SD = 4.07) singular and plural noun inflection productivity levels (t(99) = -3.56, p < .001). However, the differences may be due to sample size, as the mother produced markedly more nouns than the child (Table 24).

4.3.2.4.4 Controlled for vocabulary range and sample size

The next step in the analysis added a further control of sample size by randomly sampling the same number of tokens for each lemma. For example, the mother produced the stem *dėd-* (= uncle) twice, both times using the accusative case, while the child produced the same stem four times with two different cases (2 x NOM; 2 x ACC). The number of tokens from the smaller sample (two) were randomly sampled from the larger sample three times. The first round of sampling produced [NOM ACC]; the second round produced [ACC NOM] and the third round produced [ACC NOM]. The average number of cases for the stem used by the mother was 1 and the average number of declensions used by the child was 2.

The overall average number of inflections used by the child was 1.65 for singular forms and 1.77 for singular and plural forms. The average number of inflections used by the mother was 1.76 for singular forms and 1.95 for singular and plural forms. One inflection per noun occurred in 40.00% of singular forms and 34.41% of singular and plural forms in the child's speech and 31.25% of singular forms and 23.66% of singular and plural forms in the mother's speech (Table 24). The higher average number of inflections and the lower proportion of nouns occurring in only one form in the mother's speech suggests her noun use was more flexible than the child's.

A paired-sample t-test revealed no significant difference between the mother's (M = 1.76, ±SD = 0.88) and the child's (M = 1.65, ±SD = 0.79) singular noun inflection productivity levels ($t(79) = -1.21$, $p = .23$). However, a paired-sample t-test revealed a significant difference between the mother's (M = 1.95, ±SD = 4.92) and the child's (M = 1.77, ±SD = 4.07) singular and plural noun inflection productivity levels ($t(92) = -2.10$, $p = .038$). While the overall analysis supports the constructivist claim that adults' and children's grammars are different, the singular form analysis cannot support this idea. Furthermore, neither analysis can reject the generativist explanation that any significant differences may be due to the child not yet having learned the relevant morpheme.

4.3.2.4.5 Controlled for vocabulary range, sample size and inflectional knowledge

Finally, the inflectional knowledge control was implemented to the sample, analysing data only from the point at which the child has used the relevant form correctly twice (following Aguado-Orea and Pine's 2015 methodology). The average number of inflections used by the child was 1.20 for singular forms and 1.31 for singular and plural forms. The average number of inflections used by the mother was 1.21 for singular forms and 1.36 for singular and plural forms. One inflection per noun occurred in 37.50% of singular forms and 38.46% of singular and plural forms in the child's speech and 20.00% of singular forms and 16.48% of singular and plural forms in the mother's speech. Once again, the higher average number of inflections and the lower proportion of nouns occurring in only one form in the mother's speech suggests her noun use is more flexible than the child's.

However, a paired-sample t-test revealed no significant difference between the mother's (M = 1.21, ±SD = 0.52) and the child's (M = 1.20, ±SD = 0.53) singular noun inflection productivity levels ($t(68) = -0.10$, $p = .93$). A paired-sample t-test revealed no significant difference between the mother's (M = 1.36, ±SD = 0.66) and the child's (M = 1.31, ±SD = 0.57) singular and plural noun inflection productivity levels ($t(82) = -0.69$, $p = .49$). The lack of significant difference between the mother's and the child's use of inflections means that the constructivist claim that adults' and children's use of grammar is essentially different cannot be supported. However, as the number of tokens used in the analysis reduced substantially during the control process, the lack of significant difference may be due to the data being too scarce to detect a difference (Table 24).

Table 24

The mother's and the child's noun inflection productivity

		SNG				SNG+PLR			
		Inflections/ noun	Tokens	Unique forms	One form (%)	Inflections/ noun	Tokens	Unique forms	One form (%)
Uncontrolled	Child	1.46	783	341	153 (44.87)	1.54	936	424	182 (42.92)
	Mother	1.44	1453	655	320 (48.85)	1.61	1778	882	360 (40.82)
Matched lemmas	Child	1.52	618	233	94 (40.34)	1.62	727	297	109 (36.70)
	Mother	1.81	751	277	77 (27.80)	2.16	948	396	72 (18.18)
Controlled for vocabulary range	Child	1.83	437	142	32 (22.54)	1.94	502	176	32 (18.18)
	Mother	2.21	617	173	24 (13.87)	2.52	722	230	22 (9.57)
Controlled for vocabulary range and sample size	Child	1.65	349	80	32 (40.00)	1.77	403	93	32 (34.41)
	Mother	1.76	349	80	25 (31.25)	1.95	403	93	22 (23.66)
Controlled for vocabulary range, sample size and inflectional knowledge	Child	1.20	220	78	30 (37.50)	1.31	297	91	35 (38.46)
	Mother	1.21	220	78	16 (20.00)	1.36	297	91	15 (16.48)

4.3.2.5 Error analysis

The overall error rate was 6.21%, which is in line with previous naturalistic studies (e.g., Hoekstra & Hyams, 1998; Marcus et al., 1992; Poeppel & Wexler, 1993; the list of errors is provided in Tables 27 in Sections 4.3.2.6). However, when the error data were split by number, case and declension, large differences were detected for different contexts (Table 25).

Table 25

Overall error rate

	Tokens	Unique forms
Total nouns	998	427
Number of errors	62	39
Errors (%)	6.21	9.13

4.3.2.5.1 Case errors

Most case errors were made with medium-frequency genitive and instrumental cases (Table 26). Fewer errors were produced with more frequent accusative and nominative errors (in fact, none with the nominative; however, this might be because many of the one-word utterances including a noun were in the nominative form) and low frequency dative, locative and vocative errors. This might be because the child was already productive with the high frequency cases but was still relying on rote-learnt forms for the low-frequency cases. The evidence for this claim comes from the low number of tokens for these cases. Meanwhile, the relatively high error rate for the medium frequency cases may be due to the child still relying on some rote-learned phrases but not yet having grasped the system for the non-rote learned forms.

Most erroneously inflected stems were produced only once throughout the recording period (e.g., the stem *kamuol-* [= ball] had a single incorrect production). Out of the stems which were produced incorrectly more than once, most occurred only in one context and always led to the same incorrect case (e.g., the stem *tėt-* [= dad] was inflected erroneously six times and the error was always using the nominative ending instead of the genitive). However, a small number of stems were used incorrectly in an accusative and a genitive context: *lap-* (= leaf/page), *mėsyt-* (= meat DIM) and *led-* (= ice/icream). The accusative contexts always led to a genitive

production (with the exception of *lapą* [= leaf/page SNG ACC] → **lapas* [= leaf/page SNG NOM]) and the genitive contexts always led to an accusative production. The possible reasons for the different types of erroneous productions are discussed in more detail in the defaulting analysis section.

Table 26

Error rate by case

Errors	Total nouns		Number of errors		Errors (%)	
Case	Tokens	Unique forms	Tokens	Unique forms	Tokens	Unique forms
NOM	347	166	2	2	0.58	1.20
GEN	157	71	30	15	19.11	21.13
DAT	14	13	0	0	0.00	0.00
ACC	293	126	11	11	3.75	8.73
INST	21	18	2	2	9.52	11.11
LOC	11	8	0	0	0.00	0.00
VOC	155	12	0	0	0.00	0.00

4.3.2.5.2 Number errors

As expected, the child made more errors with the plural targets. A few singular target errors were produced with nouns that are often used in the plural (e.g., *pietūs* [= lunch]; Table 27).

Table 27

Error rate by number

	Total nouns		Number of errors		Errors (%)	
	Tokens	Unique forms	Tokens	Unique forms	Tokens	Unique forms
Singular	824	239	41	31	4.98	12.97
Plural	174	69	21	11	12.07	15.94

4.3.2.5.3 Declension errors

As expected, most of the errors were with 4.1 and 5.1 declensions, which are the least frequent cases. There were also a couple of errors in the 1.2 declension, in which the child applied the higher frequency 1.1 declension ending (Table 28).

Table 28

Error rate by declension

Dec	Total nouns		Number of errors		Errors (%)	
	Tokens	Unique forms	Tokens	Unique forms	Tokens	Unique forms
1.1	332	105	1	1	0.30	0.95
1.2	142	37	2	2	1.41	5.41
1.3	25	4	0	0	0.00	0.00
2.1	231	48	1	1	0.43	2.08
2.2	234	85	0	0	0.00	0.00
3.1	10	3	0	0	0.00	0.00
4.1	16	5	3	1	18.75	20.00
5.1	8	3	1	1	12.50	33.33

4.3.2.6 Defaulting analysis

As discussed in Chapter 2, analysing the data beyond correct/incorrect response rates can provide additional detail on children's inflection development patterns, as well as evidence for and against different language acquisition accounts. According to the constructivist approach, the child is more likely to produce errors with low frequency context words and replace the target surface form with a high frequency surface form (e.g., use 1sng verb form instead of 3plr form). The generativist approach, on the other hand, minimises the role of frequency in production. Detailed and concrete predictions of what types of errors a child is likely to produce when using a complex noun morphology system, such as Lithuanian, in accordance with generativist approach have not been produced. However, Pinker's (1994) dual-route model suggests that if the child cannot directly retrieve the necessary form, he or she is likely to apply one default inflection (the *rules* route of the model). Therefore, any finding of the child's tendency to default to one particular inflection above all others could be taken as evidence for the dual-route model.

Table 29 presents case errors produced by the child. The left side of the table indicates the target inflection based on the context, while the right side indicated the actual produced form.

Table 29

Case errors produced by the child

Error count	Target				Production			
	Case	Num	Dec	Form	Case	Num	Dec	Form
1	ACC	SNG	2.2	braškę (= strawberry)	NOM	SNG	2.2	braškė
1	ACC	SNG	1.3	kamuolį (= ball)	INST	SNG	1.3	kamuoliu
1	ACC	SNG	2.2	kortelę (= card)	NOM	SNG	2.2	kortelė
1	ACC	SNG	1.1	lapą (= leaf/page)	NOM	SNG	1.1	lapas
1	ACC	SNG	2.2	mėsytę (= meat DIM)	GEN	SNG	2.2	mėsytėmis
1	ACC	SNG	1.1	namą (= house)	NOM	SNG	1.1	namas
1	ACC	SNG	1.2	tiūtę (≈ pacifier)	NOM	SNG	1.2	tiūtė
1	ACC	PLR	1.2	dribsnius (= cereal)	GEN	PLR	1.2	dribsnių
1	ACC	PLR	1.1	ledus (= ice/ice cream)	GEN	PLR	1.1	ledų
1	ACC	PLR	2.2	mašinytę (= car DIM)	NOM	PLR	2.2	mašinytės
1	ACC	PLR	2.1	kojinytę (= sock DIM)	LOC	PLR	2.1	kojinytėse
6	GEN	SNG	1.2	tėčio (= dad)	NOM	SNG	1.2	tėtis
2	GEN	SNG	2.2	bobutės (= granny)	NOM	SNG	2.2	bobutė
2	GEN	SNG	1.1	čipso (= crisp)	ACC	SNG	1.1	čipsą
1	GEN	SNG	2.1	lazdos (= stick)	ACC	SNG	2.1	lazdą
1	GEN	SNG	1.1	lapo (= leaf/page)	ACC	SNG	1.1	lapą
1	GEN	SNG	2.2	lėlės (= doll)	NOM	SNG	2.2	lėlė
1	GEN	SNG	2.1	mėsos (= meat)	ACC	SNG	2.1	mėsą
1	GEN	SNG	2.2	mėsytės (= meat DIM)	NOM	SNG	2.2	mėsytė
1	GEN	SNG	2.2	tapkės (= slipper)	NOM	SNG	2.2	tapkė
1	GEN	SNG	1.1	teptuko (= paintbrush)	ACC	SNG	1.1	teptuką
3	GEN	SNG	1.1	ledo (= ice/ice cream)	ACC	SNG	1.1	ledą
1	GEN	SNG	1.2	megztinio (= jumper)	ACC	SNG	1.2	megztinį
1	GEN	SNG	1.2	krepšinio (= basketball)	ACC	SNG	1.2	krepšinį
1	GEN	SNG	1.2	megztučio (= jumper DIM)	ACC	SNG	1.2	megztutį
4	GEN	PLR	1.1	balionų (= balloon)	ACC	PLR	1.1	balionus
1	GEN	PLR	1.1	čipsų (= crisp)	NOM	PLR	1.1	čipsai
1	GEN	PLR	2.2	lėlių (= doll)	ACC	PLR	2.2	lėles
1	GEN	PLR	1.1	ledų (= ice/ice cream)	ACC	PLR	1.1	ledus
1	INST	SNG	1.1	pienu (= milk)	ACC	SNG	1.1	pieną
1	INST	PLR	2.1	rankomis (= hand)	NOM	PLR	2.1	rankos
1	NOM	SNG	1.1	poponautas (type of toy)	GEN	SNG	1.1	poponauto
1	NOM	SNG	1.1	šaukštas (= spoon)	INST	SNG	1.1	šaukštu

4.3.2.6.1 Accusative – genitive swap

A large number of errors were based on similar formulaic conversations about food. These included *mėsytė* [= meat DIM], *dribsniai* [= cereal], *ledai* [= ice cream], *čipsai* [= crisps], *mėsa* [= meat]. For example, the mother would interchangeably use two similar types of sentences to ask the child what she would like to eat:

- *Ką nori valgyti?* (= What do you want to eat*?*)
- *Ko nori?* (= What do you want*?*)

Both of these sentences can be used to ask the daughter what she wants to eat, and despite their structural similarity, the "*wh-*" question is different, and requires a different case noun to respond. In the first instance, an accusative is used, whereas a genitive is required for the second question. The child's tendency to occasionally erroneously swap case when answering one of these questions can be seen in the high number of food words in the ACC-GEN swapping error list.

4.3.2.6.2 Defaulting to nominative

The second most common type of error seen in the child's speech is the defaulting to the nominative form of the word when another case was needed. This is in line with previous cross-linguistic research (e.g., Babyonyshev, 1993; Dabašinskienė & Cubajevaitė, 2009) and not unexpected, as the nominative form is usually the most frequent form of the noun. As seen in Table 27, this was also the case in the child's speech. Additionally, one of the most common examples of defaulting to the nominative form in the child's speech was the use of **tėt-is* (= dad SNG:NOM) instead of *tėč-io* (= dad SNG:GEN), which may be due to the child avoiding a stem change.

4.3.2.6.3 Number substitution

Number substitution errors are listed in Table 30. The most frequent number error was using the singular form *tree* instead of the plural, possibly due to the stem change required in the plural form (*med-is* → *medž-iai* = tree SNG → tree PLR). The next most frequent form was with the word *pietūs* (= lunch). Unusually, it is used in its plural form in Lithuanian, and it belongs to a low frequency declension, making the slot-and-frame construction particularly difficult.

Table 30

Number substitution errors

Error count	Target				Production			
	Case	Number	Dec	Form	Case	Number	Dec	Form
1	NOM	SNG	1.1	rankinuk**as** (= handbag)	NOM	PLR	1.1	rankinuk**ai**
1	DAT	SNG	1.1	bat**ui** (= shoe)	DAT	PLR	1.1	bat**ams**
1	GEN	SNG	1.1	puoduk**ą** (= cup DIM)	GEN	PLR	1.1	puoduk**ų**
3	GEN	PLR	4.1	piet**ų** (= lunch)	GEN	SNG	2.1	piet**os**
4	NOM	PLR	1.2	medž**iai** (= tree)	NOM	SNG	1.2	med**is**
2	NOM	PLR	1.2	gaidel**iai** (= rooster DIM)	NOM	SNG	1.2	gaidel**is**

4.3.2.6.4 Declension substitution

Declension substitution was a relatively uncommon type of error. As discussed above, *pietūs* (= lunch), proved difficult for the child, who produced the word incorrectly three times. The infrequent *-uo* ending in *vanduo* (= water) was substituted with a frequent *–as* ending. Interestingly, four out of eight errors involved the medium frequency 1.2 declension, which included one error when the child used a less frequent declension (*peilis* [= knife]; Table 31). Perhaps the error was due to the similarity of the produced form (**peilus*) to the existing PLR ACC form of the word (*peilius*).

Table 31

Declension substitution errors

Error count	Target				Production			
	Case	Num	Dec	Form	Case	Num	Dec	Form
1	NOM	SNG	1.1	šokolad**as** (= chocolate)	NOM	SNG	1.2	šokolad**is**
1	GEN	SNG	1.2	sausain**io** (= biscuit)	GEN	SNG	2.2	sausain**ės**
1	NOM	SNG	1.2	peil**is** (= knife)	NOM	SNG	4.1	peil**us**
1	ACC	SNG	2.1	bal**ą** (= puddle)	ACC	SNG	1.2	bal**į**
1	NOM	SNG	5.1	vand**uo** (= water)	NOM	SNG	1.1	vand**as**
3	GEN	PLR	4.1	piet**ų** (= lunch)	GEN	SNG	2.1	piet**os**

4.3.3 Conclusions

The analysis of the mother's and the child's naturalistic speech data has revealed that the child's speech mirrors mother's use of noun inflection very closely. The pattern is also similar to adult speech data, only the differences between the high and low frequency contexts is more pronounced in the mother's and especially the child's

speech. On the face of it, these data suggest that the child's speech reflects input data. However, the possibility that the similarities are due not to input effects, but simply to the fact that both are speaking the same language cannot be ruled out. In order to properly contrast constructivist and generativist claims regarding productivity a controlled productivity analysis is required.

The productivity analysis showed that when the sample included matched lemmas or was controlled for vocabulary range, the mother was significantly more productive with use of inflections than the daughter. On the face of it, this finding contradicts the generativist view that as children's grammar is no different from adult grammar, there should be no difference in their inflection use. However, once the analysed samples were controlled for sample size and inflectional knowledge, the differences disappeared.

One possibility is that the generativist account is correct, and that children really do show full adult-like productivity. Another possibility, however, is that the controlled analysis was underpowered, since the controls – particularly the requirement of overlap between nouns in the child's and adult's speech – markedly reduced the amount of available data. Consistent with this view, in the controlled analysis, the number of adult inflections per noun was reduced to childlike levels, rather than the number of child inflections per noun being boosted to adult-like levels. In short, these data highlight the dangers of drawing strong conclusions about productivity on the basis of naturalistic data which are often either too uncontrolled or – when suitably controlled – too sparse. One solution to this problem involves conducting elicited production studies, with both familiar nouns and – crucially – novel nouns that constitute a direct test of productivity (e.g., Berko, 1958). Studies of this type are presented in the two following chapters.

In the meantime, the error data showed that although the overall error rate was low, and similar to that observed in previous spontaneous speech studies, a more detailed breakdown revealed 'pockets' of much higher error rates, which cannot be easily explained by generativist accounts. Most case errors were with the medium-frequency cases, suggesting that the child was already productive with high frequency cases and was possibly still using a large number of rote-learned utterances for the low frequency cases. It is possible that the medium frequency

cases were a mixture of still rote-learned forms and not-yet-fully-productive non-rote-learned forms.

Finally, the erroneous form used by the child tended to be high frequency forms, providing some evidence for the notion of frequency-based competition between similar forms in memory. However, she showed no evidence of using a single ‘default’ form used as a substitute, challenging the generativist words-and-rule claim that errors are produced by a default rule, rather than frequency-based competition in memory.

5. Familiar noun elicitation study

5.1 Introduction

A common criticism of naturalistic language studies testing morphological acquisition theories, including the study reported in Chapter 4, is the lack of low frequency contexts and possible skewing of findings based on only a small number of low frequency utterances. For example, the three least frequent cases used by the child in the previous chapter made up only 4% of the tokens used. Similarly, Aguado-Orea and Pine (2015) reported that a 3plr error rate of 46% for one of the two children studied (Lucia) was based on just 28 3plr contexts. A 2plr error rate of 33% for the other child (Juan) was based on just three contexts, with Lucia producing no suitable contexts at all. Therefore, conclusions based on low frequency areas of the inflectional systems, where arguably generativist and constructivist theories could in principle be distinguished most easily, are usually based on a relatively small number of utterances. Additionally, due to practical considerations, spontaneous speech studies often take place in a home environment and around the same activities, such as mealtimes. Activity repetition can lead to frequent repetition of the same utterances, which makes it difficult to determine whether the child is demonstrating the ability to use certain forms productively, or whether they are repeating rote-learned phrases.

An obvious way to address this problem is to conduct elicited production studies, in which the target context productions can be controlled. As discussed in Chapters 1 and 2, studies investigating morphological development have often focused on verbs and/or languages with limited inflection (e.g., the past tense *–ed* debate in English; Albright & Hayes, 2003; Ambridge, 2010; Marcus et al., 1992; Kuczaj; 1977; Marchman, 1997; Marchman, et al., 1999; Maslen et al., 2004). Recent years have seen an increase in examining complex morphological systems in languages such as Russian and Polish. However, the studies tended to focus on either naturalistic data (e.g., Babyonyshev, 1993; Krajewski et al., 2012); use novel nouns (e.g., Dąbrowska & Szczerbiński , 2006; Dąbrowska & Tomasello, 2008; Krajewski et al., 2011); and/or focus on the role of diminutives (e.g., Kempe et al., 2009; Dąbrowska, 2005).

Furthermore, none of the studies discussed above have attempted to test the whole inflectional paradigm, potentially missing trends in correct and erroneous response production, which could further inform inflectional development in children. Such inclusive analysis is particularly important following the results of the naturalistic language study in Chapter 4. Data showed that most errors were made with medium-frequency genitive and instrumental cases and the error rates of the most and least frequent cases were very similar. Therefore, deciding to focus on high and low frequency targets would have led to the conclusions that a) case data displayed no frequency effects and b) the error rate was very low across the cases. Similar 'pockets of error' have been found in other naturalistic (e.g., Aguado-Orea & Pine, 2015) and elicited production (e.g., Dąbrowska & Szczerbiński, 2006; Räsänen et al., 2016) studies, albeit in more predicable areas of declensional paradigms.

The study in this chapter therefore aims to address this gap in the literature by using familiar nouns and studying the whole noun inflectional paradigm, including all declension, number and case combinations, with the exception of the nominative and the vocative cases. As Lithuanian does not use uninflected nouns, the nominative was used as the stimulus form; the vocative case was not tested because inanimate objects being used as stimulus items.

5.2 Previous studies

As discussed in Chapter 1, studies supporting generativist explanations of morphological development have been mostly based on spontaneous speech. Elicited production experiments, on the other hand, have largely supported constructivist productions, although results challenging different constructivist accounts have also been found.

English past tense inflection was investigated by Marchman (1997). Children between three and 15 years old were asked to describe a picture using past tense after the experimenter had described the action in the present tense (e.g., *This boy is walking. He walks every day. Yesterday, he...*). The overall error rate was 20%, which was markedly higher than that observed in naturalistic speech findings, and what would be predicted by generativist theories. Furthermore, the age range tested was notably wider than many other studies in morphological development, which further challenges nativist ideas of full early productivity. Error analysis revealed

that alongside low token frequency, having high rates of phonological enemies (e.g., *know* → *knew* but *mow* → *mowed*) predicted higher error rates, indicating the influence of phonological neighbourhoods in inflection production.

A similar picture description task eliciting past tense forms in Icelandic and Norwegian four to eight-year-old children saw correct responses ranging from 51% and 38% in Norwegian and Icelandic, respectively, at age four, to around 90% at age eight. Both token frequency and phonological neighbourhood density were significant predictors, as was phonological coherence (internal consistency denoted by the same/different vowel in the stem in the study; Ragnarsdóttir et al., 1999).

Similarly, Orsolini et al. (1998) found that token frequency was a good predictor of correct past tense forms for Italian five to eight-year-olds. The error rate for the conjugation II verbs with stem change (e.g., *credere* → *credette* [= to believe → he/she believed]; *prendere* → *prese* [= to take → he/she took]) ranged from 76% in the youngest group to 14% in the oldest group; the error rate for the conjugation III verbs with stable roots (e.g., *dormire* → *dormì* [= to sleep → he/she slept]; *sentire* → *sentì* [= to feel → he/she felt]) ranged from 67% in the youngest group to 8% in the oldest group. Within it, verb with higher token frequency were inflected correctly more often than low frequency verbs. The findings again challenge the notion of full early productivity but also highlight that factors beyond frequency are also important.

When past tense inflection was tested with three to six-year-old Finnish speaking children (Kirjavainen et al., 2012), the overall error rate was 22%, similar to Marchman's (1997) study of English. As in previous studies, fewer errors were seen with an increase in token frequency, phonological neighbourhood density and age. When children produced an erroneous response, they were likely to either repeat the stimulus form, produce a present tense form, or use another frequent past tense suffix. In addition, children seemed to struggle with verbs requiring a stem change. Another frequent type of error was described as "not totally correct" (p. 292), such as **lasketti* instead of *lasvitti*.

Another elicited production study in Finnish (Räsänen et al., 2016) tested two to four-year-olds' ability to produce present tense forms. When the overall error rate of 14% was analysed in greater detail, large differences across contexts emerged –

from 0.46% for 3sng forms, which are highly frequent in the input, to 35.83% in 2plr verbs, which are infrequent in the input. Furthermore, the erroneous responses almost always involved replacement by a more frequent form (e.g., 3plr target replaced by 3sng). Both token frequency and phonological neighbourhood density were also significant predictors of correct production.

Dąbrowska and Szczerbiński (2006) tested 2;4 to 4;8-year-olds Polish-speaking children's ability to produce genitive, dative and accusative case-marked noun forms. During a game with various animate objects, the experimenter tried to elicit different forms using sentences such as *We'll give the ball to* _ (to elicit the dative case). The results showed that the correct response rate was around 60% for the youngest group. The four-year-olds showed an almost adult-like performance of around 85%, although a precise figure for adult performance was not stated. However, when the results were analysed in more detail, large differences in production rates were revealed at each age group. For example, even the two-year-olds showed good performance with accusative neuter targets (93%), but the correct response rate dropped to only 6% for dative neuters. The four-year-olds showed ceiling or near-ceiling performance for most of the contexts, except for genitive neuter (65%), dative masculine (83%) and dative neuter (41%). These 'pockets of error' further support the constructivist view of morphological development.

Elicited production studies have consistently found that both token frequency and phonological neighbourhood density are important in correctly inflected verb and noun production, supporting input-based, constructivist accounts. However, none of the studies have attempted to test the full inflectional noun system.

5.3 Current study

Adapting the principles of constructivist accounts to noun morphology acquisition, a child attempting to produce a correctly inflected noun form in Lithuanian (or any language) goes through the following steps. First, the child attempts to retrieve the relevant word form (i.e., a stored form of the target noun with the correct case + number marking) directly from memory. The account assumes that storage is probabilistic: the greater the number of times that the relevant form has been witnessed, the greater the likelihood that it is available for retrieval.

If the first process does not yield an output with sufficient strength the child generates one using phonological analogy. This process involves retrieving a phonologically similar noun (i.e., one from the same declension) in both a suitable source form (e.g., the stem) and the target form with the relevant desired case + number combination, and applying the transformation to the target noun. For example, if the child wants to produce the word *ratas* (= wheel NOM:SNG) in genitive singular form (*rato*) but cannot retrieve this form directly, they may create a phonological analogy using *rūkas* (= fog NOM:SNG) and *rūko* (= fog GEN:SNG), both of which are already stored in the child's memory, by applying the stem change from the known noun to the target noun (Figure 5).

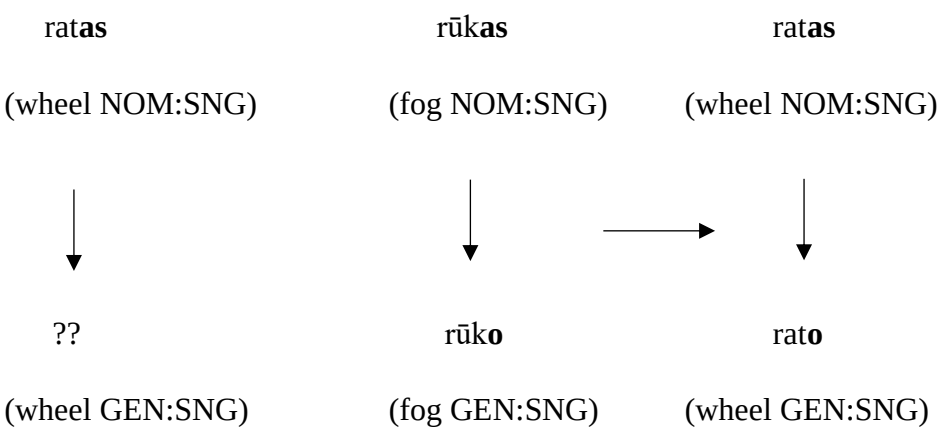


Figure 5. *Phonological analogy forming process.*

Finally, if both (1) direct lexical retrieval and (2) phonological analogy fail to generate a form, then the child will (3) default to a frequent inflection. Often, it is expected to be a more frequent form of the relevant noun stored in memory, resulting in a form with incorrect case and/or number marking. For example, if the child is expected to produce *laiv-ais* [= ship INST:PLR], he or she might produce **laiv-o* [= ship GEN:SNG], a form which is markedly more frequent in the input. However, it is also expected that the children may produce a generally frequent morpheme across the paradigm (see Aguado-Orea & Pine (2015) and Räsänen et al. (2014, 2016), for evidence of this defaulting effect in Spanish, English and Finnish respectively). If the child is lucky, this will yield the correct morpheme (possibly fortuitously, via a homophone); otherwise it will yield an error of case and/or number marking, and/or the application of a morpheme from an inappropriate declension. As with previous steps, frequency plays a part – the child is more likely to pick a frequent case and/or number-marked form than an infrequent one.

Unlike studies of languages such as English, bare stems are not expected to be found in this study, as all grammatical forms of nouns comprise of a stem and an inflected ending. Indeed, bare stem forms have not been recorded in either previous Lithuanian naturalistic or experimental studies or in the naturalistic data discussed in the previous chapter.

The aim of the present study, which elicited familiar nouns across the entire declension, case and number-marking paradigm, was to test the predictions of a constructivist account of the acquisition of inflectional morphology. Two sets of analyses were conducted. First, a broad-brush analysis was used to test the central constructivist prediction that children will make more errors in low frequency contexts (in terms of number, case and declension). Secondly, a more fine-grained analysis was used to test in detail the three-stage process outlined above:

(1) The corpus frequency of the individual target word form (i.e., bearing appropriate case + number marking) is taken as a predictor of the availability of that form for direct lexical retrieval from memory, and hence of the relative likelihood of producing the correct form versus an error.

(2) The number of nouns in the relevant declension class was taken as a measure of phonological neighbourhood density; a predictor of the availability of phonological analogy (or, roughly speaking, of a suitable phonologically-conditioned slot-and-frame pattern), and hence of the relative likelihood of producing the correct form versus an error.

(3) The overall frequency of the target morpheme (regardless of homophony) was taken as a measure of the relative likelihood that while "seeking" for a form that is neither stored nor generable by phonological analogy, the child will produce the correct form versus an error. The assumption here is that children are rarely "seeking" entirely in the dark, but usually have at least some incomplete phonological representation of the target morpheme. Consequently, the greater the input frequency of the target morpheme, the greater its strength in memory, and the greater the likelihood it will be retrieved.

The prediction that, when direct lexical retrieval and phonological analogy fail, children will default to a more frequent form of the relevant noun stored in memory, was tested using a separate analysis of the types of errors that children

produce (which can also be used to investigate any systematicity in children's "seeking" patterns).

Finally, although the study focuses on testing a detailed constructivist account of an inflected morphological system, findings of relatively high error rates (especially in low frequency contexts), statistically significant roles of surface form frequency and phonological neighbourhood density, and defaulting patterns in erroneous responses could also be treated as evidence against generativist accounts that operate on the basis of innate symbolic rule formation.

5.3.1 Method

5.3.1.1 Participants

Eighteen participants, six boys and 12 girls aged 4;0 - 5;5 (*M* = 4;10), were recruited from and tested in nurseries in Kaunas, Lithuania. Written consent was obtained from the parents and the nursery head teacher. All children were normally developing, monolingual, speakers of Lithuanian.

The study was first piloted with three-year-olds, in an attempt to match the age of the participants as closely to the age of the naturalistic study participant as possible. However, while they often succeeded with high frequency target forms, many of the children did not attempt to respond to lower frequency targets. It was then decided that older children would better allow for testing of the predictions set out about low frequency contexts.

5.3.1.2 Design and materials

5.3.1.2.1 Noun stimuli

Nouns selected were two syllables long in the nominative and the majority of other cases, except for several target forms in the locative case and/or 5.1 declension, which require additional suffixes. Words with stems ending in *–d* or *–t,* and therefore requiring stem changes to *–dž* and *–č* respectively, as well as words with the softener *–i-* were excluded (e.g., *kėd-ė* → *kėdž-ių*; chair SNG:NOM → chair PLR:GEN). Although some previous research has found that stem change can act as a significant predictor (e.g., Granlund et al., 2019), meaning that it would, in principle, be interesting to investigate any effect of stem change, a complication here is that *–dž* and *–č* are difficult for children to pronounce. Therefore, any potential effect of stem

change would be confounded by physical factors. Only inanimate objects were used, in order to avoid any semantic gender associations (for some animals, occupations etc., in addition to the 'default' noun form, a masculine/feminine form is used when referring to a particular individual of that gender). Nouns were chosen to be easy to illustrate in still pictures and to span a large frequency range, while all still being familiar to young children.

5.3.1.2.2 Cases and declensions

All cases and declensions were tested, except for the nominative case (used for the experimenter's prompt form) and declensions 3.2 (MASC) and 5.2 (FEM), as these are extremely rare and the relevant nouns did not fulfil the selection criteria. Additionally, the vocative case was excluded, as it is used when addressing someone, predominantly a living person/animal, and hence was unsuitable for use with inanimate objects in this study. The list of real nouns used in this study can be found in Table 31.

5.3.1.2.3 Visual stimuli

One hundred ninety-two stimulus pictures were created. Thirty-two depicted the stimulus object in a neutral context (to be described by the experimenter using the nominative case), in either singular or plural form. The remainder depicted a girl interacting with the same objects in a way designed to elicit the use of different cases (genitive, dative, accusative, instrumental, or locative). A selection of pictures can be seen in Figure 6. In order to allow for a range of noun frequencies, two nouns from each declension were selected; one each towards the lower and upper ends of the frequency range.

5.3.2 Procedure

Children were tested in their nursery over several days, with two sessions taking place each day. Children were tested in a quiet area of their playgroup room. The session began with the experimenter describing the task to the child and then completing a practice run using a non-test noun. The experimenter showed the child a picture of an object and stated its name using the nominative case (*Tai yra…* [= *This is…*]) and asked the child to repeat the noun. Then, the experimenter showed the child another picture of the same object, but with a girl interacting with it in a

certain way. The experimenter began a sentence describing the picture, but always omitted the last word: the name of the object in question. The child was then expected to finish the sentence using the appropriate case-marked form of the relevant noun. The full list of stimulus sentences can be found in Table 32. Due to time considerations, no further testing of individual children's familiarity with stimulus nouns was undertaken.

Nominative form was used as the stimulus case for two main reasons. First, the nominative is the most frequent case in naturalistic speech and is one of the first cases to emerge (see Chapter 4 for in-depth discussion of case usage in naturalistic speech). Therefore, it was assumed that children would be sufficiently familiar with nominative forms by the age of four, especially if they belong to a low frequency declension. Secondly, nominative forms are easy to depict, reducing the cognitive demands of children understanding the stimulus picture. However, it is important to note that changing the stimulus case could also have an effect of the produced case, a was found by Krajewski et al. (2011).

Children's responses were noted by hand and also audio recorded for checking later, and each was rewarded with a sticker. If children did not respond, they were gently encouraged to do so. However, if the child remained reluctant after this second prompt, the experimenter moved onto the next stimulus picture (note that such trials were not scored as incorrect, but instead recorded as missing data). As discussed in Chapter 2, investigating children's inability to repeat or use a word can also provide insight into children's production (Bannard & Matthews, 2008; Matthews & Bannard, 2010), but detailed analyses on non-responses were not conducted in this study.

Because the total number of trials (160) was too great for young children, each child completed 40 trials, selected using a pseudo-randomisation procedure. This procedure ensured that each item appeared an equal number of times across children (or as close as possible, given missing data), and that each child completed 20 singular trials and 20 plural trials.

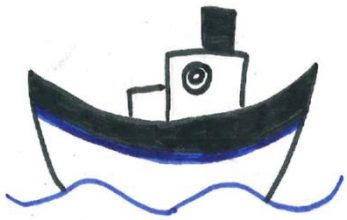
a) 1. Experimenter: Tai yra laivas = *This is a boat SNG:NOM:1.1*	2. Experimenter: Mergaitė yra… = *The girl is on the…* Child: … laive = *boat SNG:LOC:1.1*
	
b) 1. Experimenter: Tai yra pilis = *This is castle SNG:NOM:3.1*	2. Experimenter: Mergaitė žaidžia su… = *The girl is playing with...* Child: … pilimi = *castle SNG:INST:3.1*
	
c) 1. Experimenter: Tai yra knygos = *These are book PLR:NOM:2.1*	2. Experimenter: Mergaitė nemato… = *The girl cannot see the...* Child: … knygų = *book PLR:GEN:2.1*
	

Figure 6. A selection of pictures and accompanying descriptions used in the familiar noun study.

Table 32

Stimulus sentences by case

Case	Stimulus sentence
NOM	This is X (*Tai yra X*)
GEN	The girl cannot see… (*Mergaitė nemato…*)
DAT	The girl is waving at… (*Mergaitė mojuoja…*)
ACC	The girl is picking up… (*Mergaitė ima…*)
INST	The girl is playing with… (*Mergaitė žaidžia su…*)
LOC	The girl is in… (*Mergaitė yra…*)

5.3.3 Frequency counts

To analyse the data, several different token frequency and phonological neighbourhood density counts were obtained.

5.3.3.1 Lexical word forms (surface forms)

An online database of 140 million written and spoken words (Current Lithuanian Language Corpus, http://tekstynas.vdu.lt/) was used to find counts of lexical forms used in the familiar noun study (see Table 33). In case of homophones (e.g., *šaka* [= branch], which can be either 2.1 SNG NOM or 2.1 SNG INST), 200 entries were checked at random within context, and the proportions applied to the total word count.

5.3.3.2 Frequency of forms by case and number (surface forms)

Because the Current Lithuanian Language Corpus is not tagged, it was not possible to obtain counts of the frequency of individual word forms broken down by case and number. To obtain these counts (see Table 34), the Morphologically Annotated Frequency Corpus of Lithuanian (Rimkutė et al., 2011) was used, which comprises parts of the Current Lithuanian Language Corpus and the Spoken Language Recording Database (http://donelaitis.vdu.lt/garsynas/) and includes (after the removal of foreign borrowings, archaisms, etc.) 142,502 noun tokens. Because this

Table 33
Noun form frequencies

Dec	Noun	Stem	Num	Case					
				NOM	GEN	DAT	ACC	INST	LOC
1.1	shoe	bat	SNG	224.0	359.0	16.0	280.0	174.0	56.0
			PLR	1384.0	2179.0	119.0	2370.0	1058.0	70.0
1.2	cheese	sūr	SNG	984.0	1762.0	63.0	554.0	530.0	50.0
			PLR	357.0	1173.0	82.0	313.0	74.0	56.0
1.3	bag	krepš	SNG	226.0	664.0	13.0	2231.0	430.0	276.0
			PLR	151.0	196.0	14.0	409.0	497.0	65.0
2.1	book	knyg	SNG	10614.0	13940.0	904.0	12114.0	2654.0	9459.0
			PLR	6117.7	16024.0	567.0	7419.0	1180.0	2024.0
2.2	sun	saul	SNG	8186.0	13247.0	1451.0	2488.0	1276.0	1526.0
			PLR	66.6	516.0	3.0	44.0	17.0	0.0
3.1	eye	ak	SNG	2048.5	2458.0	495.0	4198.0	1211.0	336.0
			PLR	12048.0	12349.0	703.0	23558.0	10287.0	6658.0
4.1	fruit	vais	SNG	1758.5	1320.0	184.0	5078.0	88.0	17.0
			PLR	2534.0	5078.0	205.0	1559.5	885.0	221.0
5.1	water	vand	SNG	11559.0	20725.0	1685.0	10107.0	6677.0	4968.0
			PLR	1979.0	2606.0	166.0	1740.0	362.0	1058.0
1.1	boat	laiv	SNG	3433.0	5909.0	631.0	2650.0	979.0	1532.0
			PLR	2236.0	5686.0	645.0	1556.0	772.0	573.0
1.2	kiwi	kiv	SNG	21.0	5.0	0.0	4.0	1.0	3.0
			PLR	15.0	14.0	0.0	6.0	3.0	5.0
1.3	hook	kabl	SNG	195.0	138.0	2.0	108.0	125.0	11.0
			PLR	57.0	49.0	1.0	44.0	80.0	0.0
2.1	branch	šak	SNG	1781.1	2689.6	283.0	1035.0	289.90	305.0
			PLR	2245.4	4665.0	409.0	2006.0	716.0	712.0
2.2	snowflake	snaig	SNG	558.0	530.4	34.0	54.0	19.0	15.0
			PLR	311.5	152.0	11.0	89.0	44.0	1.0
3.1	castle	pil	SNG	1551.6	4372.0	71.0	1571.0	162.0	1092.0
			PLR	648.0	1210.0	39.0	603.4	76.0	170.0
4.1	honey	med	SNG	599.0	1885.0	36.0	559.0	618.0	46.0
			PLR	5.0	0.0	0.0	0.0	0.0	0.0
5.1	stone	akm	SNG	2922.0	4944.0	83.0	2145.0	840.0	306.0
			PLR	1861.0	3530.0	65.0	1570.0	1364.0	94.0

corpus does not show words in context (it is simply a list of word forms and their token frequencies), homophones were included in the counts of all possible forms. For example, *knyga* (= book) could be classed as either SNG NOM or SNG INST, so the overall token frequency was included in the count for SING INST context. Thus, the columns in Table 33 add up to considerably more (648,930) than the total number of noun tokens. Table 34 shows that masculine forms are more frequent than feminine forms, that singular forms are more frequent than plural forms, and that the

nominative, genitive, dative and accusative cases are the most frequent. These case frequencies generally match those obtained from smaller corpora of child and child-directed speech (Dabašinskienė & Kamandulytė, 2009; Savickienė & Kalėdaitė, 2007), as well as the data obtained through naturalistic recordings for the previous chapter, though the dative, locative and vocative cases were more frequent in the present corpora (presumably due to multiple counting of homophones).

Table 34

Case and number frequencies of 142,502 Lithuanian noun surface forms

Gender	MASC		FEM		Total	
Num	SNG	PLR	SNG	PLR	SNG	PLR
GEN	20831	14080	19535	7718	40366	21798
DAT	14391	8283	11028	734	25419	9017
ACC	9648	6284	7784	4604	17432	10888
INST	3655	2686	7896	1269	11551	3955
LOC	2632	1028	2893	1106	5525	2134
VOC	4260	9798	2252	1493	6512	11291
Total	109316	73391	94656	47102	203972	120493

Note. Although the counts are also broken down by gender, gender is not used as a predictor variable in its own right, as it is determined by declension.

5.3.3.3 Frequency of individual morphemes (surface forms)

The same corpus was used to obtain counts of the overall frequency of individual surface morphemes, regardless of case, gender, number or declension (recall that many morphemes appear in more than one cell of the paradigm).

5.3.3.4 Frequency of forms by declension (surface forms)

Because the Morphologically Annotated Frequency Corpus of Lithuanian does not mark for declension, the counts were obtained by analysing 1000 entries at random (see Table 33). Again, the absence of sentence contexts means that it was necessary to include homophonous forms in all relevant cells. Table 35 shows that the most frequent declensions are 1.1, 1.2, 2.1 and 2.2, which, together, account for 85% of noun tokens. The percentage is likely to be even higher in child-directed (and children's) speech due to the high frequency of diminutive forms, all of which fall into 1.1, 1.2 and 2.2 (Savickienė, 2001; Dabašinskienė, 2012). Table 36 shows these counts further broken down by number and case.

Table 35

Declension frequencies of 1000 Lithuanian noun surface forms

Declension	SNG NOM and GEN endings	Frequency	Percentage
1.1	-as/-o	2051	41.23
1.2	-is/-io	555	11.16
1.3	-ys/-io	248	4.99
2.1	-a/-os	933	18.76
2.2	-ė/-ės	697	14.01
3.1	-is/-ies	232	4.66
4.1	-us/-ūs	98	1.97
5.1	-uo/-ens	160	3.22

Table 36

Declension, case and number frequencies of 1000 Lithuanian noun surface forms

		Case													
		Count							Percentage						
Number	Dec	NOM	GEN	DAT	ACC	INST	LOC	VOC	NOM	GEN	DAT	ACC	INST	LOC	VOC
SNG	1.1	350	412	46	232	62	45	50	29.24	34.42	3.84	19.38	5.18	3.76	4.18
	1.2	127	37	5	64	15	21	5	46.35	13.50	1.82	23.36	5.47	7.66	1.82
	1.3	41	114	0	3	1	3	1	25.15	69.94	0.00	1.84	0.61	1.84	0.61
	2.1	149	149	25	120	149	0	25	24.15	24.15	4.05	19.45	24.15	0.00	4.05
	2.2	110	175	3	39	9	23	8	29.97	47.68	0.82	10.63	2.45	6.27	2.18
	3.1	4	48	4	9	10	3	6	4.76	57.14	4.76	10.71	11.90	3.57	7.14
	4.1	6	31	3	23	4	0	0	8.96	46.27	4.48	34.33	5.97	0.00	0.00
	5.1	1	0	40	0	0	16	0	1.75	0.00	70.18	0.00	0.00	28.07	0.00
PLR	1.1	201	785	51	116	58	23	199	14.03	54.78	3.56	8.09	4.05	1.61	13.89
	1.2	32	128	5	55	15	12	29	11.59	46.38	1.81	19.93	5.43	4.35	10.51
	1.3	0	59	4	5	1	2	14	0.00	69.41	4.71	5.88	1.18	2.35	16.47
	2.1	105	696	21	34	23	14	2	11.73	77.77	2.35	3.80	2.57	1.56	0.22
	2.2	152	124	5	33	7	4	0	46.77	38.15	1.54	10.15	2.15	1.23	0.00
	3.1	44	24	6	25	16	0	33	29.73	16.22	4.05	16.89	10.81	0.00	22.30
	4.1	12	0	0	6	0	1	12	38.71	0.00	0.00	19.35	0.00	3.23	38.71
	5.1	22	0	0	58	1	0	22	21.36	0.00	0.00	56.31	0.97	0.00	21.36

5.3.4 Results

Two different sets of analyses were conducted. The first investigates whether children's patterns of correct use and error broadly reflect the relative input frequency of different number, case and declension forms at an abstract level. The second investigates the prediction that input effects will also be observed at the lexical level.

5.3.4.1 Overall error rates

The aim of the analysis was to investigate whether rates of correct production of Lithuanian nouns are higher for forms that bear more frequent number-, declension- and case-marking inflections. Out of the total of 720 responses, 402 (55.83%) were coded as correct, 243 (33.75%) as incorrect (i.e., the target noun, but with an incorrect number and/or declension and/or case marked inflection) and 75 (10.42%) as unscorable (e.g., non-target noun, diminutive form) or missing. Unscorable responses were then removed from further analysis. The reason for removing unscorable responses rather than treating them as errors was to conservatively minimise the chances of detecting an effect supporting the proposed model, as such forms were more likely to appear in the lower frequency areas of the inflection system. The percentage of correct responses then increased to 62.33% (see Table 37 for full results; response data broken down by number, declension and case, after removing unscorable responses, are summarised in Table 38). The error rate is considerably higher than many naturalistic studies of grammatically similar languages to Lithuanian, such as Polish (e.g., Dąbrowska, 2001; Krajewski et al., 2012; Weist et al., 1984) and some elicitation studies (e.g., Dąbrowska & Szczerbiński, 2006; Kirjavainen et al., 2012; Marchman, 1997). However, this is not completely unexpected: As previously discussed, naturalistic data studies by their very nature do not capture many infrequent case-marked forms, and elicitation experiments also often focus on a small number of frequent cases (usually in the singular), without looking at the low-frequency areas of the paradigms. Furthermore, the high error rate should not be seen as a limitation of the study, as neither the predicted model, nor constructivist theories more generally have made any claims regarding the absolute error rate for highly inflected languages. However, it does

provide some initial evidence against the generativist approach, which tends to highlight low error rates as support for early full productivity.

Table 37

Correct responses by number, declension and case (familiar nouns)

Num	Dec	Case									
		ACC		DAT		GEN		INST		LOC	
		M	±*SD*	*M*	±*SD*	*M*	±*SD*	*M*	±*SD*	*M*	±*SD*
SNG	1.1	0.88	0.35	1.00	0.00	0.78	0.44	1.00	0.00	0.78	0.44
	1.2	0.88	0.35	0.57	0.53	0.89	0.33	0.80	0.42	0.14	0.38
	1.3	0.86	0.38	0.75	0.46	0.83	0.41	1.00	0.00	0.63	0.52
	2.1	0.89	0.33	1.00	0.00	1.00	0.00	0.83	0.41	0.78	0.44
	2.2	0.80	0.42	0.75	0.46	1.00	0.00	0.75	0.46	0.86	0.38
	3.1	0.80	0.42	0.13	0.35	0.43	0.53	0.22	0.44	0.43	0.53
	4.1	0.86	0.38	0.71	0.49	0.60	0.52	0.86	0.38	0.50	0.53
	5.1	0.40	0.55	0.56	0.53	0.50	0.53	0.38	0.52	0.50	0.55
PLR	1.1	0.88	0.35	0.86	0.38	0.75	0.46	0.44	0.53	0.44	0.53
	1.2	0.67	0.50	0.80	0.42	1.00	0.00	0.67	0.50	0.22	0.44
	1.3	0.86	0.38	0.50	0.53	0.56	0.53	0.67	0.50	0.29	0.49
	2.1	0.80	0.45	0.71	0.49	0.86	0.38	0.89	0.33	0.29	0.49
	2.2	0.78	0.44	0.75	0.46	0.75	0.46	0.89	0.33	0.33	0.50
	3.1	0.13	0.35	0.25	0.46	0.75	0.46	0.44	0.53	0.13	0.35
	4.1	0.50	0.53	0.56	0.53	0.56	0.53	0.67	0.50	0.13	0.35
	5.1	0.30	0.48	0.17	0.41	0.14	0.38	0.11	0.33	0.00	0.00

Table 38

Correct responses by number, declension and case

		Correct	
		M	±*SD*
Num	SNG	0.71	0.45
	PLR	0.54	0.50
Dec	1.1	0.77	0.42
	1.2	0.67	0.47
	1.3	0.69	0.47
	2.1	0.81	0.39
	2.2	0.76	0.43
	3.1	0.38	0.49
	4.1	0.58	0.50
	5.1	0.31	0.46
Case	GEN	0.72	0.45
	DAT	0.64	0.48
	ACC	0.70	0.46
	INST	0.65	0.48
	LOC	0.41	0.49

Note: since all unscorable responses were removed, each proportion can be subtracted from 1 to yield the rate of number/declension/case-marking errors.

5.3.4.2 Frequency effects

Binomial (correct/incorrect) mixed-effects linear regression models (lme4 package; Bates, Mächler, Bolker & Walker, 2015) were used to analyse the data in the R environment (R Core Team, 2014). The initial model included declension, case and number, and all possible interactions, as fixed effects, and item (noun stem) and participant as random effects (a random slopes model would not converge). P values were obtained using a backward elimination procedure that removes all non-significant fixed effects, beginning with the highest order interaction (using the step function from the lmerTest package). The final model (see Table 39) included the main effects of number, case and declension, but no two- or three-way interactions.

A potential criticism of the analysis is that the declension/PND measure could be too static and not account for the fact some non-nominative forms have high degrees of similarity, despite belonging to different declensions. In a recent paper, Granlund et al. (2019) used a more sensitive measure of phonological

neighbourhood density. Instead of assigning one declension to all noun forms sharing the same stem, a continuous measure was created based on the number of morphophonological changes between the stimulus and the target forms. Phonological forms which underwent a similar number and type of transformations between the stimulus and the target forms were regarded as "friends", while forms which underwent a different number and/or type of transformations were regarded as "enemies". The PND was therefore a ratio between phonological "friends" and "enemies", with each number+case combination being assigned its own PND score.

While the computational work required for this type of analysis was beyond the scope of the current thesis, the potential effects of declension syncretism were addressed by rerunning the analysis with the two most overlapping declensions (declensions 1.2 and 1.3) merged and analysed as one.

Treating the two most similar declensions as one did not lead to any marked differences in the final model. The final model (see Table 40) included the main effects of number, case, and declension, but no two- or three-way interactions.

Table 39

Final model for familiar nouns (declensions 1.2 and 1.3 separate)

	Sum Sq	Sq	*F*	*p*	sig
Declension	**13.01**	**1.86**	**9.96**	**.002**	**
Number	**4.79**	**4.79**	**25.65**	**<.001**	***
Case	**8.27**	**2.07**	**11.08**	**<.001**	***
Eliminated					
Declension*Number*Case	5.41	0.19	1.05	0.40	*Ns*
Declension*Number	1.66	0.24	1.28	0.34	*Ns*
Declension*Case	5.65	0.2	1.10	0.26	*Ns*
Number*Case	1.39	0.35	1.86	0.12	*Ns*

Random effects:

	χ^2	df	*p*	χ^2
Child	0.92	1	0.34	0.25
Stem	0.25	1	0.61	0.08

Table 40

Final model for familiar nouns (declensions 1.2 and 1.3 merged)

	Sum Sq	Sq	*F*	*p*	sig
Declension	15.00	2.50	13.31	<.001	***
Number	4.80	4.80	25.60	<.001	***
Case	8.31	2.08	11.08	<.001	***
Eliminated					
Declension*Number*Case	4.79	0.20	10.8	0.37	*Ns*
Declension*Number	1.07	0.18	0.95	0.46	*Ns*
Declension*Case	4.31	0.18	0.96	0.51	*Ns*
Number*Case	1.39	0.35	1.87	0.11	*Ns*

Random effects:

	χ^2	df	*p*
Child	0.25	1	0.62
Stem	0.08	1	0.78

5.3.4.3 Frequency of forms by declension (tokens)

5.3.4.3.1 Number

The significant main effect of number (see Tables 39 and 40) indicates a lower rate of correct responses (i.e., a significantly higher error rate) for plural forms (M = 0.54, ±SD = 0.50) than singular forms (M = 0.71, ±SD = 0.46). This finding is consistent with the predictions of an input-based account, as singular forms are more frequent in the input (see Table 34).

5.3.4.3.2 Case

To unpack the significant main effect of case (see Tables 39 and 40) another binomial (correct/incorrect) mixed effects model was ran with the overall token frequency of each case as the only fixed effect. P values were obtained by comparing this model to a random-effects only model, using a likelihood ratio test (the ANOVA procedure in R). The analysis revealed a significant positive effect of case frequency on the production of correct forms, β = 0.30, SE = 0.06, χ^2, (5) = 27.77, p < .001 (see Figure 7). In line with input-based predictions, the most frequent case tested – genitive – received the most correct response, while the case occurring least often – locative – was the hardest for children to use correctly. Accusative and instrumental

cases appear to be somewhat easier than what the frequency counts suggest they should be. This is possibly due to over-representation of accusative case in child-language and child-directed language compared to, for example, the dative case. Instrumental, on the other hand, while not frequent in child language, comes with an additional overt cue – the preposition *su* (= with). Most uses of the instrumental case deploy this preposition in everyday language, while the preposition can be used only with an instrumental noun. Furthermore, the low correct rate for locative, despite numerous homophones for locative forms across a number of declensions, suggests that Step 3 (defaulting to a frequent inflection) in the proposed account is unlikely to play a significant part in the process.

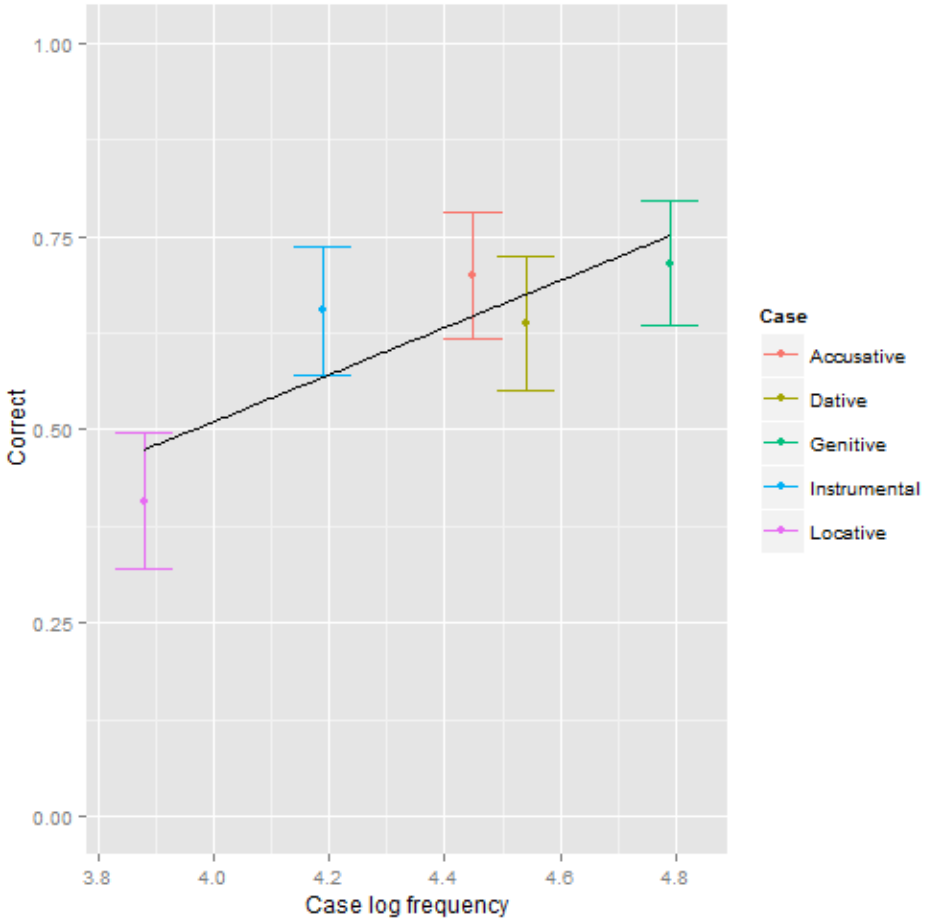


Figure 7. *Correct responses by case frequency.*

5.3.4.3.3 Declension

A binomial model was used to unpack the significant main effect of declension (see Tables 39 and 40) and revealed a significant positive effect of declension frequency

of the production of correct forms, $\beta = 0.30$, $SE = 0.09$, χ^2, (5) = 10.12, $p = .001$ (when the declensions were merged, the analysis also revealed a significant positive effect of declension frequency of the production of correct forms, $\beta = 0.21$, $SE = 0.03$, χ^2, (15) = 7.04, $p < .001$). As with case, frequency appears to be a strong indicator of a child's ability to produce a correct response. Whilst most declensions follow the trend line closely, declension 4.1 received more correct responses than expected, which may be due to relative similarity between the plural endings between declension 4.1 and plural endings of declensions 1.1 and 1.2 (see Figures 8 and 9).

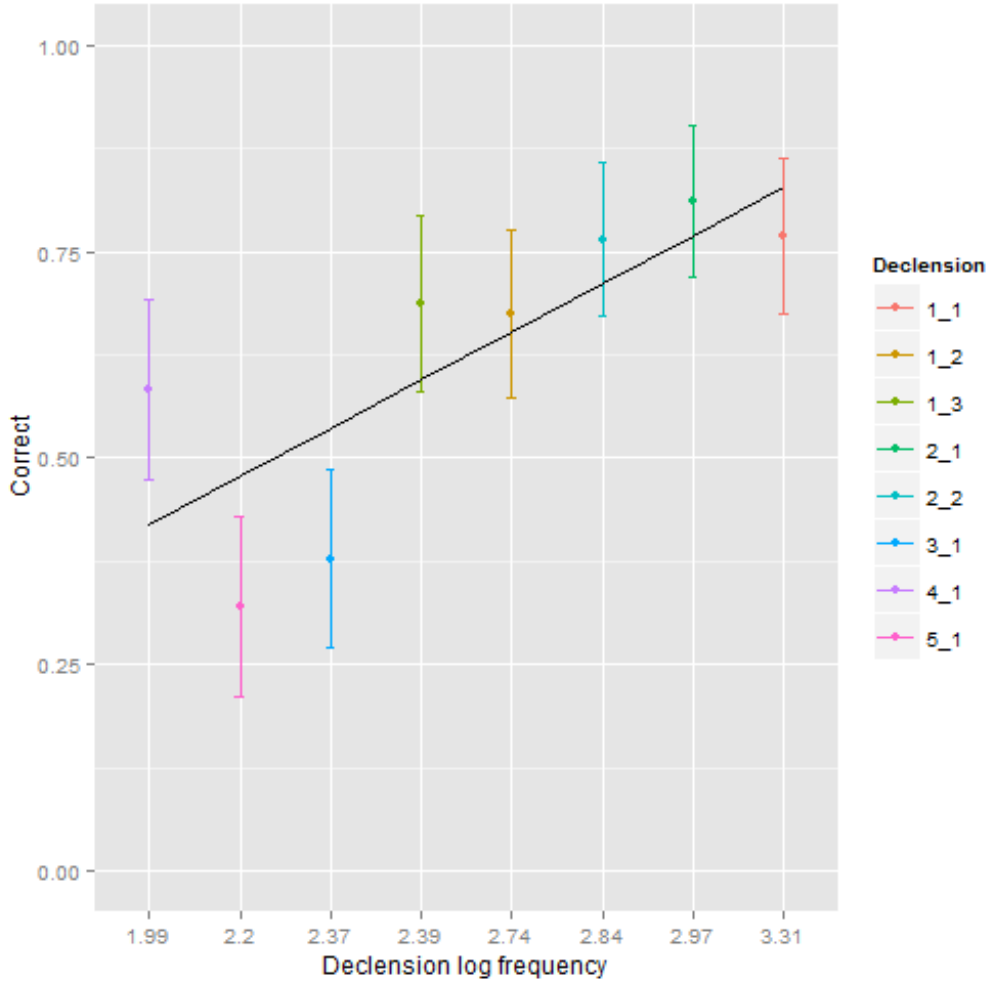


Figure 8. *Correct responses by declension frequency.*

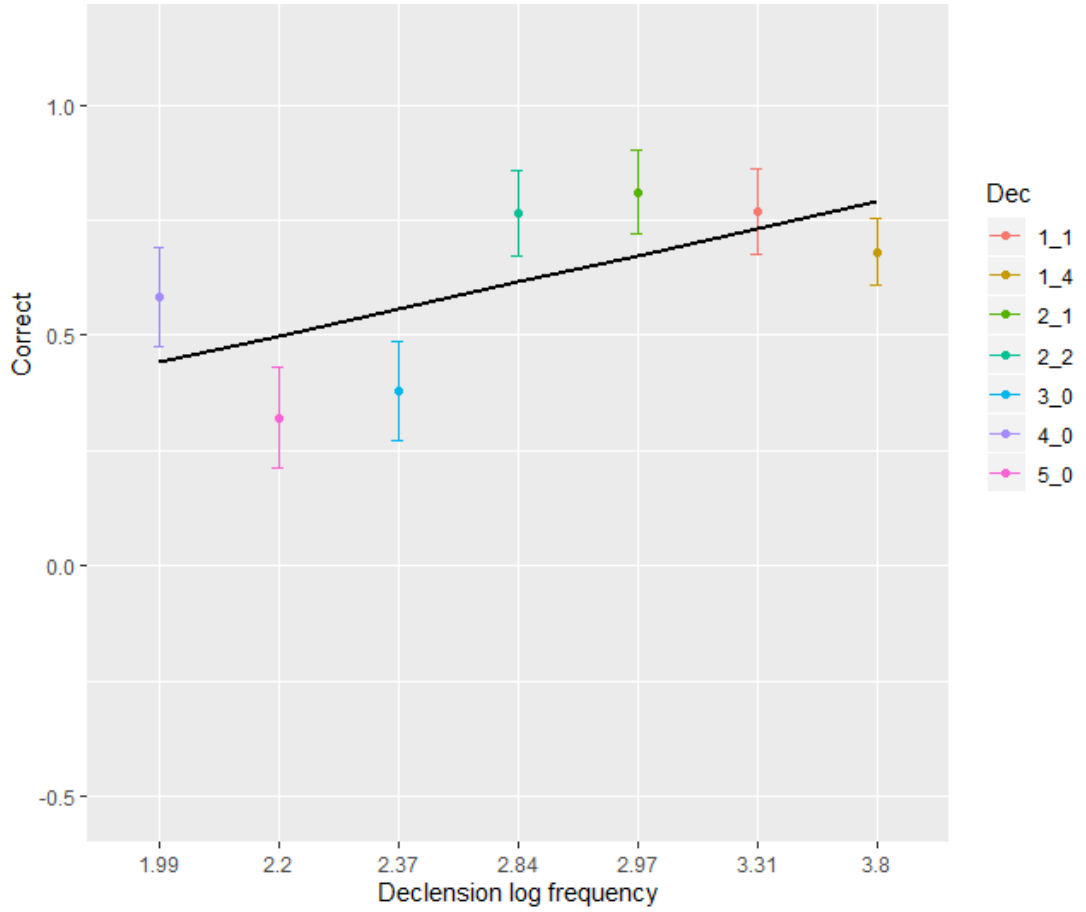


Figure 9. *Correct responses by declension frequency (declensions 1.2 and 1.3 merged)*

5.3.4.4 Error analysis

Table 41 summarises the different types of errors made by children, not including unscorable responses (i.e., including only errors in which children produced the target noun with incorrect number, case, or declension marking).

The most common types of errors included substituting the plural form with the relevant singular form (21.40%), using the nominative (16.05%) or the accusative (7.00%) form in place of one of the less frequent forms, using one of the masculine endings for a feminine noun (11.11%), or using one of the 1.x declension endings when the target form belonged to one of the other masculine declensions, 4.1 or 5.1 (5.76%). Errors in the 'Other' category (29.22%) included 30 responses with more than one type of error (e.g., wrong number and wrong case), 13 ambiguous errors (e.g., when the erroneous form could be coded as either 2.2 singular nominative or 2.2 singular accusative form), 18 error-types that were unambiguous but very infrequent (e.g., only three erroneous responses involved

inappropriate use of the 2.2 declension) and 9 miscellaneous errors (e.g., 3 errors in the stem or 6 using a non-existent ending).

Thus, this error analysis largely supports the idea that the majority of children's errors reflect defaulting to a more frequent form of the relevant noun. The most common type of error involved use of the singular form of the noun instead of the plural form (21.81%) – as opposed to only 5.76% in the other direction – which was expected, as singular forms are more frequent than plural forms. Similarly, the vast majority of case marking errors reflected defaulting to the nominative case, the most frequent in the input (though, since this was the form used by the experimenter, some of these errors may simply reflect children repeating the form that they heard). The only major unexpected finding was a low rate of errors in which children incorrectly use the genitive form; the second most common in the input. One possible explanation is that the genitive is restricted to a few situations that are highly restricted semantically (e.g., possession, negation); thus, children are not tempted to default to genitive case if the situation does not meet these semantic conditions.

The analysis presented above suggests that children's errors largely reflect the input. A limitation of this analysis, however, is that it is relatively broad brush, considering the input only in terms of the relative frequency of different morphemes. However, any account under which children learn systems inflectional morphology from the input predicts an effect of the input at the level of individual inflected word forms. This prediction is investigated in the following analysis.

Table 41

Types of errors

Type of error	Total	Errors (%)
Nominative case	39	16.05
- Instead of locative	11	4.53
- Instead of dative	9	3.70
- Instead of genitive	8	3.29
- Instead of accusative	7	2.88
- Instead of instrumental	4	1.65
Masculine instead of feminine	27	11.11
1.x declension	23	9.47
- Instead of 5.1	15	6.17
- Instead of 4.1	8	3.29
Accusative case	17	7.00
- Instead of dative	7	2.88
- Instead of instrumental	5	2.06
- Instead of genitive	3	1.23
- Instead of locative	2	0.82
Plural instead of singular	14	5.76
Other	70	28.81

5.3.4.5 Input effects

According to the current interpretation of a lexical learning account, children attempting to produce a correctly inflected noun go through three steps in order: first, if the correctly inflected noun is available, they retrieve it from memory. If not, they generate the form by phonological analogy with another noun from the same declension. If no analogy is available, the child will either "seek" for a frequent form in general or default to (one of) the most frequent form(s). The process is influenced by the child's age - the older the child, the greater the likelihood that an appropriate form will be generated at the first or second step. To investigate this account, a hierarchical regression analysis was conducted with the predictors in the corresponding order: age, target word form frequency (the corpus frequency of the noun in the relevant particular inflected form), phonological neighbourhood density (number of nouns in the relevant declension), overall target morpheme frequency (i.e., frequency of the relevant number + case + declension morpheme for the target noun; in instances of suffix syncretism, the same frequency value was assigned to all cells in the inflectional paradigm sharing a particular suffix) and interactions with

age. P values were obtained using the model comparison (likelihood ratio) ANOVA procedure (in R).

The analysis (see Tables 42 and 43) revealed significant main effects of word form frequency (p <. 001), phonological neighbourhood density (p = .002) and overall morpheme frequency (p = .02), but no significant interactions with age. The positive beta values for the main effects show that greater the relevant frequency predictor, the greater the likelihood of a correct response. When the data were reanalysed with the two most similar declensions merged together (Tables 44 and 45), the overall result pattern remained the same, with significant main effects of word form frequency (p <. 001), phonological neighbourhood density (p = .001) and overall morpheme frequency (p = .04)

A potential objection to this analysis is that the frequency counts were based mainly on written corpora that may be unrepresentative of the speech that children hear. As the online corpus (Current Lithuanian Language Corpus, http://tekstynas.vdu.lt/) allows data extraction from written and spoken sources separately, the analysis was re-run with the individual word form counts sourced only from spoken data (2119 tokens). The analysis revealed the same pattern of significant main effects: word form frequency (p = .001), phonological neighbourhood density (p < .001) and individual morpheme frequency (p < .001) and no interactions with age.

Table 42

The influence of age, word form frequency, phonological neighbourhood density (PND), surface morpheme frequency and their interactions with age on correct response rates based on data with declensions 1.2 and 1.3 analysed separately

Model		β	*SE*	Variance Child	Noun
(a) Age model	(intercept)	0.19	0.26	1.00^{E-03}	0.03
	Age	0.01	0.004		
(b) Word form	(intercept)	-0.14	0.27	1.65^{E-03}	0.20
frequency model	Age	0.01	4.43^{E-03}		
	Form freq	0.13	0.02		
(c) PND model	(intercept)	-0.29	0.27	1.53^{E-03}	0.03
	Age	0.01	4.39^{E-03}		
	Form freq	0.13	0.02		
	PND	5.20^{E-05}	1.59E-05		
(d) Morpheme	(intercept)	-0.38	0.27	1.26^{E-03}	0.02
frequency model	Age	0.01	4.31^{E-03}		
	Form freq	0.10	0.02		
	PND	4.35^{E-05}	1.41^{E-05}		
	Morpheme freq	0.07	0.03		
(e) Age*Form	(intercept)	-0.44	0.54	1.25^{E-04}	0.02
frequency model	Age	0.01	0.01		
	Form freq	0.12	0.20		
	PND	4.35^{E-05}	1.41^{E-05}		
	Morpheme freq	0.07	0.03		
	Age*Form freq	-3.96^{E-04}	3.42^{E-03}		
(f)Age* PND model	(intercept)	-0.66	0.38	1.33^{E-03}	0.02
	Age	0.01	0.01		
	Form freq	0.10	0.02		
	PND	1.26^{E-04}	8.30^{E-05}		
	Morpheme freq	0.07	0.03		
	Age* PND	-1.42^{E-06}	1.39^{E-06}		
(g) Age* Morpheme	(intercept)	-0.38	0.88	1.25^{E-03}	0.02
frequency model	Age	0.01	0.02		
	Form freq	0.01	0.02		
	PND	4.35^{E-05}	1.41^{E-05}		
	Morpheme freq	0.01	0.28		
	Age*Morpheme freq	-7.24^{E-05}	4.82^{E-03}		

Table 43

Model comparisons *based on data with declensions 1.2 and 1.3 analysed separately*

	df	AIC	BIC	logLik	deviance	χ^2	*p*
Age model (a) versus random effects only model	5	850.44	872.78	-420.22	840.44	2.82	.09
Word form frequency model (b) versus model (a)	**6**	**818.67**	**845.49**	**-403.34**	**806.67**	**33.77**	**<.001**
PND model (c) versus model (b)	**7**	**811.25**	**842.54**	**-398.63**	**797.25**	**9.42**	**.002**
Morpheme frequency model (d) versus model (c)	**8**	**807.86**	**843.62**	**-395.93**	**791.86**	**5.39**	**.02**
Age*Word form frequency model (e) versus model (d)	9	809.86	850.08	-395.93	791.86	0.01	.93
Age*PND model (f) versus model (d)	9	808.85	849.08	-395.43	790.85	1.01	.31
Age*Morpheme frequency model (g) versus model (d)	9	809.86	850.09	-395.93	792.21	2.00 E-04	.99

Table 44

The influence of age, word form frequency, phonological neighbourhood density (PND), surface morpheme frequency and their interactions with age on correct response rates based on data with declensions 1.2 and 1.3 merged

Model		β	*SE*	Variance Child	Noun
(a) Age model	(intercept)	0.21	0.24	2.00^{E-04}	0.03
	Age	0.01	4.09^{E-03}		
(b) Word form	(intercept)	-0.13	0.26	7.51^{E-04}	0.05
frequency model	Age	0.01	4.15^{E-03}		
	Form freq	0.13	0.02		
(c) PND model	(intercept)	-0.34	0.25	6.15^{E-04}	0.02
	Age	0.01	4.10^{E-03}		
	Form freq	0.10	0.02		
	PND	6.04^{E-5}	1.24^{E-05}		
(d) Morpheme	(intercept)	-0.42	0.30	3.43^{E-04}	0.01
frequency model	Age	0.01	4.0^{E-03}		
	Form freq	0.01	0.02		
	PND	5.11^{E-05}	1.20^{E-05}		
	Morpheme freq	0.06	0.03		
(e) Age*Form	(intercept)	-0.48	0.53	3.42^{E-04}	0.01
frequency model	Age	0.01	0.01		
	Form freq	0.13	0.20		
	PND	5.12^{E-05}	1.20^{E-05}		
	Morpheme freq	0.06	0.03		
	Age*Form freq	-4.44^{E-04}	3.43^{E-03}		
(f)Age* PND model	(intercept)	-0.46	0.41	3.46^{E-04}	0.01
	Age	0.01	0.01		
	Form freq	6.09^{E-05}	7.85^{E-05}		
	PND	0.10	0.02		
	Morpheme freq	0.06	0.03		
	Age* PND	-1.67^{E-07}	1.32^{E-06}		
(g) Age* Morpheme	(intercept)	-0.43	0.88	3.38^{E-04}	0.01
frequency model	Age	0.01	0.02		
	Form freq	0.06	0.28		
	PND	0.10	0.02		
	Morpheme freq	5.11^{E-05}	1.19^{E-05}		
	Age*Morpheme freq	-7.35^{E-05}	4.82^{E-03}		

Table 45

Model comparisons based on data with declensions 1.2 and 1.3 merged

	df	AIC	BIC	logLik	deviance	χ^2	*p*
Age model (a) versus random effects only model	5	850.74	873.09	-420.37	840.74	3.01	.08
Word form frequency model (b) versus model (a)	**6**	**819.20**	**846.02**	**-403.60**	**807.20**	**33.554**	**<.001**
PND model (c) versus model (b)	**7**	**804.16**	**835.45**	**-395.08**	**790.16**	**17.04**	**<.001**
Morpheme frequency model (d) versus model (c)	**8**	**801.78**	**837.54**	**-392.89**	**785.78**	**4.38**	**.04**
Age*Word form frequency model (e) versus model (d)	9	803.77	844.00	-392.89	785.77	0.01	0.92
Age*PND model (f) versus model (d)	9	803.77	843.99	-392.89	785.77	0.01	0.91
Age*Morpheme frequency model (g) versus model (d)	9	803.78	844.01	-392.89	785.78	0.00	1.00

5.4 Discussion

When constructivist approaches to morphological development are applied to a highly inflected noun system such as Lithuanian, a possible three-step process emerged, which was tested in this study: (1) direct lexical retrieval; (2) phonological analogy based on shared phonological neighbourhood density; (3) defaulting to a frequent inflection.

The analysis of the present data, which investigated familiar nouns only, broadly supports this claim. As expected, there were significant main effects of declension, number, and case, with surface form frequency and phonological neighbourhood density significantly predicting correct response rates. Singular form (which is more frequent in the input) targets received significantly more correct responses than the plural form. Case frequency in the input was a significant predictor of correct response rates. Dative targets received slightly fewer correct responses than would be expected from these data, but this may be due to a number of homophones, especially between 2.1 SNG DAT and 1.1 PLR NOM and VOC somewhat overinflating the frequency of the dative. Homophones may also explain a slightly higher than expected correct response rate for the instrumental case, especially 2.1 SNG INST and NOM, which made it impossible to separate correct responses and responses in which the child was repeating the form used by the experimenter. Similarly, phonological neighbourhood density was also a significant predictor, with more frequent declensions receiving more correct responses. Declension 5.1 received more correct responses than expected – this may be because children often chose to use the diminutive form (which belongs to a more frequent 1.1 declension), or a completely different noun with this declension in particular, which did not contribute to correct/incorrect counts.

The reported error analysis also supports the constructivist idea that children default to a more frequent noun context. Although the most common type of error – wrongly choosing the nominative case – could reflect either a frequency effect or, more likely, children simply repeating the form used by the experimenter, the other common types of errors, such as applying a masculine ending to a feminine noun or a more frequent masculine declension to another masculine noun and using the accusative instead of another target case, broadly support the prediction that children will default to a more common form of the noun.

The hierarchical regression found that, as predicted, surface form frequency and phonological neighbourhood density were all significant predictors of productivity, supporting the three-stage model set out above.

Despite the results supporting the three-stage model, the non-significance of the child's age in the model was surprising. As direct lexical retrieval was shown to

play an important role in this process, it was expected that this would be linked with age – the older the child, the more likely they are to have the target form already stored in their memory.

Although using familiar nouns as targets has the advantage of allowing the investigation of the effect of word form frequency on learning of noun morphology, a shortcoming is that it does not allow for a direct assessment of productivity. For example, the observed effect of phonological neighbourhood density does not necessarily demonstrate that children were actually *generating* forms by phonological analogy, it could be that neighbours somehow boosted retrieval of stored forms. The next chapter therefore reports a second elicited production study using novel nouns, which allowed the direct testing of the constructivist account set out here with regard specifically to the issue of productivity.

6. Novel noun elicitation study

6.1 Introduction

Familiar nouns are a useful tool to measure the effect of, amongst other factors, real-life input frequencies on children's language acquisition. However, the effects of direct lexical retrieval could potentially affect any observed effects of phonological neighbourhood density, especially as each child will have had a unique experience of the noun in the input. To counter this criticism, novel nouns may be profitably used to test children's productivity with morphological systems. The use of novel nouns eliminates the possibility of direct lexical retrieval from memory and therefore allows for more direct testing of the roles of (a) phonological analogy, (b) defaulting and (c) "seeking" in children's attempts at productivity.

6.2 Previous studies

Fewer elicited production studies into complex morphology have been conducted for novel than familiar nouns. However, as with familiar nouns, frequency and appears to play an important role in production.

Dąbrowska (2005) presented 2;6 - to 10;4 - year-old children with novel objects. The names for the objects were presented in the nominative case (e.g., *Look, this is X)* and the genitive was elicited during a hiding game, in which the child was encouraged to say *The X is gone!* (lit., *Isn't X!*). The results showed that although 78% of 2;6-year-olds could produce at least one correct response, the overall correct response rate was 42% for this age group. However, this rose to 77% at 4;6. The oldest age group showed adult-like correct response levels of 88%. The most common type of error was the repetition of the nominative form, although the proportion of such responses declined with age from 37% to 11%. The children also produced some feminine endings, although this type of error ranged from 11% of total responses at 2;6 to only 1% at 10;4. It was also noted that the animacy/inanimacy of the object was also linked to the type of ending the children used. The results showed that while children can start producing correct forms early, adult-like competence takes years to achieve.

Polish-speaking children's ability to produce other cases was investigated by Dąbrowska and Szczerbiński (2006). They tested 2;4 to 4;8-year olds using a similar game as in Dąbrowska's 2005 study, only with the addition of different questions to elicit genitive, dative and accusative cases. The correct response rate for novel nouns in the youngest age group was around 45%. The rate increased to around 65% for the four-year olds, which was close to the 70% correct response rate seen in adults. As with familiar nouns discussed in the previous chapter, the correct response rates varied significantly across the different contexts. Accusative neuter was the easiest for two-year olds (75% correct response rate), while dative neuter was the hardest (10%). The differences were even greater for four-year olds, with genitive masculine being the easiest (87%), and the dative neuter the hardest (15%). Additional analyses also found that the case ending phonological neighbourhood density and ending token frequency were significant predictors for the younger children, while phonological diversity was a significant predictor for older children.

Another study on Polish noun inflection conducted by Krajewski et al. (2011) focused on the effect of the stimulus case on production. One hundred-and-one children between the ages of 2;2 and 3;11 were shown pictures of a novel creature interacting with a person, which were labelled using the creature's name in either dative, locative, or instrumental case (e.g., *the girl is greeting X*). The children were then asked to respond to a question or complete a sentence about another picture, which would require a genitive form. The results showed significant effects of age, with the older children producing more correct responses. There were also significant differences between the stimulus cases and the correct production rates. Although the overall correct production rate was not reported, the rates ranged from about 20% for the DAT MASC and DAT FEM conditions in the younger children to 96% for LOC FEM condition in the older children. Additional analyses showed that the similarity of the target form to the stimulus form, rather than the overall frequency of the target form, appeared to be linked to correct production rates. While the results present challenges to strictly frequency-based acquisition accounts, suggesting more intricate frequency counts may be required for a full model, the large differences in error rates, as well as the phonetic similarities affecting correct production rates, supported input-, rather than a rule-based account of morphological development.

6.3 Current study

As in the previous chapter, an elicited-production sentence completion task was used to test the whole of Lithuanian noun inflection system (this time including the vocative case, as animate objects were used). The predicted process children would employ in trying to form an inflected noun was the same as in the previous chapter. However, as novel nouns are used, step one – direct lexical retrieval was eliminated. Furthermore, defaulting to a more frequent form of the noun is also not a possibility when using novel words, which leaves a two-stage process:

(1) Forming a phonological analogy.

(2) Aiming for a more frequent morpheme across the system, with the search also being guided by some imperfect knowledge of the relevant target case/declension/number.

The predicted process therefore would see a child first attempting to form an analogy by basing the novel noun on a phonologically similar novel noun they have acquired previously. For example, if a child is presented with a novel noun *mip-ė* [= mipė SNG:NOM:2.2] and is asked to produce this word in an INST SNG context, they might create an analogy based on the real word *bit-ė* [= bee SNG:NOM:2.2] and apply the instrumental ending of *-e* in *bit-e* [= bee SNG:INST:2.2] to the target word resulting in *mip-e* [= mipė SNG:INST:2.2].

If the first step does not yield an output form with sufficient strength, the child is likely to aim for a frequent morpheme based on their imperfect knowledge of the inflectional system. While the precise process for this step is more speculative, a potential scenario for inflected form production could involve the child still utilising a familiar, similar-sounding noun, only to arrive at a more frequent surface form of the noun with incorrect case and/or number marking. If this is applied to the previous example, the child might create an analogy based on *bit-ę* [= bee SNG:ACC:2.2] to the target noun creating *mip-ę* [= mipė SNG:ACC:2.2]. Alternatively, the child might just produce a familiar ending from the noun inflection system, which they think may have a chance of being correct. This process is also highly probabilistic, with more frequent surface forms being more likely to be chosen than the less common forms.

Results supporting these predictions, and therefore providing evidence of the importance of frequency and phonological neighbourhood density in inflecting novel nouns, would also count as evidence against generativist predictions which argue for the use of innate symbolic rules in noun inflection.

6.3.1 Method

6.3.1.1 Participants

Twenty-three children in total, nine boys and 15 girls aged 4;1-5;5 (*M* = 4;9), were recruited from, and tested in, nurseries in Kaunas, Lithuania. Written consent was obtained from the parents and the nursery head teacher. All children were normally developing, monolingual speakers of Lithuanian.

6.3.1.2 Design and materials

6.3.1.2.1 Noun stimuli

As with the familiar nouns study, novel nouns consisted of two syllables across all cases, with the exception of some locative forms and words belonging to the 5.1 declension, in which suffixes are obligatory to form grammatical targets (Table 7). The novel nouns selected also avoided stem changes or the use of the softener *-i* where possible. Unlike in the real noun study, animated creatures were used. The reason for this decision was to ensure that children would not be able to employ any past-experience semantic gender associations due to the novel nature of the nouns, avoiding any interference from other grammatical gender declensions.

6.3.1.2.2 Cases and declensions

With the exception of the nominative case, which was used as the stimulus form by the experimenter, and the extremely rare declensions 3.2 (MASC) and 5.2 (FEM), all cases and declensions were tested. Unlike in the familiar noun study, the vocative case was also included due to the animate nature of the stimulus creatures.

Table 46

Novel stimulus singular nominative forms

Declension	Noun
1.1	talb-as
1.2	gup-is
1.3	doln-ys
2.1	laf-a
2.2	mip-ė
3.1	nig-is
4.1	zel-us
5.1	sud-uo

6.3.1.2.3 Visual stimuli

The novel noun study included 112 (16 nominative) pictures in similar format to the real noun study. The only differences were that the objects the girl was interacting with were made-up creatures, there was only one creature per declension, and the vocative case was also included. The novel creatures also had gender-specific aspects to them (e.g., moustache or pig-tails), in order to ensure that children would assign them to the relevant declensions, which are split by gender. This was especially important in the 1.2 and 3.1 cases where the ending in the singular nominative case is the same (*-is*), with the declensions distinguished by gender. A selection of novel creature pictures can be seen in Figure 10.

6.3.2 Procedure

Children were tested in their nurseries over five days, with two sessions per day. The testing took place in a quiet area in the nursery. The testing began with the experimenter showing a picture of one of the made-up creatures and stating its name using the nominative case. The experimenter then swapped the picture for another card displaying the same creature, this time interacting with a girl. The experimenter began describing what the girl is doing with the creature, but omitted the last word in a sentence. The sentence was structured in such a way that the missing word required was the name of the creature in the target case. The child then attempted to finish the sentence using the target word, received a sticker and moved onto the next stimulus picture If the child did not produce a word, he or she was gently encouraged

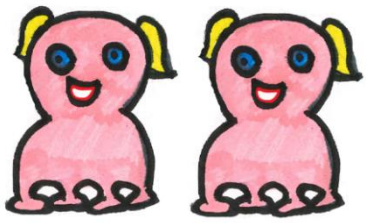
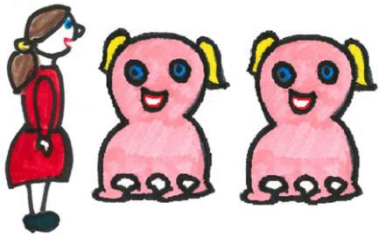
a) 1. Experimenter: Tai yra mipės = *These are mipė PLR:NOM:2.2*	2. Experimenter: Mergaitė šneka su… = *The girl is talking with…* Child: … mipėmis = *mipė PLR:INST:2.2*
	
b) 1. Experimenter: Tai yra lafa = *This is lafa SNG:NOM:2.1*	2. Experimenter: Mergaitė kutena… = *The girl is tickling...* Child: … lafą = *lafa SNG:INST:2.1*
	
c) 1. Experimenter: Tai yra dolnys = *This is dolnys SNG:NOM:1.3*	2. Experimenter: Mergaitė duoda dovaną… = *The girl is giving the gift to...* Child: …dolniui = *dolnys SNG:DAT:1.3*
	

Figure 10. *A selection of pictures and accompanying descriptions used in the novel noun study.*

to do so, but if the child was still reluctant to respond, the experimenter moved on nonetheless, with the trial being marked as ‘no response’, rather than ‘incorrect’. The full list of stimulus sentences can be found in Table 47.

Because the total number of trials (96) was too great for young children, each child completed 24 trials, selected using a pseudo-randomisation procedure, which

ensured that each item appeared an equal number of times across children (or as close as possible, given missing data), and that each child completed 12 singular trials and 12 plural trials.

Table 47

Stimulus sentences by case

Case	Stimulus sentence
NOM	This is X (*Tai yra X*)
GEN	The girl cannot see… (*Mergaitė nemato…*)
DAT	The girl is giving the present to… (*Mergaitė duoda dovaną...)*
ACC	The girl is tickling… (*Mergaitė kutena…*)
INST	The girl is playing with… (*Mergaitė žaidžia su…*)
LOC	The girl is in… (*Mergaitė yra…*)
VOC	The girl is calling *(Mergaitė šaukia...)*

6.3.3 Frequency counts

Due to the novel nature of the stimulus words, word form (token) frequency was not used as a predictor. However, overall case, number, and declension frequencies were obtained from the same sources as for the familiar nouns study. The Morphologically Annotated Frequency Corpus of Lithuanian (Rimkutė et al., 2011) was used to obtain the token frequencies of individual morphemes, case, number and declension. The corpus does not mark for declension, so 1000 entries at random were analysed to obtain frequencies for declension (Tables 33 and 34).

Phonological neighbourhood density (type) frequencies were sourced from data in Savickienė et al. (2004), who analysed 26,188 noun entries in a popular dictionary (Current Lithuanian Language Dictionary, 4th ed., 2000; Table 35).

6.3.4 Results

Two different sets of analyses were conducted. The first investigated whether children's patterns of correct use and error broadly reflect the relative input frequency of different number, case and declension forms at an abstract level. The

second investigated the prediction that input effects will also be observed at the lexical level.

6.3.4.1 Overall error rates

Out of the total 537 responses, 188 (35.01%) were coded as correct, 211 (39.29%) as incorrect (i.e., the target noun, but with an incorrect number, and/or declension, and/or case marked inflection), and 138 (25.79%) as unscorable (e.g., non-target noun, diminutive form) or missing. Once the unscorable responses were removed, the percentage of correct responses increased to 52.88%. The response data, broken down by number, declension and case, are summarised in Table 48. A more detailed summary is available in Table 49.

Table 48

Correct responses by number, declension and case.

		Correct	
		M	±*SD*
Number	SNG	0.52	0.50
	PLR	0.42	0.49
Declension	1.1	0.72	0.45
	1.2	0.50	0.50
	1.3	0.67	0.48
	2.1	0.45	0.50
	2.2	0.50	0.50
	3.1	0.17	0.34
	4.1	0.42	0.50
	5.1	0.13	0.34
Case	GEN	0.65	0.48
	DAT	0.35	0.45
	ACC	0.53	0.50
	INST	0.50	0.50
	LOC	0.18	0.34
	VOC	0.62	0.49

Table 49

Correct responses by number, declension and case (novel nouns)

Num	Dec	Case											
		ACC		DAT		GEN		INST		LOC		VOC	
		M	±*SD*	*M*	±*SD*	*M*	±*SD*	*M*	±*SD*	*M*	±*SD*	*M*	±*SD*
SNG	1.1	0.67	0.52	1.00	0.00	1.00	0.00	0.83	0.41	0.00	0.00	0.80	0.45
	1.2	0.57	0.53	0.75	0.50	0.83	0.41	0.60	0.55	0.00	0.00	0.00	0.00
	1.3	0.50	0.55	0.25	0.50	0.80	0.45	0.67	0.52	0.50	0.55	1.00	0.00
	2.1	0.67	0.58	0.33	0.52	0.75	0.50	0.67	0.58	0.40	0.55	1.00	0.00
	2.2	0.86	0.38	0.50	0.55	0.75	0.46	0.80	0.45	0.33	0.58	1.00	0.00
	3.1	0.50	0.71	0.25	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4.1	0.50	0.58	0.50	0.55	0.67	0.58	0.43	0.53	0.50	0.58	0.00	0.00
	5.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PLR	1.1	0.86	0.38	0.25	0.50	1.00	0.00	0.60	0.55	0.00	0.00	1.00	0.00
	1.2	0.33	0.52	0.33	0.58	0.86	0.38	0.67	0.52	0.00	0.00	0.33	0.58
	1.3	0.50	0.55	0.67	0.58	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
	2.1	0.80	0.45	0.17	0.41	0.80	0.45	0.00	0.00	0.25	0.50	0.00	0.00
	2.2	0.29	0.49	0.20	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.71
	3.1	0.20	0.45	0.00	0.00	0.40	0.55	0.00	0.00	0.50	0.71	0.00	0.00
	4.1	0.60	0.55	0.00	0.00	0.75	0.50	0.20	0.45	0.00	0.00	0.50	0.71
	5.1	0.50	0.58	0.33	0.58	0.20	0.45	0.00	0.00	0.00	0.00	1.00	0.00

6.3.4.2 Frequency counts

Again, two sets of analyses were conducted; one at a more abstract level (i.e., the frequency of number, case and declension classes), one at a more fine-grained level (i.e., phonological neighbourhood density and morpheme frequency; though, since the nouns were novel, it was not, of course, possible to use word form frequency as a predictor).

In the first analysis, the final model (see Table 50) revealed significant main effects of declension and case and interactions of declension by number and declension by case.

As in Chapter 5, the model was also run based on data with the two most overlapping declensions (declensions 1.2 and 1.3) merged together. The results revealed a significant main effect of number, case and declension (Table 51).

Table 50

Final model for novel nouns based on data with declensions 1.2 and 1.3 analysed separately

	Sum Sq	Sq	*F*	*p*	sig
Declension	**10.42**	**1.49**	**8.59**	**<.001**	*******
Number	0.46	0.46	2.67	0.10	ns
Case	**6.92**	**1.38**	**8.00**	**<.001**	*******
Declension*Number	**5.43**	**0.77**	**4.48**	**<.001**	*******
Declension*Case	**8.97**	**0.26**	**1.48**	**0.04**	*****
Eliminated					
Declension*Number*Case	6.35	0.18	1.06	0.39	*ns*
Number*Case	0.61	0.12	0.70	0.62	*ns*

Random effects:

	χ^2	df	*p*
Child	3.26	1	.07
Stem	0.00	1	1.00

Table 51

Final model for novel nouns based on data with declensions 1.2 and 1.3 merged

	Sum Sq	Sq	*F*	*p*	sig
Declension	**4.31**	**0.72**	**3.97**	**.001**	*******
Number	**1.34**	**1.34**	**7.10**	**.01**	******
Case	**7.90**	**1.58**	**8.75**	**<.001**	*******
Eliminated					
Declension*Number*Case	5.78	0.19	1.10	0.34	*ns*
Declension*Case	7.01	0.23	1.32	0.13	*ns*
Number*Case	0.60	0.12	0.68	0.64	*ns*
Declension*Number	3.04	0.51	2.68	0.30	*ns*

Random effects:

	χ^2	df	*p*
Child	2.81	1	.09
Stem	2.32	1	.13

6.3.4.2.1 Number

When the analysis was conducted with declensions 1.2 and 1.3 merged, the results revealed a significant main effect of number. The significant main effect of number (see Table 51) indicates a lower rate of correct responses (i.e., a significantly higher error rate) for plural forms (M = 0.42, ±SD = 0.49) than singular forms (M = 0.52, ±SD = 0.50). This finding is consistent with the predictions of an input-based account, as singular forms are more frequent in the input (see Table 34).

6.3.4.2.2 Case

A binomial model, run to unpack the significant main effect of case (see Table 50 and 51), revealed a significant positive effect of case frequency on the production of correct forms, β = 0.39, SE = 0.08, χ^2, (5) = 23.91, p < .001. In line with the prediction above, more frequent cases resulted in more correct responses. The pattern closely resembles the results of the familiar noun study, with the instrumental appearing to be more productive than expected and the dative less so, potentially due to the preposition *su* (= with) preceding the instrumental noun providing a cue for the case inflection. The vocative was also somewhat more productive than expected – possibly due to a high number of homophones across the declensions (Figure 11).

6.3.4.2.3 Declension

A binomial model, run to unpack the significant main effect of declension (see Table 50 and 51), revealed no relationship between declension frequency and the production of correct forms β = 0.27, SE = 0.15, χ^2, (5) = 3.20, p = .07 (see Figure 12). Given the significant interactions of declension by (a) number and (b) case (as discussed in more detail below), the failure of this correlation to reach significance is presumably the fact that it collapses inappropriately across both number and case. It is worth noting, however, the similarity between the patterns of the declension analysis in the familiar and the novel noun studies.

However, a significant relationship was found when the analysis was re-run with the two most syncretic declensions (declensions 1.2 and 1.3) merged β = 0.20, SE = 0.04, χ^2, (6) = 4.66, p = .003 (see Figure 13).

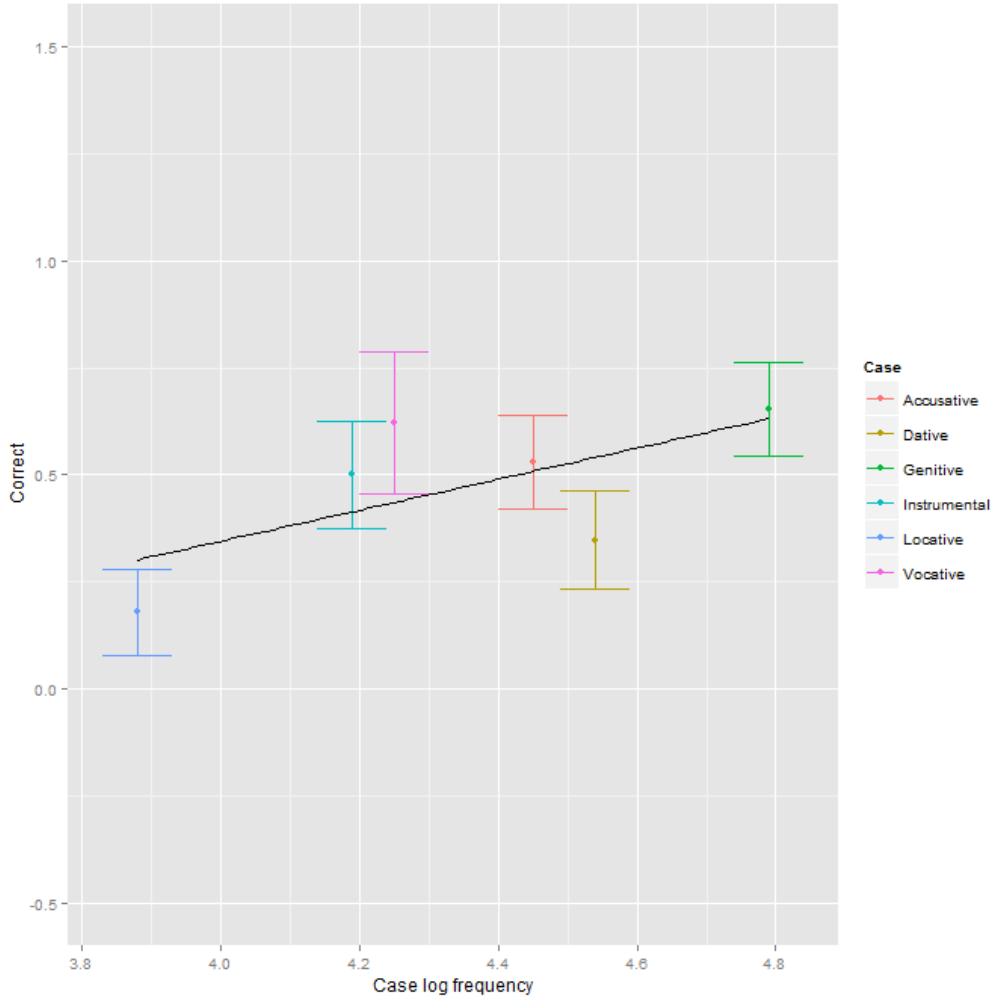


Figure 11. Correct responses by case frequency.

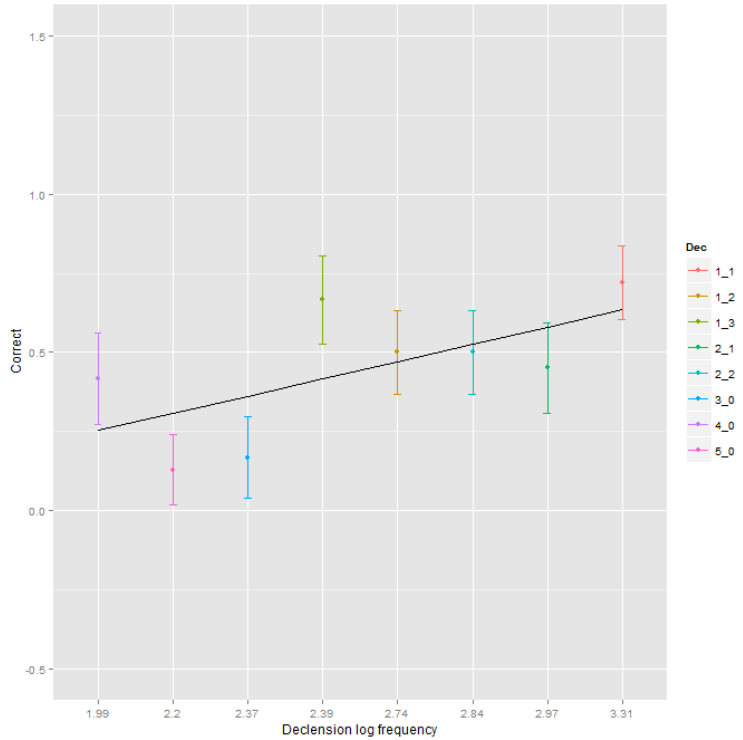


Figure 12. Correct responses by declension frequency (declensions 1.2 and 1.3 separate).

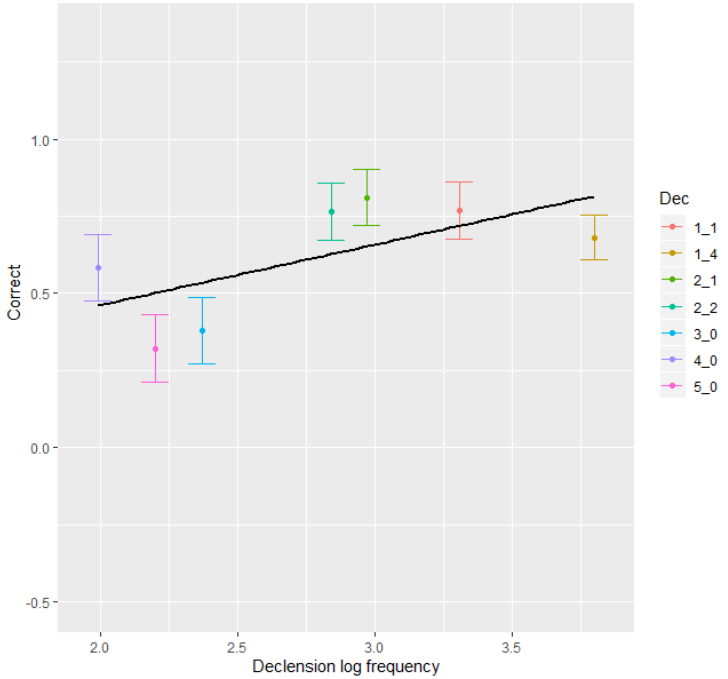


Figure 13. Correct responses by declension frequency (declensions 1.2 and 1.3 merged).

6.3.4.2.4 Declension x number

A binomial model, run to unpack the significant interaction of declension by number, (see Table 50) revealed that the effect of the frequency of the relevant declension + number combination on the production of correct forms was non-significant, but trending, β = 0.20, *SE* = 0.12, χ^2, (1) = 3.19, *p* = .07 (see Figure 14).

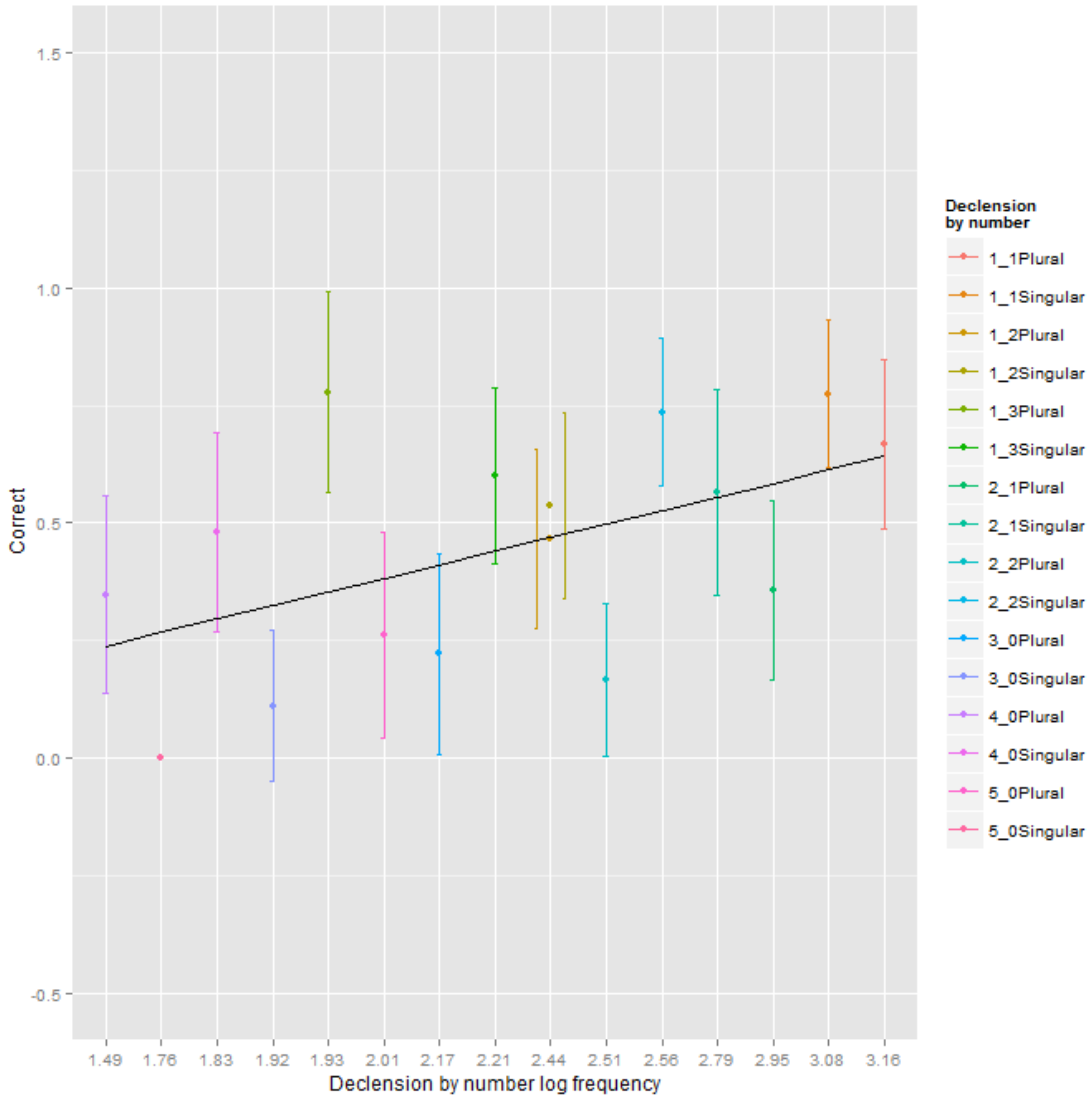


Figure 13. *Correct responses by declension + number frequency.*

6.3.4.2.5 Declension x case

A binomial model, run to unpack the significant interaction of declension by case (see Table 50), revealed a significant positive effect of the frequency of the relevant declension + case combination on the production of correct forms, $\beta = 0.17$ ($SE = 0.04$), χ^2, (1) = 16.39, $p < .001$ (see Figure 15). While an examination of individual declension and case combinations would be overly time-consuming and unlikely to bring significant contributions to this discussion, the overall trend follows the prediction of the effect of frequency on the likelihood of a correct response – the more frequent the combination, the more likely the child was to provide the correct response.

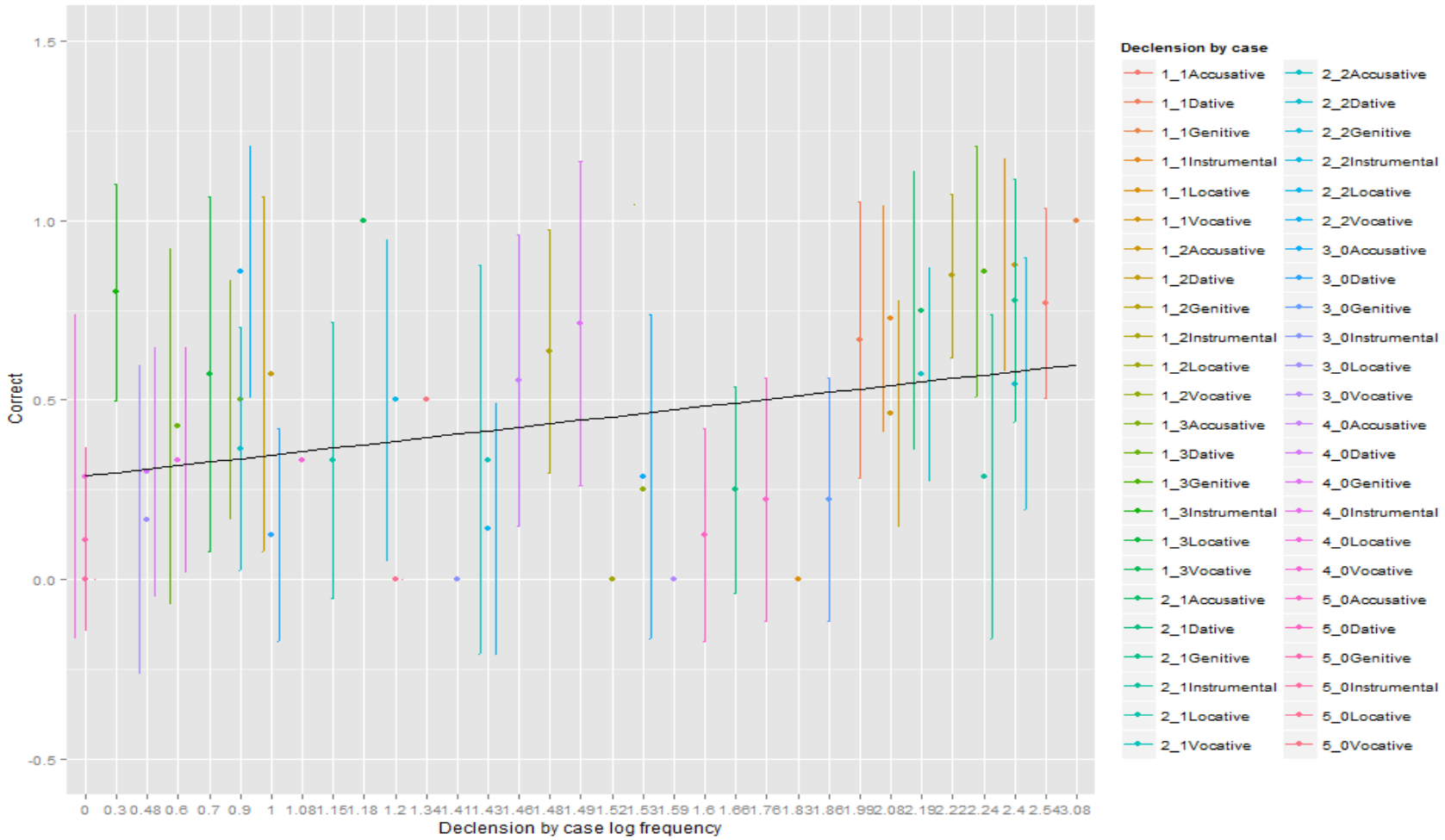


Figure 14. *Correct responses by declension + case frequency*

6.3.4.3 Error analysis

Table 52 lists the types of errors children produced when they gave a response. Almost a quarter of the errors were due to child using the nominative form instead of the target case. This type of error does not necessarily give an insight into children's morphological development process, as it may be due to their simply repeating the form they heard used by the experimenter (presumably particularly likely in the case of novel nouns). The second most common type of error – using singular instead of the target plural form – appeared in 10% of erroneous responses. As singular forms are more frequent than plural forms, this offers support for the predictions set out above. The use of one of the masculine endings instead of a feminine one occurred in 8.53% of errors. This once again supports the frequency-based predictions set out above, as masculine declensions (1.1, 1.2, 1.3, 4.1 and 5.1) are more frequent than the feminine declensions (2.1, 2.2 and 3.1). The opposite type of error – using a feminine ending with a masculine target noun – appearing almost as often, at 7.58%, might seem to undermine this claim. However, in 12 cases out of 16, this substitution occurred where the target masculine noun belonged to the least frequent masculine declensions - 4.1 and 5.1.

The other relatively frequent types of errors – substituting accusative, dative or an instrumental case ending for one of the other cases - also largely support the idea that when children make a morphological error, they are likely to use a more frequent morpheme than the target morpheme. A notable absence from this list of common errors is the use of a genitive ending when a different ending should be used. This may be because of the semantic restrictiveness of the genitive, which may be only used in frequent, but not wide-ranging, contexts. For comparison, when children used an instrumental form erroneously, the sentences they produced did not match the picture, but sometimes still made sense grammatically (e.g., instead of *The girl is tickling ALBA* SNG:ACC, they produced *The girl is tickling WITH ALBU* SNG:INST*).*

Table 52

Types of errors: novel verbs

Type of error	Total	Errors (%)
Nominative case	49	23.22
- Instead of locative	14	6.64
- Instead of accusative	9	4.27
- Instead of instrumental	8	3.79
- Instead of genitive	8	3.79
- Instead of dative	7	3.32
- Instead of vocative	3	1.42
Singular instead of plural	21	9.95
Masculine instead of feminine	18	8.53
- Instead of 3.1	7	3.32
- Instead of 2.1	6	2.84
- Instead of 2.2	5	2.37
Accusative case	16	7.58
- Instead of locative	9	4.27
- Instead of genitive	3	1.42
- Instead of dative	2	0.95
- Instead of vocative	2	0.95
Feminine instead of masculine	16	7.58
- Instead of 4.1	8	3.79
- Instead of 5.1	4	1.90
- Instead of 1.1	2	0.95
- Instead of 1.2	2	0.95
Dative case	14	6.64
- Instead of accusative	6	2.84
- Instead of instrumental	5	2.37
- Instead of locative	2	0.95
- Instead of vocative	1	0.47
Instrumental case	9	4.27
- Instead of accusative	4	1.90
- Instead of dative	3	1.42
- Instead of locative	2	0.95
Other	68	32.23

6.3.4.4 Input effects

As for the familiar noun study, a second analysis to investigate the effects of input frequency in more detail was conducted (see Tables 53 and 54). The data were analysed in the same way, except that no word-form frequency predictor was included, as the nouns are novel. The analysis found a main effect of age (p = .02), phonological neighbourhood density (p = .02) and overall morpheme frequency (p < .001), but no significant interactions. The positive beta values for the significant

predictors indicate higher correct response rates for (a) older children, (b) targets from larger phonological classes and (c) targets that use morphemes with greater surface frequency.

When the data were reanalysed with the two most similar declensions merged together (Tables 55 and 56), the overall result pattern remained the same, with significant main effects of word form frequency (p =.01), phonological neighbourhood density (p = .001) and overall morpheme frequency (p < .001)

Table 53

The influence of age, phonological neighbourhood density (PND), surface morpheme frequency, and their interactions with age, on correct response rates for novel nouns based on data with declensions 1.2 and 1.3 analysed separately

Model		*B*	*SE*	Variance Child	Noun
(a) Age model	(intercept)	-0.45	0.37	0.01	0.04
	Age	0.02	0.01		
(b) PND model	(intercept)	-0.60	0.38	0.01	0.02
	Age	0.02	0.01		
	PND	4.46^{E-05}	2.14^{E-05}		
(c) Morpheme	(intercept)	-0.57	0.37	0.01	0.02
frequency model	Age	0.01	0.01		
	PND	3.09^{E-05}	2.06^{E-05}		
	Morpheme frequency	3.19^{E-05}	6.12^{E-06}		
(d) Age*PND	(intercept)	-0.87	0.05	0.01	0.02
model	Age	0.02	0.01		
	PND	1.15^{E-04}	1.10^{E-04}		
	Morpheme frequency	3.17^{E-05}	6.13^{E-06}		
	Age* PND	-1.48^{E-06}	1.88^{E-06}		
(e) Age*Morpheme	(intercept)	-0.951	0.46	0.01	0.02
frequency model	Age	0.02	0.01		
	PND	2.01^{E-04}	7.94^{E-05}		
	Morpheme frequency	2.99^{E-05}	2.14^{E-05}		
	Age*Morpheme frequency	-1.62^{E-06}	1.28^{E-06}		

Table 54

Model comparisons: Novel nouns based on data with declensions 1.2 and 1.3 analysed separately

	df	AIC	BIC	logLik	deviance	χ^2	*p*
Age model (a) versus random effects only model	5	544.46	564.41	-267.23	534.46	5.68	.02
Phonological neighbourhood density model (b) versus model (a)	6	542.03	565.96	-265.01	530.03	4.44	.04
Morpheme frequency model (c) versus model (b)	7	517.59	545.51	-251.79	503.59	26.43	<.001
Age*Phonological class size model (d) versus model (c)	8	518.95	550.86	-251.48	502.95	0.64	0.42
Age*Morpheme frequency model (e) versus model (c)	8	518.01	549.93	-251.01	502.01	1.58	0.21

Table 55

The influence of age, phonological neighbourhood density (PND), surface morpheme frequency, and their interactions with age, on correct response rates for novel nouns based on data with declensions 1.2 and 1.3 merged

Model		*B*	*SE*	Variance	
				Child	Noun
(a) Age model	(intercept)	-0.46	0.36	3.70 E-03	0.04
	Age	0.02	0.01		
(b) PND model	(intercept)	-1.18	0.39	4.00 E-03	0.01
	Age	0.02	0.01		
	PND	0.23	0.05		
(c) Morpheme	(intercept)	-1.32	0.42	0.01	0.01
frequency model	Age	0.01	0.01		
	PND	0.11	0.07		
	Morpheme frequency	0.20	0.03		
(d) Age*PND	(intercept)	-0.14	1.44	0.01	0.01
model	Age	-0.01	0.03		
	PND	-0.24	0.42		
	Morpheme frequency	0.20	0.03		
	Age* PND	0.01	0.01		
(e) Age*Morpheme	(intercept)	-1.78	1.24	0.01	0.01
frequency model	Age	0.02	0.02		
	PND	0.11	0.37		
	Morpheme frequency	0.34	0.07		
	Age*Morpheme frequency	-2.60 E-03	0.01		

Table 56

Model comparisons: Novel nouns based on data with declensions 1.2 and 1.3 merged

	df	AIC	BIC	logLik	deviance	χ^2	*p*
Age model (a) versus random effects only model	5	545.25	565.19	-267.62	535.25	6.14	.01
Phonological neighbourhood density model (b) versus model (a)	6	535.50	559.43	-261.75	523.50	11.75	.001
Morpheme frequency model (c) versus model (b)	7	506.62	534.54	-246.31	492.62	30.88	<.001
Age*Phonological class size model (d) versus model (c)	8	507.90	539.81	-245.95	491.90	0.72	0.40
Age*Morpheme frequency model (e) versus model (c)	8	508.46	540.38	-246.23	492.46	0.00	0.00

6.4 Discussion

The results from the novel noun study largely show the same patterns as the familiar noun study, although as expected, the overall correct response rate was lower – 53%. As in Chapter 5, the analyses revealed significant main effects of declension and case. Somewhat surprisingly, target number was significant only when the two most syncretic declensions were merged. However, as the analysis based on data treating declensions 1.2 and 1.3 separately revealed interactions between declension and number (as well as declension and case), the results point to a close relationship between number and declension on correct production. The pattern for case frequency mirrored the familiar noun data well, with case frequency significantly predicting correct response rates. The more unexpected results for the dative and instrumental targets were also seen in the familiar-noun study. Although the differences were more pronounced in the present study, their effect was stronger due to the novelty of the targets. The performance with vocative targets was also better than expected. This may be due to the large number of homophones, especially plural nominative and vocative endings. Although the present study found a significant main effect of declension and a significant declension by number interaction, the relationships between their frequencies and correct response rates were only trending based on data treating declensions 1.2 and 1.3 separately. This is possibly due to the influence of declension being inappropriately collapsed across number and/or case. Finally, the declension by case interaction showed that although there is considerable variation in the data, their combined frequency can also predict correct response rates, in line with constructivist accounts.

The error analysis revealed a broader range of errors than was observed in the familiar noun study, but children still showed a tendency to default to a more frequent case, number, or declension, supporting the constructivist suggestion that children will default to a more frequent form (e.g., accusative instead of dative, as accusative forms are more frequent in the input) or morpheme (e.g., apply morpheme *-a*, as it is found frequently across the paradigm) when they make an error, but still with some regard to the semantic and/or phonological properties of the target. For example, if the target noun is *sud-enimis* (= suduo PLR INST DEC 5.1), the child might produce **sud-ens* (= suduo SNG GEN DEC 5.1), which is a more frequent

number x case x declension combination than the target form, or **sud-ė* (= suduo SNG NOM DEC 2.2), as *-ė* is more frequent in the input than *-enimis.*

Investigation into input frequency effects revealed that as expected, and in support of the constructivist predictions outlined above, phonological neighbourhood density and morpheme frequency (i.e. the overall frequency of a suffix across the noun inflectional system) were significant predictors of correct response rates. Additionally, the present study – unlike the familiar-noun study – observed a significant effect of age, with older children producing more correct forms. This is not unexpected, as all theories of language suggest that children improve with age. A possible reason why age was a significant predictor in this study, but not the familiar noun study, is that the task involving novel stimuli was harder – evident through the lower rates of correct responses overall – and older children therefore enjoyed an advantage when completing the task.

To summarise, the relatively high error rate, as well as the number (in the merged declension analysis only), declension frequency, case frequency, declension by number and declension by case interactions (in the separate declension analysis only) predicting the error rate clearly support input-based accounts of morphological acquisition and challenge theories refuting the importance of lexically-specific effects on inflection production. The defaulting analysis also supported the constructivist claim that children are more likely to use a more frequent form when they produce an erroneous form. Finally, the input frequency analysis supported the prediction that when children attempt to produce a novel form, they are likely to use an analogy based on a similar, familiar, noun of the same declension, or apply a generally frequent morpheme.

7. Discussion

7.1 Overview

Chapter 1 introduced the generativist explanation of language acquisition with a particular focus on inflectional morphology. Main theoretical points were discussed, with the strengths and weaknesses of the account illustrated with empirical evidence. The central assumption of the approach is that children are born with Universal Grammar containing all possible grammar rules. When the child is exposed to his or her native language, they process the language in an abstract manner and narrow down the possible rule sets. Once they learn the rule, they are able to apply it freely to new lexical items. The process is said to be quick and largely error-free. Evidence of children producing grammatically marked words in their spontaneous speech early in their linguistic development with relatively few errors has been taken as evidence of pre-existing abstract grammatical knowledge. However, studies offering support tended to be based on surface-level analysis of spontaneous speech, English language data, and a strong focus on the past tense *–ed* inflection.

Chapter 2 introduced the opposing, constructivist, view. The approach argues against domain-specific innate linguistic knowledge and instead highlights children's sensitivity to syntactical and morphological frequency. Although more fine-grained analysis of naturalistic speech, as well as research into more grammatically diverse languages, have tended to support input-based accounts, none have attempted to test the full noun inflectional system of an inflectionally complex grammar.

Chapter 3 provided an overview of the Lithuanian language and its grammatical inflection system – the focus of this thesis. The chapter presented the complexity of Lithuanian grammatical morphology, which presents challenges to either of the morphology acquisition approaches.

Chapter 4 reported a naturalistic language study, in which the spontaneous speech of a two-year-old girl and her mother were analysed. The results did not follow the predictions of either approach fully – significant differences in the mother's and the child's productivity with noun inflections were found only with the least conservative measurements; most of the errors were found in the medium-frequency cases, rather than the lowest frequency ones; the child did not always

default to a more frequent form of the noun. However, there were clear differences of production rates based on stem and ending frequencies, which is more difficult to explain under the generativist account compared to the constructivist account.

Chapter 5 described a study designed to address the main weakness of the naturalistic language research – the lack of context variety in the child's speech – an elicited production experiment, which covered the whole noun case system. The results broadly supported the constructivist predictions with both phonological neighbourhood density and token frequency playing a role in predicting correct production rates, as well as defaulting patterns. The use of familiar nouns, however, made it difficult to distinguish between the roles of direct and analogy formation on noun inflection.

This ambiguity was addressed in Chapter 6, which described an elicited production experiment using novel nouns. As novel noun inflection cannot be based on direct retrieval from memory, the effects of surface form frequency can be easily separated from the effects of inflection frequency. The results confirmed the significant effect of phonological neighbourhood density on correct form production rates, which further demonstrated that input frequency-based accounts can explain the findings better than generativist accounts. The current chapter discusses theoretical implications of the findings, potential criticisms and refinements of the studies, as well as areas of future research arising from each of the studies. Overall implications of the results of the studies for the main theoretical explanations of morphology acquisition are discussed at the end of this chapter.

7.2 Naturalistic speech

Study 1 investigated a two-year-old child's use of Lithuanian noun morphology and error patterns.

7.2.1 Conclusions and theoretical implications

Naturalistic data studies have often been used as evidence for generativist approaches to morphological acquisition, as findings of overall low error rates were interpreted as the child showing adult-like knowledge of the inflectional system (e.g., Harris & Wexler, 1996; Hoekstra & Hyams, 1998; Hyams, 1986; Marcus et al., 1992; Poeppel & Wexler, 1993; Stemberger, 1989). However, as Rubino and Pine

(1998) and Aguado-Orea and Pine (2015) demonstrated, controlling for such factors as sample size and inflectional knowledge, as well as more in-depth analysis of errors, can reveal patterns contradicting claims of full early productivity.

Two major analyses were conducted on the naturalistic data: productivity and error analyses. The productivity analysis was used to compare whether the child was equally as flexible with her use of noun cases as her mother. The error analysis was used to test constructivist predictions regarding possible patterns in the child's erroneous utterances.

The productivity analysis revealed mixed results. A significant difference in the child's and the mother's use of noun cases was found with the least conservative measures: when the speech samples included matched lemmas or were controlled for vocabulary range only, and vocabulary range and sample size, but only when both singular and plural forms were analysed. The differences disappeared in the singular form condition, and once the samples used for comparison took vocabulary range, sample size and the child's inflectional knowledge into account. Although the least conservative analyses support the constructivist idea that the child will be less productive with inflectional use than the adult due to the child's dependence on slot-and-frame templates (e.g., *duok X- ą* [= give me X]), the results of more controlled analyses did not support the idea. While this may be interpreted as evidence that the child and the mother essentially had the same grammars, it is possible that the differences disappeared due to the reduced amount of analysed data with more control – the number of tokens roughly halved between the vocabulary range only condition and the most conservative condition.

The overall error rate of 6.21% is in line with previous studies, (e.g., Hoekstra & Hyams, 1998; Marcus et al., 1992; Poeppel & Wexler, 1993), and could therefore be interpreted as supporting Wexler's (1998) claim of very early productivity. Under a generativist account, it is expected that once a child learns a rule (here a rule for noun inflection), they should be able to apply this rule to all relevant items (here, noun stems and morphemes). Although there are no detailed explanations of how such a rule would apply to a language with complex noun morphology, there is no reason why errors would appear at different levels throughout the inflectional system and would be related to lexical meaning or

frequency. However, a more detailed analysis has revealed a wide range of error levels – from performing at ceiling level (e.g., 0% errors in the dative context) to over a fifth of genitive contexts coded as errors.

Although the error data at first glance do not completely follow the frequency patterns, the child's erroneous responses can be better explained under a constructivist than generativist account. That said, although a constructivist account would seem to predict a straightforward negative correlation between input frequency and error rates, in fact, most errors were seen with medium frequency cases and declensions. As schema building is said to be a gradual, item-dependent process (e.g., Tomasello, 2003), it is possible that the child was already productive with high frequency contexts (e.g., nominative forms) and was still relying on rote-learned utterances in low frequency contexts (e.g., locative forms), while the medium-frequency case constructions (e.g., genitive) were still in the process of becoming abstract.

Finally, defaulting data allowed the testing of (mainly) constructivist predictions regarding the types of response a child is likely to produce when failing to produce a correct response. Although there is no detailed generativist account of what type of erroneous inflection is likely to be produced in a language with complex noun morphology, Pinker's dual-route hypothesis (1994) suggests that if the child cannot identify a pre-stored whole lexical item, he or she utilises the default route and combines the default inflection with the stem. However, as there was no evidence that the girl frequently produced one default inflection, the idea of a default route is not well supported by the present data. Conversely, data showing that incorrect productions tended to reflect the substitution of low frequency targets with higher frequency forms of the same noun (e.g., substitution of NOM PLR by NOM SNG) support the notion that inflectional frequency has a strong effect on inflected form production, as predicted by input-driven constructivist accounts. Nonetheless, the child did not always choose the most frequent target form of the relevant noun, demonstrating that factors other than frequency are also influential in morphological development.

7.2.2 Practical and methodological implications

Analysis of children's spontaneous speech data has been a popular method of analysing child language development, resulting in a number of studies concluding that language learning – and, in particular, learning of morphology – is a quick and largely error-free process (e.g., Harris & Wexler, 1996; Hoekstra & Hyams, 1998; Marcus et al., 1992). While the overall error rate data in Chapter 4 is broadly in line with such studies, the large differences in error rates observed across different contexts highlighted the importance of a more fine-grained analysis when dealing with naturalistic data. The findings of higher error rates in the medium-frequency contexts in particular stressed the importance of studying the whole inflectional system, not just the most and the least frequent ends of the spectrum.

Furthermore, the mixed results of the productivity analysis suggest two important implications for future studies. Firstly, child speech should not be investigated in isolation; providing a comparison with their caregivers' speech can add an additional layer of insight and help to differentiate between different theories of inflectional development. Secondly, the density of data is important. While a longer duration of the speech sampling period may allow for the detection of developmental changes over time, a dense sample is vital if the data are to be used to test theoretical claims regarding children's morphology productivity, particularly in less frequent contexts. Indeed, even though the present data were more densely sampled than in most naturalistic data studies, the fact that the controlled analysis reduced the mother's (apparent) productivity to child-like levels suggests that even these data were probably too sparsely sampled to properly test claims regarding productivity.

Looking at the types of errors children make, not just how often they produce erroneous utterances, can also help to test competing predictions regarding the pathways children use to arrive at an inflected form. Such analyses can provide support or challenges not only for broad approaches in general, but also to individual factors within an approach, by e.g., looking at the effect of frequency versus the effect of the phonological neighbourhood density. However, such work would require much fuller child- and child- directed speech corpora.

Finally, unlike many of the previously discussed naturalistic speech studies (e.g., Aguado-Orea & Pine, 2015; Harris & Wexler, 1996; Marcus et al., 1992), the current study investigated noun production, a crucial, yet underinvestigated part of speech. It highlights the importance of theories that work for all morphological paradigms, since some investigate the development of only one part of the speech (for example, the VLM focuses only on tense marking [Legate & Yang, 2007; Yang, 2002]).

7.2.3 Potential problems and refinements

Dense sampling of naturalistic speech has been shown to be an important factor in studies investigating grammar development (e.g., Aguado-Orea & Pine, 2015; Rubino & Pine, 1998), especially if lower-frequency target contexts are of interest. As discussed above, although the present data were more densely sampled than in most comparable studies, they were not as dense as would have been ideal. The data from the current naturalistic study showed extensive overlap between the forms used by the mother and the child, especially when the data were controlled for sample size and inflectional knowledge. Therefore, focusing on obtaining a denser sample could help to explore children's grasp of the lower frequency forms with more precision.

Additionally, the present recordings mostly took place during mealtimes and when the child was getting ready to leave the home, making food and clothing-related utterances somewhat over-represented in the data. The mother frequently asked questions such as *What would you like?* and *What would you like to eat?*, which potentially led to a slight overrepresentation of accusative and genitive target responses. A wider range of settings could potentially show different, and perhaps more representative, patterns of correct productions and errors.

In addition to the restricted number of settings, the child's gender may have also influenced the results. Dabašinskienė (2012) found some differences in the rates of diminutive use in boys' and girls' child speech, as well as their caregivers' child-directed speech. Constructivist theories place a great importance on the type of input children receive, therefore child directed speech tendencies should be considered.

7.2.4 Additional future research

The child produced several declension errors. Unlike incorrect utterances where the wrong case or number was used, declension errors produced novel forms, rather than just an existing form of the noun being used in the wrong context. Most of the declension errors were not simply a substitution of a low frequency declension with a higher frequency one, so neither a frequency-based constructivist account, nor a default-route generativist account can explain such errors easily. Further investigation of whether the incorrect utterances were near replications of previously correctly used utterances could provide evidence for rudimentary slot-and-frame formation, for example:

Ką nori valgyti? (= What do you want to eat?)

Noriu šokolad-o (= I want chocolate)

→ *Noriu X-o* (= I want X)

**noriu sriub-o* (= *I want soup)

Evidence of lexically-specific frames would further challenge generativist accounts, under which children are claimed to be utilising abstract rules and categories at an early age. A more detailed investigation of the development of such frames could also help to build a more specific account of how lexically-specific slot-and-frame units become more abstract.

It was suggested in the naturalistic speech study chapter that the low error rate in the low frequency context may be due to the child still relying heavily on rote-learned forms. To test this possibility, a longer-term naturalistic speech recording study could be conducted to find out if the high error rate levels move from medium frequency contexts to the low frequency ones as the child develops. Such findings would further challenge the generativist claim that child and adult grammars are essentially the same (e.g., Hyams, 1986; Pinker, 1989; Wexler, 1994).

Finally, verbs in Lithuanian are also highly inflected, yet even fewer studies have been conducted investigating verb development. Such research could provide a more direct comparison to studies of other languages, such as Rubino and Pine (1998).

7.3 Familiar nouns

Study 2 investigated 4;0 – 5;5-year-old children's production of the full Lithuanian noun inflectional system using familiar nouns.

7.3.1 Conclusions and theoretical implications

The familiar noun elicitation study was conducted to test specific frequency- and phonology-based predictions of constructivist accounts, which could not be tested fully using the naturalistic speech data due to the lack of variability in spontaneous child speech. The analysis showed that targets with the more frequent declension, case and number inflections were produced correctly more often than the low frequency ones.

Furthermore, using frequency-controlled stimuli allowed testing of constructivist assumptions about inflected noun production in greater detail. The predicted production steps suggested that the child is likely to produce the correct form if the form is frequent in the input; if the form was not available, children were expected to apply the ending of another noun belonging to the same phonological neighbourhood; or if the first two options were unavailable, produce a generally frequent morpheme. A sentence completion study requiring children to produce an inflected noun found that surface form frequency, phonological neighbourhood density and morpheme frequency were all significant predictors of the correct production rate, supporting the constructivist approach. Conversely, these findings do not sit easily with generativist approaches, as they do not explain why a particular aspect of a noun, such as its declension, could predict correct production rate, despite the nouns and inflections belonging to the same abstract categories.

Additionally, predictions of what the child is likely to produce when he or she fails to produce the correct target form were tested by analysing the erroneous responses. Most errors were produced by the child substituting a less frequent inflected form (e.g., INST) with a more frequent one (e.g., ACC). However, the children did not show a preference for only one type of erroneous response, which counts against the generativist claim that the speaker will choose the abstract stem + default inflection route if an already inflected form is not available (Pinker, 1994).

Finally, although most errors were of using an incorrect, but existing word form (e.g., SNG instead of PLR), there were also several declension errors, which effectively resulted in novel forms. Such examples of abstraction demonstrate that any successful model of morphological acquisition should include elements of analogy forming/abstraction (e.g., Ambridge, 2010).

7.3.2 Practical and methodological implications

The elicited production methodology (Chapter 5) proved extremely beneficial in enabling the testing of children's knowledge of the full inflectional paradigm, including both singular and plural forms, rather than – as for naturalistic data – being limited to a restricted number of frequent utterances used in everyday situations, such as meal times. Unlike spontaneous speech, testing an equal number of all the different inflectional contexts allowed to make clear comparisons between different case, number and declension variations. This type of direct comparison is vital in order to allow researchers to directly test predictions of constructivist and generativist approaches regarding the effects of frequency and phonological analogy on productivity.

The use of both higher and lower frequency inflected forms for each of the target contexts countered against any potential unforeseen effects of the lexical item, such as one particular form appearing more than expected in a particular context in the input than expected, or being more difficult to pronounce for a young child, leading them to use a different form or stem.

Compared to some of the elicited production studies discussed previously (e.g., Dąbrowska & Szczerbiński, 2006; Räsänen et al., 2016), the current study tested relatively older children. One of the benefits of testing older children (as well as testing nouns instead of other parts of speech, such as verbs) was the opportunity it afforded of using a more practically convenient mode of stimulus presentation – physical cards instead of videos. It did not appear that children consistently misinterpreted any particular scenario, and the task was not so difficult as to result in the children losing interest. Additionally, as they were older and had received input from a bigger variety of sources by the time of testing, the children's speech input was more likely to be more averaged out and closer to the general adult speech data used for comparison.

Previous experimental studies investigating complex inflectional grammars have shied away from testing the whole system. However, the experiments presented in this thesis have demonstrated that with the help of dividing the trials between children, testing the complete inflectional paradigm is feasible. The results showing different response patterns across different case + number + declension combinations also suggest that focusing only on a few inflections could miss response patterns which could help to support or challenge different language acquisition theories.

The findings of low correct response rates for the low frequency contexts also highlights the importance of challenging the prevailing view that children learning highly inflected languages do not struggle with inflection. The findings could be of particular importance in educational or therapeutic settings, for example by assessing and focusing on children's ability to use less frequent contexts.

Finally, finding similar result patterns across the naturalistic and the elicited production study of large differences in error rates across the system, as well as the tendency to default to a frequent form is a good way to increase confidence in the results of each study.

7.3.3 Potential problems and refinements

In order to test as much of the inflectional system as practically viable, the case used by the experimenter was the nominative form of the noun. As the nominative case is used in declarative contexts, such as *This is a X,* or *Look! It's a X,* and children tested were very familiar with such statements, it was reasoned that using the nominative form is likely to reduce task effects. However, evidence from Krajewski et al. (2011) showed that correct production rates varied depending on the stimulus case in a Polish elicited production study. Furthermore, defaulting to the nominative was the most frequent type of defaulting pattern. However, it is impossible to distinguish between 'true' nominative defaults and utterances in which the child simply repeated the form used by the experimenter. Therefore, an alternative may be to use a variety of stimulus forms and/or use objects familiar to children, so that a stimulus form would not be needed at all.

Another drawback of the study was the relatively low number of participants compared to some other complex morphology elicitation studies (e.g., Granlund et

al., 2019; Räsänen et al., 2016). Although the number of children participating was enough to test the complete paradigm, future studies should aim to test a greater number of children. Practical details, such as nursery seasonal closing times, should also be considered when designing the studies.

Although two nouns were used for each declension to control for any stem effects, a more direct way of investigating the effects of phonological neighbourhood effect could be to test low frequency declension nouns and their diminutive counterparts. As the diminutive forms in Lithuanian use one of the more frequent declensions, high productivity rates with diminutive forms and low productivity rates with low frequency declension simplex forms could be used as evidence for phonological neighbourhood size influence. Additionally, such a setup could help to account for stem frequency and object familiarity. On the other hand, it has been suggested that diminutive forms are often easier to produce due to standardised stress patterns (Kempe et al., 2009; Savickienė et al., 2009), so careful stress pattern matching would also be required.

Analysis of the data depended significantly on the use of the spoken data corpus frequency counts, which mostly relied on adult speech. As Dabašinskienė and Kamandulytė (2009) demonstrated, some differences between adult-directed, child-directed and child speech can be found in the Lithuanian language. Obtaining a large, child-directed speech corpus could help to improve the accuracy of the analysis, as well as allowing for well-powered, tightly-controlled naturalistic analyses.

7.3.4 Additional future research

It has been suggested that the free stress pattern of the Lithuanian language may affect noun acquisition (Savickienė et al., 2009). The stimulus nouns used in the familiar noun elicitation study were two syllables long in their singular nominative form, which helped to limit any potential stress pattern effects. However, investigating production differences based on stress pattern frequency could provide an even more fine-grained test of constructivist accounts of inflection production. On the face of it, frequency effects at the level of stress patterns would seem to be more naturally explained by such accounts than by generativist accounts, which view

inflection as an abstract process of feature checking, far removed from phonetic details such as stress patterns.

As discussed in Chapter 5, Granlund et al. (2019) raised the issue of using overly synthetic declensional categories and proposed a new method of PND calculation based on the target item's similarity to other items, irrespective of their official declension class. The creation of such item-based PNDs could help to explain the findings of Krajewski et al. (2011), as well as inform predicted production rates in complex inflectional systems, such as Lithuanian. For example, a similar measure could account for certain low frequency declension+case+number combinations sharing an inflection with a more frequent context. Furthermore, the use of more precise PNDs could also potentially help to explain the link between the age, token frequency and the PND. For example, Rispens and de Bree (2014) found that token frequency becomes more important in predicting children's correct production rates as they get older, while Dąbrowska and Szczerbinski (2006) found the opposite.

Alternatively, replicating the study with a wider age range and with more defined age groups could help to support and challenge different constructivist claims. For example, findings of surface form frequency being a better predictor for younger children, with the phonological neighbourhood density dominating older children's correct production rate prediction, would support Dąbrowska and Szczerbinski's (2006) suggestion that younger children rely on low-level abstractions, which become more generalisable as they get older. The reverse finding would support Rispens and de Bree's (2014) claim that children need to amass a significant number of tokens before their effects begin to significantly affect production rates. As token frequency and the PND play a crucial role in constructivist accounts, using more precise PND measures and establishing the order the different types of frequencies children rely on the most during their morphological development could lead to a more precise account.

7.4 Novel nouns

Study 3 investigated 4;1 – 5;5-year-old children's production of the full Lithuanian noun inflectional system using novel nouns.

7.4.1 Conclusions and theoretical implications

As predicted, the analysis showed that targets with the more frequent declension, case and number inflections were produced correctly more often than the low frequency ones. Although there were some differences between analyses based on data with the most syncretic declensions merged and treated as separate, the general direction of the correct production resembled familiar noun data closely.

Nonetheless. the primary objective of the novel noun elicitation study was to help to differentiate the effects of phonological neighbourhood density and token frequency on rates of correct production. In line with constructivist predictions, children were expected to form a correct response using a phonological analogy based on its phonological neighbourhood, default to a more frequent case/number-marked ending, or, if neither of these options were available, use a generally frequent morpheme.

The results again showed clear effects of phonology and frequency, with phonological neighbourhood density and overall morpheme frequency acting as significant predictors of correct production rate. The error analysis provided further evidence for the importance of input-based predictors on production: most erroneous responses were due to children defaulting to a more frequent case- and/or number-marked form. There were several instances of declension shift; however, the majority of such responses used a more frequent declension than the target declension. The clear differences between frequent and infrequent forms in both the production of correct and incorrect nouns provide support for constructivist theories, which consider frequency to be an integral part of inflectional development. Conversely, it is difficult to see how a generativist rule-based account could explain this pattern of results. A dual-route model could trivially succeed by using the irregular route for the entire paradigm, though this would make it indistinguishable from a single-route constructivist account. Alternatively, it could posit one particular ending (e.g., NOM SNG 1.1 declension) as a default; but this solution would also be rather unsatisfactory since no single form accounted for a large proportion of errors.

As discussed in Chapter 2, Ambridge (2019) proposed that abstractions may be superfluous to grammar and inflections can be produced through an analogy formed in the moment based on previously stored exemplars weighted by their level

of similarity to the target. Lithuanian noun inflection system was used as one of the examples to show that the number and the complexity of abstractions needed to account for all number+case+declension combinations made the exemplars-only proposition more appealing. The findings that the PND – built on previously rote-learned exemplars – plays an important role in morphology provide potential evidence that exemplars are indeed important in inflection formation, at least in the early stages of language. However, more details need to be provided on the similarity weighing to explain findings such as why children are more likely to produce a case, instead of a number or declension error. Additionally, as noted by the Ambridge (2019), the current exemplar-only models do not take into the account token frequency, which was shown to influence production in the previous studies.

Finally, although the elicitation studies used the SVO order, and it is unclear to what extent the word order influenced the results, the data could potentially fit with the Bates and MacWhinney's Competition Model (1987, 1989). It was noted that the instrumental case, which is often preceded by the preposition *su* (= with) and therefore could be considered as having high reliability performed better than expected. Furthermore, out of the least frequent declensions, 5.1 declension outperformed declensions 3.1 and 4.1. Despite availability being low for all three, declension 5.1 includes the addition of the suffix *-en-* in almost all number + case combinations, potentially increasing its salience and/or reliability cue values.

7.4.2 Practical and methodological implications

Unlike many studies that only focused on only some of cases, testing the whole system showed that even older children struggle with low frequency contexts, further challenging the idea of early productivity (e.g., Marcus et al., 1992; Schütze & Wexler, 1996; Wexler, 1998). In terms of methodological implications, it is surprising – given the long history of "wug tests" (e.g., Berko, 1958), how infrequently novel nouns have been used to investigate children's productivity with inflectional morphology, particularly for highly complex systems. The present study shows that this can certainly be done, in a way that covers the entire paradigm, and with children who are – although perhaps rather old relative to many participants in studies of child language acquisition – still young enough to make the types of errors that can be used to differentiate between theories.

Additionally, unlike studies investigating the English past tense or plural production (e.g., Marchman, 1997; Marchman et al., 1999), the current study required children to substitute, rather than add inflections to the stem. The additional task of word segmentation may have partly influenced the low correct production rate.

Furthermore, findings of similar correct production and defaulting patterns between the familiar noun study, which used familiar objects, and the novel noun study, which used novel creatures, demonstrated that the stimulus action or the target familiarity had limited effects.

Finally, all three studies – spontaneous speech analysis, familiar and novel noun elicitation experiments – resulted in similar findings, increasing the confidence in the results. Indeed, this is probably the first time that a particular complex inflectional system has been investigated with all three methods at once. Together, the studies help to create a possible explanation of not just what types of frequencies are important in inflectional development, but also suggest the pathways children might take when producing an inflected form. Additionally, the studies highlight important limitations of different methodologies, such as the lack of low frequency contexts in spontaneous speech samples, and the practical demands of testing a complex inflectional paradigm in full. It is suggested that future studies into complex morphology would consider using both naturalistic and experimental methods together, in order to ensure that no important patterns of results are missed due to methodological limitations.

7.4.3 Potential problems and refinements

The novel targets used in the unfamiliar noun study sounded natural to a native Lithuanian speaker. However, there is a possibility that some of the stems used may have resembled existing stems more than others, which may have facilitated production. Asking adults to rate the "naturalness" of the stimulus nouns and/or measuring unfamiliar stem distance from existing nouns more formally could help to address the potential confound.

Similarly, the stimulus creatures were designed in a way that they would look like living beings, without closely resembling any familiar animals. Nonetheless,

additional measures could be taken in order to check that children do not associate them with any familiar objects, such as cartoon characters. For example, a separate group of children could be asked to give the creatures names, without any prompt. Findings of any names repeating for the same creatures could suggest an association with an existing object.

7.4.4 Additional future research

The constructivist approach places a great amount of importance on the phonological neighbourhood density (e.g., Ambridge, 2010; Kirjavainen, et al., 2012; Marchman, 1997), which was reinforced by the findings in the current study. However, Vaicekauskienė, Dabašinskienė and Kamandulytė-Merfeldienė (2014) found that adults do not always apply the most frequent declension to new words borrowed from other languages. A study investigating adult choices for novel noun endings could further inform which phonological factors play a significant role in inflection production, which could in turn help to build better controlled child inflection acquisition research.

Many of the studies reporting low error rates in inflection use in children have focused on the addition, rather than the substitution, of inflectional morphemes, such as the past tense *–ed* or the plural *–s* in English (e.g., Marcus et al., 1992; Schütze & Wexler, 1996; Van der Lely & Ullman, 2001). The substitution nature of the study, especially considering the large number of inflections available, may have resulted in a relatively low correct response rate. In addition to the potential high cognitive load, the low correct response rates may be the product of children struggling to segment the noun, especially as they could not rely on direct retrieval in the novel noun study. Presenting the novel nouns in two different cases (e.g., nominative and accusative as the stimulus cases, and instrumental as the target case) could help the children to segment the target words. While this may inflate the correct response rates across the system, it could also reduce the rate of no responses. Further analysis of the kinds of endings children use when they make an error could further help to distinguish between the theoretical approaches; findings of a consistent default rule pattern would support the generativist approaches, while the production of various high frequency morphemes would support the constructivist

approaches. A more detailed analysis could also help to investigate potential frames children use in different contexts.

It is also important to note that both experimental studies were studies of production, rather than comprehension. Although there have been relatively few studies focusing on comprehension in a non-English setting, pointing and act-out studies, which can be used to test children at earlier stages than the corresponding production studies, have suggested that word order plays an important part in sentence comprehension for young children, even in languages with more case marking and less static word order than English (e.g., Bates et al., 1984; Dittmar, et al., 2008; Krajewski et al., 2010). As discussed in Chapter 1, Lithuanian allows any SVO order combination, with the direction of action marked in case inflections. Therefore, Lithuanian nouns are highly suited to such studies. While the SVO order would be predicted to be the easiest for children under either approach (either due to default route setting according to the generativist approach, or the high word order frequency according to the constructivist approach), frequency-based pattern across the less frequent orders would point to an input-based explanation.

In addition to testing the influence of word order on morphology, other factors in morphological development, such as the openness of the case, or the interplay between token frequency and the PND, could be explored. For example, findings of younger children performing better with high PND, low token frequency targets, with the reverse findings for older children would point to the PND exerting more influence on morphology at the early stages, with token frequency overtaking later in the development.

Finally, as methodologies used in comprehension studies, such as pointing, acting-out or eye-tracking do not require children to speak, they could be used to investigate case development at earlier stages of development.

7.5 Comparison with Polish data

Due to the similarities between Polish and Lithuanian noun systems, it is worth comparing data presented in this thesis to previous data on Polish morphology. While findings across the two languages are broadly consistent, the need for more investigation into age and phonological neighbourhood effects have also been found.

Although the conclusions of Lithuanian naturalistic speech data presented in this thesis differs to Weist et al. (1984), who concluded that Polish children produce few inflectional errors even at early stages of language production, the differences might be due to the lack of fine-grained analysis in the Polish data. The error rate was also higher than the error rate reported in Dąbrowska (2001). In fact, while the error rate for the Polish genitive was only 0.5% - 2%, the error rate fir the Lithuanian genitive was 19%. However, the age range in the Polish data was notably more wide-spread (1;4-4;11) than that of Lithuanian (2;6-2;8). A broad-brush presentation of error rates at different ages showed that the rate varied significantly throughout the duration of the Polish study, up to 33% for genitive plurals at 3;8 for one of the children. The variation in error rates further supports the suggestion that children may produce more errors while moving away from rote-learned items to abstract schemas. Furthermore, both sets of data did not show evidence for a 'default' but did find that children were likely to use a more frequent inflection in erroneous productions, supporting constructivist accounts. Finally, Krajewski et al. (2012) found somewhat stronger evidence that adult speakers are significantly more flexible with their use of inflections than children. However, the analysis methods were not identical and both studies share similar overall direction of the results suggesting that children's morphological development is more gradual than what is predicted by generativist accounts.

Elicited production studies in Lithuanian and Polish have consistently found token frequency to be a significant predictor for correct production rates (e.g., Dąbrowska & Szczerbinski, 2006; Dąbrowska, 2008; Granlund et al., 2019). Furthermore, data for both languages revealed large differences in error rates across the inflectional system (Dąbrowska & Szczerbinski, 2006). However, data from Lithuanian and Polish noun studies show that the effects of age and phonological neighbourhood density need to be explored further. For example, age has been found to be a significant predictor in Polish (Krajewski et al., 2011, Granlund, 2019) but in Lithuanian, it was significant only in the novel noun elicitation study. Furthermore, phonological neighbourhood density has been found to be a significant predictor in both Lithuanian and previous Polish elicitation studies (e.g., Dąbrowska & Szczerbinski, 2006; Dąbrowska, 2008). However, Granlund et al. (2019) found that the effects of phonological neighbourhood density were not consistent depending on

the type of analysis used to examine the data. Nonetheless, all studies found that the data could not be explained by a generativist, rule-based approach and instead advocated for a gradual, constructivist approach.

7.6 Conclusion

Chapters 1 and 2 outlined how two opposing approaches to language acquisition – generativist and constructivist – explain morphologically complex language acquisition, as well as highlighting areas requiring more research. While the generativist approach sees morphological development as a quick process based on pre-existing abstract rules and grammars, which are essentially the same as adults' grammar structure, the constructivist approach argues that the process is relatively slow, and that abstract knowledge is built on input exemplars and that both correct and erroneous utterances are susceptible to frequency effects. The three study chapters addressed many of the questions raised by the differences between these theories by investigating noun inflection development in a highly inflected language.

Together, the three studies provide perhaps the most comprehensive and detailed overview to date of children's acquisition of noun morphology in a highly inflected languages, spanning both spontaneous and controlled settings, as well as a wide age range. The naturalistic language data showed that high degree of (apparent) productivity can be observed in high frequency contexts at an early age. Nevertheless, both the naturalistic data (in the more tightly-controlled analyses) and the elicited production studies demonstrated that full productivity was not achieved even at a relatively late age, especially in low frequency contexts. These findings reinforced the idea that children could be heavily relying on rote-learned forms in less frequent contexts, which may appear as early pseudo-productivity.

Defaulting data from erroneous responses was fairly uniform across the studies: children tended to substitute the target form with a high-frequency form of the same noun with the target case and/or number marking. However, there were also instances of wrong declension application, with children occasionally creating novel forms of the nouns they struggled with. At present, none of the accounts considered really give detailed explanations for exactly when, how and why children generate such forms.

Although there is no detailed generativist theory which makes quantitative predictions regarding children's noun production in a highly inflected language, the different theories belonging to this approach frequently stress the significance of (a) early acquisition (e.g., Schütze & Wexler, 1996), (b) lexicality-free abstraction (e.g., Legate & Yang, 2007) and (c) application of the default inflection when the target form is not available in memory (e.g., Prasada & Pinker, 1993). However, findings of (a) considerably less than full productivity even by 5;5, (b) significant effects of whole form, declension and inflectional morpheme frequency and (c) the lack of one dominant erroneous response (or "default route"), are difficult to explain under rules-driven generativist theories.

The input-based constructivist approach, on the other hand, provides a more successful – if still rather underspecified – account of noun production amongst young children learning a highly inflected language. Evidence for slow- and late-emerging productivity, with clear differences between high and low frequency contexts, as well as children's tendency to produce highly frequent forms in erroneous productions clearly support the constructivist approach. In particular, the elicited production experiments were able to demonstrate the importance of phonological neighbourhood density, as well as form and ending frequency on noun production.

The analyses also demonstrated the importance of considering a detailed breakdown of the data, as significant differences in production across the system are obscured if only overall production rates are reported. The findings also showed that investigating what children produce when they produce an incorrect form may be as informative, or even more informative, than looking simply at rates of correct responses versus errors.

To sum up, the present findings highlight the need for both further empirical work, and further theoretical development. On the empirical side, there is a clear need for larger and more densely sampled corpora, and larger, better powered elicited production studies with children across development. On the theoretical side, although the overall trends in the results clearly supported the constructivist approach, some findings – especially children's declension errors and "defaulting" to erroneous forms that are not particularly frequent – are not naturally explained by

this approach (or the rival generativist approach) in its current form. Computational modelling work may be useful here (e.g., Engelmann et al., 2019), since such models make precise quantitative predictions about both the frequency and types of errors that would be expected across different parts of the paradigm.

In conclusion, it is to be hoped that the studies set out in this thesis inspire, and provide a framework for, more work investigating the acquisition of inflectional morphology in highly-inflected languages, particularly those that currently remain under-studied. Despite their clear importance for theories of both morphological development and language acquisition more generally, detailed quantitative research into children's acquisition of these systems has barely begun.

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