UNIVERSITY OF AMSTERDAM

UvA-DARE (Digital Academic Repository)

Acquiring diminutive allomorphs: taking item-specific characteristics into account

Boersma, T.; Rispens, J.; Weerman, F.; Baker, A.

DOI
10.1017/S0305000919000047

Publication date
2019

Document Version
Final published version

Published in
Journal of Child Language

Link to publication

Citation for published version (APA):
Boersma, T., Rispens, J., Weerman, F., & Baker, A. (2019). Acquiring diminutive allomorphs: taking item-specific characteristics into account. *Journal of Child Language*, *46*(3), 567-593. https://doi.org/10.1017/S0305000919000047

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: https://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

UvA-DARE is a service provided by the library of the University of Amsterdam (https://dare.uva.nl)

Download date:20 Oct 2021

Journal of Child Language (2019), **46**, 567–593
doi:10.1017/S0305000919000047

CAMBRIDGE
UNIVERSITY PRESS

ARTICLE

Acquiring diminutive allomorphs: taking item-specific characteristics into account

Tiffany BOERSMA[1], Judith RISPENS[1]*, Fred WEERMAN[1], and Anne BAKER[1,2]

[1]ACLC, University of Amsterdam, the Netherlands and [2]University of Stellenbosch, South Africa
*Corresponding author. E-mail: J.E.Rispens@uva.nl

(Received 21 July 2017; revised 22 March 2018; accepted 25 January 2019;
first published online 11 March 2019)

Abstract

Phonological characteristics and frequencies of stems and allomorphs have been explored as possible factors causing differences in production accuracies between allomorphic forms. However, previous findings are not consistent and the relative contributions of these factors are unclear. This study investigated target and erroneous productions of the Dutch diminutive, which has five allomorphs with varying type frequencies and of which the selection depends on the phonological characteristics of the stems. Typically developing children (N = 115, 5;1–10;3) were tested on their production of real and nonce diminutives. Linear mixed effects modelling was used to analyse the data taking nonverbal IQ into account. Type frequencies of the allomorphs and differences in phonological characteristics of the stems were found to be related to differences in production accuracies between the allomorphs. However, phonological characteristics of the stems appeared to have a bigger impact, mainly due to the phonological complexity of these characteristics.

Keywords: morphophonology; frequency effects; diminutive acquisition

Introduction

Using morphophonological constructions involves changes in the surface phonological forms of stems and suffixes and thus requires the phonological analysis of morphemes. Morphophonological patterns are complex to acquire and are likely to entail many errors during development (Buckler & Fikkert, 2016; Pierrehumbert, 2003; Tomas *et al.*, 2017a; 2017b; Zamuner, Kerkhoff, & Fikkert, 2012). Differences in production accuracies of allomorphs, i.e., phonologically variant forms of morphemes, have been observed in many languages with some allomorphic forms reaching adult-like accuracies before others (Bybee & Slobin, 1982; Kerkhoff, 2007; Matthews & Theakston, 2006; Rispens & de Bree, 2014; Royle & Stine, 2013; Song, Sundara, & Demuth, 2009; Tomas, *et al.*, 2015; Tomas *et al.*, 2017a, 2017b; Zamuner *et al.*, 2012, amongst others). Some researchers attribute this variation to effects of type or phonotactic frequencies mostly (among others Blom, Paradis, & Duncan, 2012; Bybee, 2007; Bybee & Slobin, 1982; de Bree & Kerkhoff, 2010; Marchman, 1997; Matthews & Theakston, 2006; Zamuner *et al.*, 2012), while others acknowledge the

© Cambridge University Press 2019

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

phonological characteristics of the stems that give rise to the allomorphs which lead to more or less phonologically complex representations (among others Berko, 1958; Marchman, Wulfeck, & Weismer, 1999; Marshall & Van der Lely, 2006; Mealings, Cox, & Demuth, 2013; Oetting & Horohov, 1997; Song *et al.*, 2009; Tomas *et al.*, 2017a; Tomas *et al.*, 2015).

The main aim of the present study was to investigate possible factors involved in the production of morphophonological patterns: phonological characteristics of the stem, phonotactic frequencies of the stem and allomorph, and type frequencies of the allomorphs. In previous studies these factors have been studied in isolation. In the current study the goal was to investigate the relative influence of these three factors on the production of the Dutch diminutive, which has five allomorphs. Production accuracies of these allomorphic forms were investigated and we analysed what kind of substitutions were produced, i.e., which allomorph was used instead of the expected allomorph. Below, we will first report on previous studies that have found a protracted course of acquisition of some allomorphs and the factors they attribute this to. Subsequently, the formation of the Dutch diminutive will be expanded on, followed by a more extensive overview of the goals and expectations of the current study.

The acquisition of morphophonological phenomena

The acquisition of a range of morphophonological phenomena has been studied in different languages and across different populations. The general finding of these studies is that morpho(phono)logical processes, such as the past tense or subject–verb agreement, are not acquired 'all-at-once', but that variation in the speed of acquisition exists between the different allomorphic forms reflecting these phenomena (Berko, 1958; Blom, 2003; Blom *et al.*, 2012; Kerkhoff & de Bree, 2004; Marchman *et al.*, 1999; Oetting & Horohov, 1997; Paradis, Tulpar, & Arppe, 2016; Rispens & de Bree, 2014). For example, the regular past tense in English can be expressed by three allomorphs /t/, /d/, and /ɪd/. Several studies have reported that the past tense forms of verbs that take the syllabic /id/ allomorph are acquired more slowly by typically developing (TD) children, children with English as their second language, and in children with language impairments (Blom & Paradis, 2013; Marchman, 1997; Matthews & Theakston, 2006; Oetting & Horohov, 1997; Paradis *et al.*, 2016; Tomas *et al.*, 2017a). Different explanations have been given for this protracted acquisition of some allomorphs. Frequency of the stems and stem +allomorph combinations and complexity of the morphophonological pattern may play a role in morphophonological development. The sections that follow will first expand on studies showing effects of frequency and will then describe studies that have found that the phonological complexity of the combination of stem+allomorph has an effect on production.

Previous research has shown that the higher the type frequency, the earlier the allomorph is acquired (Blom *et al.*, 2012; Bybee, 2007; Bybee & Slobin, 1982; Marchman, 1997; Matthews & Theakston, 2006). Type frequency is a measure of how many items a certain pattern, such as an allomorph, is applicable to, and has been shown to play a role in morphological productivity (Bybee, 1985, 2007). The allomorph that is attached most often to known items will most probably also be applied to new items (Bybee, 2007). It is, for example, assumed that highly frequent past tense markers, i.e., with the highest type frequency, are the most productive. In

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

the case of the English past tense, the /ɪd/ allomorph has the lowest type frequency and is also the least productive (Blom & Paradis, 2013; Blom *et al.*, 2012; Marchman, 1997; Matthews & Theakston, 2006; Tomas *et al.*, 2017a). As will be elaborated on in the next section, the few studies that have investigated the Dutch diminutive have also found that type frequencies of the different diminutive allomorphs affected production accuracies (Den Os & Harder, 1987; Peelaerts, 2008; Snow, Smith, & Hoefnagel-Höhle, 1979). In contrast, Rispens and de Bree (2014) did not find an effect of type frequency on production accuracies of the Dutch past tense in TD children and children with language impairment. They found that children produced the voiceless /tə/ past tense allomorph more accurately compared to the voiced /də/ allomorph, although the /də/ allomorph has a higher type frequency (62%) compared to the /tə/ allomorph (38%). However, the final consonants of the verb stems included in their study combined with the allomorph /tə/ had a higher phonotactic frequency than the final consonants of verb stems and /də/. They argued that this made it easier for the children to use /tə/ as the combinations of stem+/tə/ are more frequent in Dutch than stem+/də/. Phonotactic probability or phonotactic frequency is defined as the probability/frequency that adjacent phonemes (biphones) appear together in a language. In several previous studies effects of phonotactic frequency on the production of morphophonological phenomena have been reported as well (de Bree & Kerkhoff, 2010; Kerkhoff, 2007; Zamuner, Kerkhoff, & Fikkert, 2006; Zamuner *et al.*, 2012).

Next to these frequency accounts, explanations based on phonological and/or phonetic mechanisms have been given for findings in studies investigating English past tense, plural, and third person singular marking. For example, effects of coda complexity, articulatory difficulties, and perceptual saliency have been found (Berko, 1958; Marchman *et al.*, 1999; Marshall & Van der Lely, 2006; Mealings *et al.*, 2013; Oetting & Horohov, 1997; Song *et al.*, 2009; Tomas *et al.*, 2015; Tomas *et al.*, 2017a). Variations in the phonological characteristics of stem+allomorph combinations thus also impact on children's ability to use morphemes. For example, Song *et al.* (2009) tested the third person singular in English TD children between the ages of one and three-and-a-half. They found that children produce the third person singular suffix /s/ more accurately in phonologically simple coda contexts where there is no consonant cluster in the resulting coda, e.g., *sees*, as compared to complex coda contexts, where production of the stem + suffix results in a coda containing a consonant cluster which is more complex relative to a singleton coda, e.g., *needs*. These findings thus provide support for the role of phonological complexity in morphophonological accuracy. Furthermore, results of many studies indicate that children tend to acquire syllabic allomorphs (in which the suffix is expressed by adding a syllable to the stem) later than segmental ones, in which the suffix is expressed by adding a sound to the stem, which does not lead to an addition of a syllable (Berko, 1958; Marchman, 1997; Matthews & Theakston, 2006; Mealings *et al.*, 2013; Song *et al.*, 2009; Tomas *et al.*, 2015; Tomas *et al.*, 2017a). In the case of the English past tense and plural, stems that take the syllabic allomorphs (/iz/ and /ɪd/) end in an alveolar (past tense) or sibilant (plural) phoneme, which might make children think that these stems are already inflected (Berko, 1958; Marchman, 1997; Matthews & Theakston, 2006). However, Mealings *et al.* (2013) tested the English plural in two-year-olds and did not find any evidence for this hypothesis. Instead they argued that their results demonstrated that the children understood that something needed to be added to the noun, but had difficulty

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

articulating the entire morpheme as it involves a complex phonemic sequence. Testing derivational morphology in children between the ages of eight and ten, Jarmulowicz and Hay (2009) showed that children found it easier to produce derived forms that were phonologically consistent with their noun stems in terms of stress placement and syllabification, e.g., *kind–kindness*, than words that exhibited changes, e.g., *alphabet–alphabetic*. Together these studies indicate that the variable production accuracies of allomorphs seem to be related to the phonological characteristics and complexity of the stems to which the allomorphs are attached.

In sum, the aforementioned studies provide evidence for the importance of both frequency, not only type but also phonotactic frequency, and the phonological characteristics of the stems and allomorphs. However, the relative impact of these factors on morphophonological acquisition is unclear as these factors are generally studied in isolation. The goal of this study is to gain a better understanding of why some allomorphs are acquired before others by focusing on the Dutch diminutive. By doing so it is possible to evaluate the effects of frequency and complexity of the phonological characteristics as the Dutch diminutive entails five allomorphs based on different phonological characteristics and with varying type and phonotactic frequencies (see below).

The Dutch diminutive

In Dutch, diminutives have been used relatively frequently for a long time; they have been encountered in texts from the Middle-Dutch period, and are still a frequent phenomenon in everyday language. The most common way of forming a diminutive is by attaching the diminutive suffix to nouns (*hond-je* 'dog-DIM'). However, it can also be attached to other word classes, a process that results in a change of word class: adjectives (adjective *klein* + DIM *tje* > noun *kleintje*; adjective 'little' + DIM > noun 'little one'), verbs (verb *speel* + DIM *tje* > noun *speeltje;* verb 'play' + DIM > noun 'small toy'), and a few prepositions (preposition *uit* + DIM *je* > noun *uitje;* preposition 'out' + DIM > noun 'short trip'). Semantically, the diminutive usually expresses smallness in that the referent is a smaller version of its sort but it can also express the fact that a referent is a great deal smaller than the speaker, i.e., a human being (Bakema, Defour, & Geeraerts, 1993; Peelaerts, 2008). As in many languages, the diminutive can also express an affective meaning. In colloquial Dutch it is considered normal to use the diminutive form in other instances as well. Examples of diminutives used in this way are *collegaatje* (colleague + DIM suffix referring to an adult colleague); *vriendje* (boyfriend + DIM suffix referring to an adult); *wijntje/biertje* (glass of wine/beer + DIM suffix in which no small glass is intended).

The Dutch diminutive consists of five allomorphs, /jə/, /tjə/, /pjə/, /kjə/, and /ətjə/, which are attached to the noun stems based on the phonological characteristics of these stems. A summary of the regularities of the context in which the different allomorphs can appear as provided by Booij (1995) is listed in (1) to (5).

(1) /jə/ appears after stem-final obstruents

Hof 'yard'	*hofje*
Baas 'owner'	*baasje*
Huis 'house'	*huisje*
Kat 'cat'	*katje*

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

(2) /pjə/ appears after /m/ except if preceded by a short vowel

Boom 'tree'	*boompje*
Duim 'thumb'	*duimpje*
Raam 'window'	*raampje*
Zalm 'salmon'	*zalmpje*

(3) /kjə/ appears after /ŋ/ except when there is no stress on the penultimate syllable

Woning 'home'	*woninkje*
Koning 'king'	*koninkje*
Botsing 'crash'	*botsinkje*
Ontploffing 'explosion'	*ontploffinkje*

(4) /tjə/ appears after /n/, /r/, or /l/ except if preceded by a short vowel

Laan 'lane'	*laantje*
Veer 'feather'	*veertje*
Schoen 'shoe'	*schoentje*
Boon 'bean'	*boontje*

(5) /ətjə/ appears after sonorant consonants if preceded by a short vowel with primary or secondary stress

Bal 'ball'	*balletje*
Bom 'bomb'	*bommetje*
Tekening 'drawing'	*tekeningetje*
Ring 'ring'	*ringetje*

The formation of the diminutive form can be described by three processes by which the underlying form /tjə/ also can surface as /jə/, /pjə/, /kjə/, and /ətjə/ (Booij, 1995; Van de Weijer, 2002). In the case of /pjə/ and /kjə/, the diminutive form is determined by place assimilation: the first consonant of the allomorph shares the place of articulation with the final consonant of the stem and replaces the /t/ of /tjə/. The allomorph /pjə/ is used in the case of stems ending in a nasal labial, for example *raam-pje* 'window'. Stems ending in a nasal velar take the allomorph /*kjə*/, for instance in *koning-kje* 'king'. To illustrate place assimilation; in the case of the first example the final consonant of the noun *raam* and the first consonant of the allomorph /pjə/ are both bilabial and thus have a similar place of articulation.

In the case of stems ending in an obstruent, combining an obstruent with /tjə/ results in a complex obstruent cluster which is subject to the phonological process of t-deletion in Dutch (Booij, 1995). For example, *dop* 'cap' + *tje* results in *dopje* after t-deletion in *doptje*. Thus, /jə/, /pjə/, /kjə/ diminutives are derived by stem + *tje* and are subject to the Dutch phonological processes place assimilation and t-deletion.

The insertion of an /ə/ in front of /tjə/ follows from different phonological processes. For stems ending in a velar sonorant, stress placement on the stem (ultimate vs. penultimate) and the number of syllables is relevant; compare *koning-kje* 'king' versus *ring-etje* 'ring'. For stems ending in a sonorant labial or alveolar, the length of the vowel is relevant; compare *boom-pje* 'tree' with a long vowel versus *bom-etje* 'bomb' with a short vowel; similarly *zoon-tje* 'son' versus *zon-etje* 'sun'. The allomorph /ətjə/ is therefore derived by inserting an /ə/ in front of /tjə/ when the stem ends in a velar sonorant and stress lies on the ultimate syllable or when the stem ends in a sonorant labial or alveolar and the vowel is short. Also, as a consequence of the insertion of the schwa, the diminutive form of the noun is two syllables longer than the original noun (for example *ring–ringetje* 'ring'), instead of one syllable longer (compare *boom–boompje* 'tree'). As mentioned above, studies

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Table 1. Type frequencies per allomorph expressed as percentage of all diminutive use

Allomorph	Type frequency (%)
/jə/	56.8
/tjə/	32.6
/ətjə/	7.4
/pjə/	1.9
/kjə/	1.3

Notes. The type frequencies are based on the SUBTLEX-NL database, which is a database based on subtitles (Keuleers *et al.*, 2010). In the type frequency count of the allomorph /tjə/, nouns with a stem ending in a /t/ or a /d/ such as *maat-je* 'mate' are included although these nouns are actually derived with a stem + /jə/. We chose the /tjə/ calculation due to the syllabification of the word (maa + /tjə/). To calculate the type frequency of /kjə/, we selected nouns ending in a /ŋ/ which were followed by /kjə/ in the database. Words like *haak-je* 'hook' are not taken into account.

have found that allomorphs which make words longer have lower production accuracies (Song *et al.*, 2009; Tomas *et al.*, 2015; Tomas *et al.*, 2017a).

In all, the allomorph /ətjə/ seems to be more complex to derive correctly as multiple phonological characteristics of the stem need to be taken into account (see Dahl, 2004, for a definition of complexity that relates to this idea of complexity), compared to the other allomorphs. Moreover, its application results in an extra syllable compared to the other allomorphs. As a consequence, it might be expected that /ətjə/ is more difficult to acquire. In a previous study testing the productivity of the Dutch diminutive in adults, it was found that, for nonce nouns that take /ətjə/, adults only produced the target stem +/ətjə/ combinations 43% of the time (Boersma, 2018). They instead constructed their answers following place assimilation constraints adding /tjə/, /pjə/, and /kjə/ based on the final consonant of the stem. This indicates that /ətjə/ is not as productive as the other allomorphs and is more complex to use in a target-like manner even in adults (Boersma, 2018). In sum, the four short forms without a schwa follow from regular phonotactic (nasal)–obstruent cluster generalisations in Dutch (Booij, 1995). This makes these four allomorphs fairly transparent and relatively easy to apply. In contrast, /ətjə/ is more complex and less transparent in its use, as is reflected in the adult findings (Boersma, 2018).

In addition to the phonological characteristics of the nouns, the diminutive allomorphs need to also be considered in terms of their frequency of occurrence. We calculated the type frequencies of the five allomorphs by categorising the allomorphs involved in all diminutives in the SUBTLEX-NL database (Keuleers, Brysbaert, & New, 2010) using an automated script segmenting the words into stems + allomorphs that were expected based on the morphophonological rules involved in diminutive formation as outlined above. We then manually checked the words to see whether the categorisation of diminutives into stems + allomorphs had been done correctly. This was especially important in the case of words ending in the three graphemes 'tje', as words with a stem ending in a 't' should be segmented as CV[t] + /jə/ instead of CV + /tjə/. Table 1 gives an overview of the type frequencies of the allomorphs in Dutch (based on the SUBTLEX-NL database). It appears that /jə/ has the highest and /kjə/ and /pjə/ the lowest type frequency, with /ətjə/ being located somewhere in between but at the lower end. Therefore, in terms of type frequency /kjə/ and /pjə/ would be expected to have lower production accuracies due to their low type frequencies. As mentioned above, although the production of the Dutch diminutive

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

allomorphs in children has not been studied extensively, results from previous studies do indeed confirm that type frequency has an effect. Snow *et al.* (1979) assessed both adult second language learners and four-and-a-half- and seven-year-old native Dutch children on their production of the diminutive allomorphs. Considerable variation was found between the acquisition of the different diminutive allomorphs, which was attributed to the type frequencies of the allomorphs: the higher the type frequency, the earlier the allomorph seemed to be acquired. In their study testing four- to twelve-year-old native speakers of Dutch, Den Os and Harder (1987) found that the allomorph /jə/ was acquired first followed by /tjə/. Thereafter the other allomorphs appeared, with /kjə/ only being acquired around the age of twelve. Note that they also found /ətjə/ to be less productive than initially expected even in adults. More recently Peelaerts (2008) confirmed the findings from the Snow *et al.* (1979) and Den Os and Harder (1987) studies. She tested four- to ten-year-old children and also found that the lower the type frequency of the allomorph, the later it was acquired.

Finally, the Rispens and de Bree (2014) study, but also many other studies (among others, de Bree & Kerkhoff, 2010; Zamuner *et al.*, 2012), indicates that phonotactic frequency of the sound combination between stem and allomorph might also influence morphophonological development. In the current study, the phonotactic frequencies of the combination of the final stem phoneme with the phonemes of the allomorphs were calculated by averaging the log value of the biphone transitional probabilities (Dutch phonotactic frequency database (Adriaans, 2006), derived from the corpus of spoken Dutch (Oostdijk, 2000)). The phonotactic frequencies were relatively similar for /tjə/ (–1.2), /pjə/ (–1.8), /kjə/ (–1.3), and /ətjə/ (–0.90); the phonotactic frequency of the final phoneme of the stems and /jə/ was relatively low (–2.4).

The current study

The goal of the present study was to explore the effect of item-specific characteristics of the Dutch diminutive. The effects of phonological characteristics (in terms of complexity), type frequency of the allomorphs, and phonotactic frequency of the stem and allomorphs, on production accuracies in five- to ten-year old typically developing children were investigated. The diminutive has five allomorphs based on different phonological characteristics of the noun stem and with different type and phonotactic frequencies (see above). As such, the diminutive in Dutch provides information about the influence of both phonological complexity and type and phonotactic frequency. In order to gain a better understanding of the extent to which these factors are related to the development of the different allomorphs we looked at the age at which the allomorphs are acquired. In addition, we looked at the error patterns of the children, focusing on (possible) substitutions of allomorphs.

Diminutive derivations of both real and nonce nouns were assessed. Nonce forms typically follow the same structural patterns of real items but by definition have no lexical representation stored in long-term memory that can be retrieved. Children are thus required to make use of their knowledge of morphophonological patterns to apply the appropriate allomorphs to the nonce nouns. Generalisations of the diminutive to nonce items thus give extra information as to whether the children actually use a morphophonological rule. Previous studies have indicated that only from around the age of five do children start to make generalisations about morphophonological forms to inflect nonce items (Tomas *et al.*, 2017b; Zamuner *et al.*, 2012). The children tested in this study are five and above and should

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

therefore be able to inflect nonce nouns. Nevertheless, we expected to find the younger children to have more difficulties with inflecting nonce items than the older children. Moreover, all children were expected to perform better on real versus nonce items.

Research questions and hypotheses

Our first research question was whether the production of the Dutch diminutive improves between the age of 5;0 and 10;0. We hypothesised that we would find improvement with age, i.e., the older the children the better they are with inflecting the Dutch diminutive in an appropriate manner. Children's sensitivity to morphophonological patterns appears to increase with age (Tomas *et al.*, 2017b), and we expected to find that in this study as well. However, an earlier study testing adults' production accuracies with the Dutch diminutive found that, when inflecting nonce nouns, instead of the target /ətjə/, adults often produced /tjə/, /pjə/, and /kjə (Boersma, 2018). The adults performed at ceiling on the other allomorphs with both real and nonce items. For the allomorph /ətjə/ we therefore hypothesised that the older the children the more they would use one of the other allomorphs when the target was /ətjə/, as the adults did (Boersma, 2018).

Our second research question concerned the influence of phonological stem characteristics, type frequency of the allomorphs, and phonotactic frequency of the stem+allomorph combinations on the production accuracies of the Dutch diminutive in five- to ten-year-old typically developing children. Our hypothesis was two-fold. Based on the morphophonological patterns for forming the diminutive, we hypothesised (Hypothesis 2a) lower production accuracies, relative to the other allomorphs, for /ətjə/ due to phonological complexity effects (see above), and /kjə/ and /pjə/ based on the relative low type frequencies of these two allomorphs (Den Os & Harder, 1987; Peelaerts, 2008; Snow *et al.*, 1979). In addition, although /jə/ is based on the phonologically least complex stem characteristics and has the highest type frequency, based on its phonotactic frequency in combination with the final phoneme of the stem, children might also show difficulties with this allomorph (Hypothesis 2b).

Our third and final research question was whether children make erroneous stem +allomorph combinations, and, if so, whether they overgeneralise specific allomorphs. We hypothesised that when children produce erroneous stem+allomorph combinations, we would find overgeneralisations of /jə/ and /tjə/ based on the type frequencies of the allomorphs. However, the first allomorph only follows stems ending in an obstruent. Assuming that the children adhere to the basic manner of articulation obstruent–sonorant distinction, we expected to find mainly overgeneralisations of /tjə/. As also mentioned above, for /ətjə/ we expected overgeneralisations of /tjə/, /pjə/, and /kjə/ as these were also found in the adult study (Boersma, 2018).

Methodology

Participants

The participants were 125 typically developing (TD) children. All children were between the ages of 5;0 and 10;0, native speakers of Dutch, and raised in monolingual families. The children were tested on a large test battery that included

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

other general language and reading measures, which are not reported on in this study (but see Boersma, Rispens, Baker, & Weerman, 2018). Ten children had to be excluded. Three children had scores on the tasks testing general language measures that fell below the norm. Four children were raised in bilingual families (as reported by their teachers after completion of the tasks) and were therefore excluded. Three children scored 1 SD below the mean on the Dutch real- and pseudo-word reading tasks (Brus & Voeten, 1979; Van Den Bos, Spelberg, Scheepstra, & De Vries, 1994), indicating a possibility of a reading impairment. After exclusion, a total of 115 children remained. They were divided into four age groups. An overview of the participant characteristics per age group can be found in Table 2.

The children were recruited at five primary schools and were tested at their schools during school time. The teachers reported no problems such as hearing, sight, or language difficulties that could affect the outcome of the study in any of the children.

Test materials

The tasks administered to the children relevant for this study are the production task testing production accuracies of the diminutive allomorphs and the Raven progressive matrices task (Raven, Raven, & Court, 2003). The Raven was used to control for non-verbal IQ performance at the time of testing.

Test items

To make sure that the real nouns were as similar as possible and known to the children, they were selected from a list of words which had previously been established as known to children aged four to six years (Damhuis, 1992). The lexical frequencies (based on the SUBTLEX-NL database) of the nouns lay between 3 and 15 instances per million (except for the noun *raam*, which has a higher frequency). All items were controlled for phonotactic frequency or probability, i.e., the frequency with which phonological segments occur in words in a language. This was calculated by averaging the log value of the biphone transitional probabilities, i.e., the probability that two phonological segments co-occur based on the Dutch phonotactic frequency database (Adriaans, 2006) derived from the corpus of spoken Dutch (Oostdijk, 2000) (range real nouns –0.87 to –1.55; range nonce nouns –0.97 to –1.55). The nonce nouns were constructed with a pseudo-word generator called Wuggy (Keuleers & Brysbaert, 2010). Wuggy constructs nonce words based on given input by the researcher, which for this study were the real words. However, the items were adapted so that they consisted of one or two syllables and did not contain any consonant clusters, to make sure that even the youngest children could produce them. They also had to conform to the phonological and phonotactic rules of Dutch. The nonce items were tested with a word likeness task to make sure the items were considered by adult speakers as possible in the Dutch language. An overview of the items can be found in 'Appendix B'.

The diminutive stimuli were presented semi-randomly. The stimuli were grouped into four phonological conditions based on the phonological characteristics of the stems that give rise to the five allomorphs. There were ten items per phonological condition: (1) obstruent, stems ending in an obstruent taking /jə/; (2) sonorant type, stems ending in a labial taking /pjə/; (3) vowel length, stems ending in an alveolar with a long vowel taking /tjə/ and stems ending in an alveolar or labial with a short

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Table 2. Mean age per age group

	Age in months	
Age group	Mean	SD
5;0–5;11 (N = 36)	66.28	3.0
6;0–6;11 (N = 29)	77.93	3.8
7;0–7;11 (N = 24)	90.04	3.9
8;0–10;0 (N = 26)	105.73	6.3

vowel taking /ətjə/; and (4) stress, stems ending in a velar with either stress on the penultimate syllable taking /kjə/ or stress on the ultimate syllable taking /ətjə/.

Due to restrictions on time, the stimulus set was divided into two. The stimuli were semi-randomly assigned to one of the two sets. Each child was randomly assigned to one of the two sets. No significant differences between the two sets were found, so analysis of the data was done on the two sets taken together.

Production task

A wug-type task (see Figure 1 for an example of how the diminutive was elicited) was used in which children had to provide the diminutive form of a noun. The stimuli were presented auditorily: first via the computer and a second time by the experimenter. Figure 1 shows a test item to elicit the diminutive. The child looked at the pictures and the experimenter told them what the picture exhibited. Thereafter the child was asked to name the smaller version of the same picture by using a diminutive form. The answer was scored as correct if the target/appropriate stem+allomorph combination, i.e., the diminutive form that is expected based on the theoretical descriptions as provided in the previous section, was produced. Non-responses, the bare noun, and unrelated responses were scored as 'other'. When the child gave a diminutive form but with the non-target/inappropriate allomorph, this was scored as incorrect/non-target. These erroneous responses were used for the follow-up error analyses. The Dutch past tense was also tested in this task and used as a filler.

The Dutch diminutive forms are used more frequently than in many other languages and, as such, many of the stimuli presented in this study might seem odd to readers not familiar with Dutch. Although there are a few forms that are indeed slightly odd, diminutives are very frequent in Dutch and sometimes even preferred over the non-diminutive form (see Table 6 in 'Appendix B' for the frequency counts of the diminutive forms).

Procedure

The study was reviewed and approved by the ethics review board of the Faculty of Humanities, University of Amsterdam. Schools were approached and asked whether they wanted to participate in the study. Parents were then contacted and received an information letter with an active consent form they needed to sign if the parent and child were willing to participate.

Children were tested individually at their school during school time. Testing took three to five sessions of approximately 30 minutes. The children also completed

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

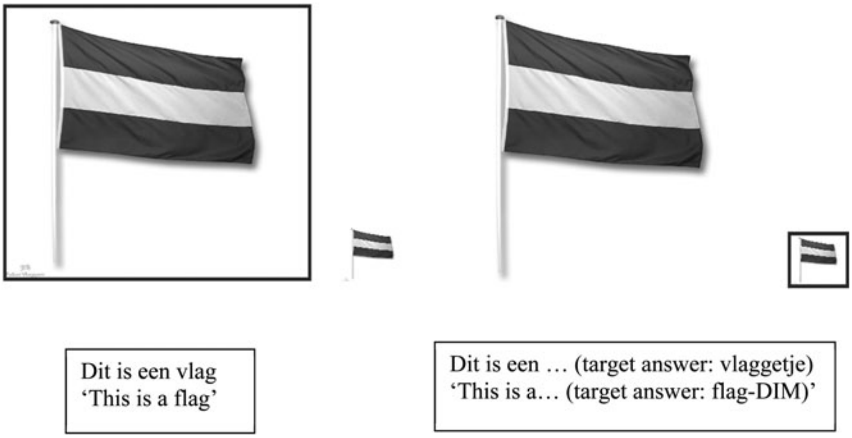

Figure 1. Example diminutive production task. The example is with a real noun.

other tasks which are not reported on in this study. Results on a judgement task and associations between morphophonological processing and other language measures are presented in a different paper (Boersma *et al.*, 2018). In the first session the children did the production task followed by some of the other tasks, such as, for example, the Raven. Sessions two and three consisted of the other tasks. A Sony Vaio and Dell laptops were used for the tasks that had to be administered online. An Olympus digital voice recorder was used to record all the sessions.

Scoring was done by two native speakers of Dutch who were trained linguists. Approximately 12% of the data from the production task was compared to calculate the inter-rater reliability. This was high (Cronbach's $\alpha = .82$). Any discrepancies were solved by discussion until 100% consensus was reached.

Analysis

Boxplots representing differences between age groups and within age groups between allomorphs for both real and nonce nouns are presented in Figures 2 and 3 (research question and Hypothesis 1). Generalised linear mixed effects modelling was used to analyse the data. We investigated whether a child gave a target (correct) or non-target (incorrect) answer (binary data) and whether this was dependent on which allomorph was to be used and the age of the child, i.e., the fixed effect factors were allomorph and age in months. This was done to evaluate the second research question and the corresponding hypotheses concerning differences in production accuracies between the allomorphs, and the first research question and hypothesis concerning development of the allomorphs. Performance scores on the Raven were included to control for the effect of IQ. The models with age, age+Raven, and age+Raven + allomorph were compared to each other using log-likelihood comparisons (using analysis of variance function in R). If age and allomorph significantly improved the model, the interaction between age and allomorph was examined as well. This was done to assess whether production of the different allomorphs had similar or diverging developmental pathways in this group of children (Hypothesis 1). Participant and item were taken as the random effect factors

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

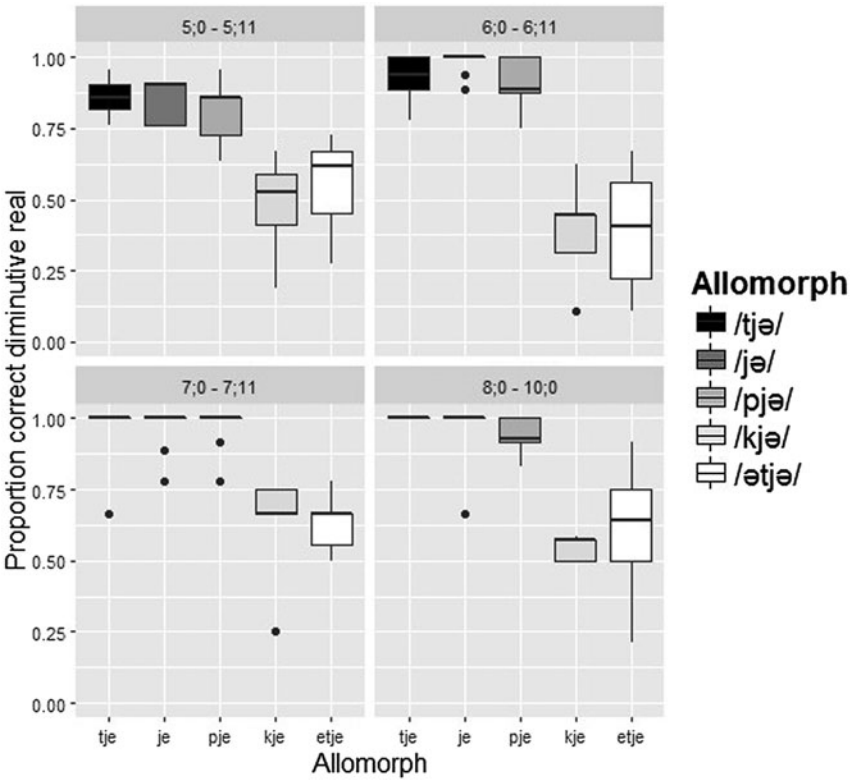

Figure 2. Mean proportion correct on the production task per age group for the real diminutive; allomorph type is expressed on the *x*-axis.

(random intercept) to control for participant and item variability. Data were modelled in R (version 3.2.0; RStudio Team, 2015) using the lme4 package (version 1.1-7; Bates, Maechler, Bolker, & Walker, 2015). Separate models were built to see whether production performance of the diminutive with real or nonce nouns differed for the different allomorphs.

The fixed effect factor allomorph was modelled by means of contrasts between levels. Each level of this factor is contrasted to a specified reference level. We hypothesised that both /ətjə/ and /kjə/ would have the lowest accuracy scores (Hypothesis 2a). Therefore these two allomorphs were taken as the reference levels to which the accuracy scores of the other allomorphs were contrasted. Hypotheses 2a and 2b stated that /pjə/ and /jə/ would have lower production accuracies. However, Figures 2 and 3 clearly show that both allomorphs are produced at ceiling level in all age groups. Consequently, no models were run with /pjə/ and /jə/ as the reference levels.

Finally, to be able to evaluate Hypothesis 3, the erroneous productions of the children were assessed per age group. Specifically, the erroneous forms were grouped according to which allomorph was used instead of the appropriate allomorph. In this way we could investigate whether the children based their erroneous answers on the phonological characteristics of the stems, or phonotactic and type frequencies of the

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

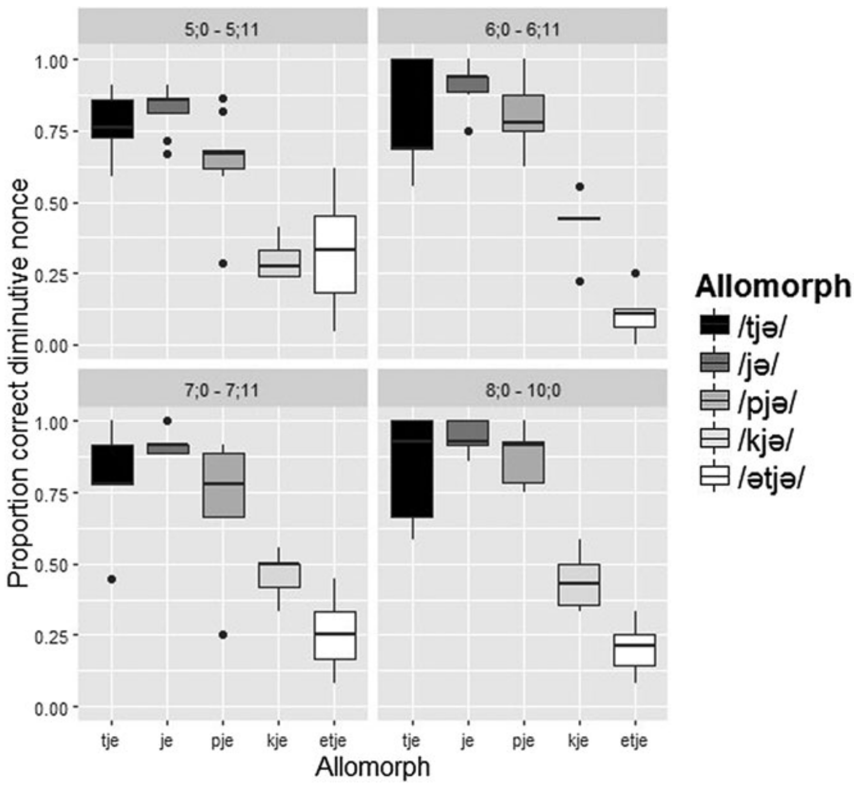

Figure 3. Proportion correct on the production task per age group for the nonce diminutive; allomorph type is expressed on the *x*-axis.

stems and allomorphs. In addition, we also looked at whether the substitutions changed between the different age groups. Two-tailed chi-square tests were conducted and error percentages per inappropriately used allomorph and age group are presented in the graphs. A final option for coding the children's answers was 'other', which reflects answers such as 'don't know', null responses, and wrong stems, or uninflected stems.

Results

Figures 2 and 3 show the boxplots for the different allomorphs per age group for the real and nonce diminutives, respectively. As the figures indicate, there was an improvement with age. The results from the multilevel models confirm this (see Table 3 for model comparisons; the final optimal models can be found in 'Appendix A'). For the real diminutive, the model with age was significantly different from the null model ($p = .006$). For the nonce diminutive, the null model compared to model with age included was significant ($p = .02$). Figures 2 and 3 indicate that, for both the real and the nonce diminutives, production accuracies were low for /ətjə/ and /kjə/ while accuracies were higher for the other allomorphs and approached ceiling levels in all the age groups and especially in the older age groups with the real diminutive.

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Table 3. Linear mixed effects model comparisons for production accuracies of the real and nonce diminutives in which accuracy of the allomorphs (/ətjə/ and (/kjə/) are compared against the other allomorphs

Model	Log-likelihood	X^2	*p*
(1) Diminutive real production /ətjə/			
Null + Age (df = 4)	−938.08	7.7	.006
+ Raven (df = 5)	−936.21	3.7	.05
+ Allomorph (/ətjə/ vs. other allomorphs) (df = 6)	−926.22	20.0	<.001
+ Age * Allomorph (df = 7)	−923.62	5.2	.02
(2) Diminutive real production /kjə/			
Null + Age (df = 4)	−938.08	7.7	.006
+ Raven (df = 5)	−936.21	3.7	.05
+ Allomorph (/kjə/ vs. other allomorphs) (df = 6)	−931.45	9.5	.002
+ Age * Allomorph (df = 7)	−930.45	2.0	.16
(3) Diminutive nonce production /ətjə/			
Null + Age (df = 4)	−1171.7	5.7	.02
+ Raven (df = 5)	−1169.0	5.4	.02
+ Allomorph (/ətjə/ vs. other allomorphs) (df = 6)	−1151	36.1	<.001
+ Age * Allomorph (df = 7)	−1138.3	25.3	<.001
(4) Diminutive nonce production /kjə/			
Null + Age (df = 4)	−1171.7	5.7	.02
+ Raven (df = 5)	−1169.0	5.4	.02
Allomorph (/kjə/ vs. other allomorphs) (df = 6)	−1167.4	3.2	.08
+ Age * Allomorph (df = 7)	−1167.4	0.1	.7

The model comparisons as presented in Table 3 confirm the findings from the figures: for the real diminutives, performance on /ətjə/ and /kjə/ was significantly worse relative to the other allomorphs (respectively $p < .001$ and $p = .002$). For the nonce diminutives, a significant difference in production accuracy of /ətjə/ compared to the other allomorphs was found ($p < .001$). This was not the case when accuracy of /kjə/ was compared to the accuracy of diminutives in which the other allomorphs were involved ($p = .08$). No significant interaction between age and /kjə/ when it was contrasted to the other allomorphs was found with either the real or the nonce items (respectively $p = .16$ and $p = .7$). A significant interaction between age and /ətje/ was found for both the real and nonce items (respectively $p = .02$ and $p < .001$). These significant interaction effects indicate that /ətjə/ seems to follow a different developmental pattern compared to the other allomorphs. The interaction with age and /ətjə/ for the real nouns reflects that /ətjə/ does not improve with age to the same extent as the other allomorphs (see Figure 2). Interestingly, for the nonce diminutive the accuracy scores for /ətjə/ actually decrease between ages 5;0 and 10;0 (see Figure 3).

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Non-target productions: types of substitutions

We performed follow-up analyses to gain a better understanding of the factors influencing acquisition during the course of development. For production of the real diminutive there was a significant association between the age group the child was in and the erroneous productions (χ^2 (15) = 71.7, $p < .001$). For production of the nonce diminutives there was also a significant association between the age group the child was in and the erroneous productions (χ^2 (15) = 94.4, $p < .001$).

Because the production accuracies of the /ətjə/ and /kjə/ allomorphs were significantly lower than the accuracy scores on the other allomorphs, it was decided to do a separate substitution analysis for these two conditions. Recall that, in our adult study with the same production task, the adults scored significantly lower on the nonce nouns that (should) take /ətjə/ (Boersma, 2018). They substituted this allomorph with /tjə/ for nouns ending in an alveolar, /pjə/ for stems ending in a labial, and /kjə/ for stems ending in a velar. The adults therefore relied on regular place assimilation processes instead of the more complex phonological characteristics of the stems. We investigated whether the children's substitutions for nouns that take /ətjə/ were also based on place assimilation constraints and whether there were differences between the age groups. In addition, the substitutions for /kjə/ were examined.

Figure 4 shows the probabilities of allomorph substitutions per age group for respectively the real (upper graph) and nonce (lower graph) diminutive for /ətjə/ in the vowel length condition. What is clear from these graphs is that the older the children are, the more adult-like they become in their choice of non-target allomorphs, i.e., substitutions. Especially when inflecting the real diminutive in a non-target manner, the eight- to ten-year-olds mainly replaced the target allomorph with either /tjə/ or /pjə/. Surprisingly, however, the eight-year-olds replaced some target allomorphs with the non-target allomorph /jə/, violating the phonological rule that stems ending in a sonorant do not combine with /jə/. A closer look at these substitutions shows that the eight-year-olds used /jə/ for the stems ending in the labial sound /m/. The substitutions for the nonce diminutive forms are somewhat more diverse and many 'other' answers were given by children in all the age groups. Yet, similar to the real items, the older the children were, the more they started to rely on simple place assimilation processes in their substitutions. It should also be noted that even the youngest children based many of their non-target stem+allomorph answers on simple place assimilation processes when inflecting both real and nonce nouns.

In the stress phonological condition (allomorphs /ətjə/ and /kjə/), Figure 5 (respectively real (upper graph) and nonce (lower graph)) shows the substitutions for /ətjə/, and Figure 6 (respectively real (upper graph) and nonce (lower graph)) the substitutions for /kjə/. Figure 5 indicates that many children used the /kjə/ allomorph instead of /ətjə/. Somewhat surprisingly, some children used the /tjə/ allomorph. This is especially apparent with the real nouns. However, the older the children the fewer non-target forms they produced, especially with the real items. As such the depiction of the substitutions might be somewhat inflated. With the nonce nouns, it is clear that most children adhered to the place assimilation process, and used /kjə/ instead of /ətjə/. Figure 6 indicates that the older the children, the more they replaced the target allomorph /kjə/ with /tjə/. The graphs also indicate that the younger children had a lot of problems with producing the target stem+/kjə/ combinations as there are many 'other' answers. These answers consisted mainly of 'don't know' or reductions of the stems, e.g., instead of *bonin-kje* they produced *boon-tje*.

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

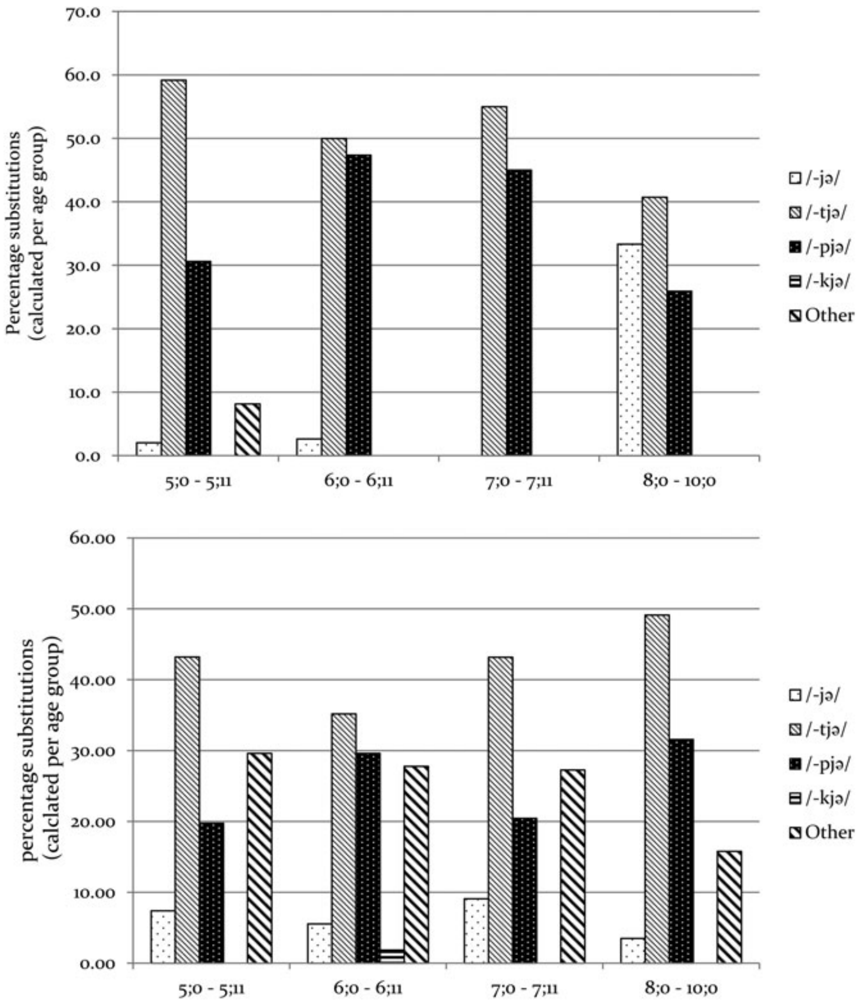

Figure 4. Substitutions for /ətjə/ in the vowel length condition calculated per age group (upper graph real diminutive, lower graph nonce diminutive).

Discussion

This study investigated the development of Dutch diminutive allomorphs in a group of five- to ten-year-old typically developing children. More specifically, we investigated whether phonological characteristics of the stems, type frequency of the allomorphs, and phonotactic frequency of the stem+allomorph combinations influence production accuracies of the diminutive allomorphs, their erroneous productions, and whether the influence of these factors changes during development. A wug-type production task was used to study children's ability to produce diminutive allomorphs in Dutch. Based on previous studies in both English and Dutch, it was hypothesised that type frequency of the allomorphs, phonotactic frequency of the stem+allomorph combinations, and phonological characteristics of the stems would

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

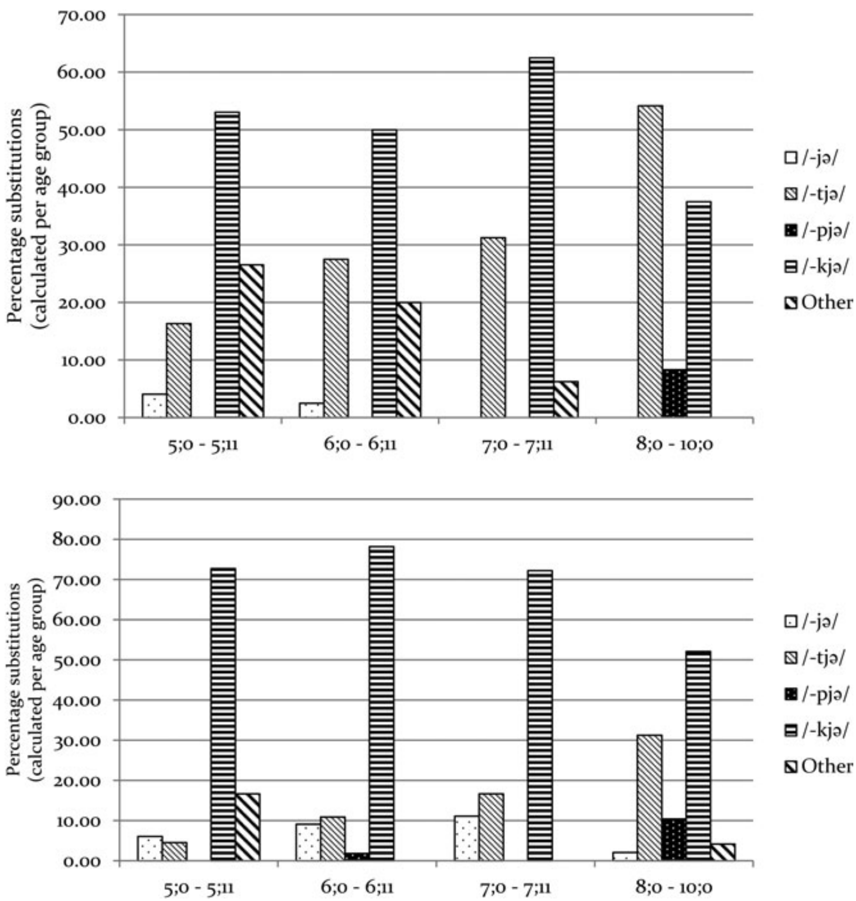

Figure 5. Substitutions for /ətjə/ in the stress phonological condition calculated per age group (above real diminutive, below nonce diminutive).

have an effect on production accuracies. Additionally, we expected to find an age-effect, i.e., the older the children, the more adult-like their performance.

Table 4 gives a general overview of the results found in this study in terms of production accuracies. The two diminutive allomorphs /ətjə/ and /kjə/ had the lowest production accuracies for both the real and nonce diminutive, as expected (see second research question and Hypothesis 2a).

We expected (Hypothesis 1) and found higher production accuracies in older children compared to younger children. In addition, all age groups had lower production accuracies for nonce nouns compared to real nouns. The results indicated that, while even the youngest children were already sensitive to the morphophonological contexts for the use of the /jə/, /tjə/, and /pjə/ allomorphs for both real and nonce nouns, all the children, including the oldest, had problems using /ətjə/ and /kjə/ in an appropriate manner (Hypothesis 2a).

The findings indicate that type frequencies of the allomorphs had some influence, as hypothesised based on previous studies (Den Os & Harder, 1987; Jolly & Plunkett,

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

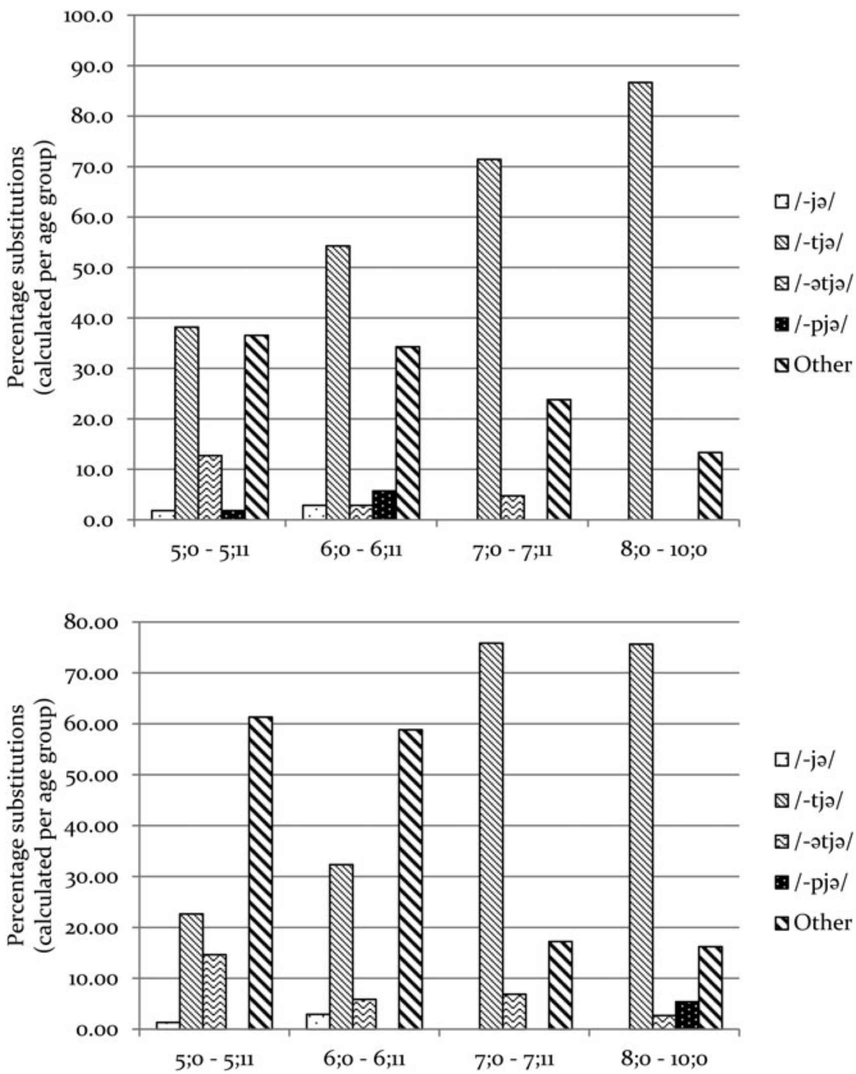

Figure 6. Substitutions for /kjə/ calculated per age group (above real diminutive, below nonce diminutive).

2008; Peelaerts, 2008; Snow *et al.*, 1979; Tomas *et al.*, 2015, 2017a, 2017b). As previously mentioned, /jə/ has the highest type frequency, followed by /tjə/, while /kjə/ has a relatively low type frequency of only 1.3%. Many children used the /jə/ allomorph in an appropriate manner and the accuracy scores for this allomorph were at ceiling level in all age groups. Since /jə/ has the lowest phonotactic frequency, but the highest type frequency, it can be concluded that phonotactic frequency did not have an effect, while the high type frequency of /jə/ probably did have an effect on the accuracy scores (Hypothesis 2b).

However, type frequency does not explain why even the youngest children performed in a target-like manner on the /pjə/ allomorph as this allomorph has a

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Table 4. Overview of the findings in terms of production accuracies

Diminutive	
Real	Nonce
/jə/, /tjə/, /pjə/ >[A] /kjə/	/jə/, /tjə/, /pjə/ >* /kjə/
/jə/, /tjə/, /pjə/ > */ətjə/	/jə/, /tjə/, /pjə/ >* /ətjə/

Notes. * = significantly lower production accuracies compared to the other allomorphs, [A] = not significant, but trend is in the right direction.

similar (low) type frequency to /kjə/ (1.9%). As was discussed, /pjə/ follows regular place assimilation constraints in that it always follows a labial, i.e., *boom–boompje* 'tree'. The stem+/pjə/ combinations are relatively easy and straightforward to pronounce as they follow regular articulatory processes. In contrast, although /kjə/ also follows place assimilation constraints in that it always follows a velar nasal, velars are different from other nasals as they are subject to some strong phonotactic constraints, are relatively difficult in terms of articulation, and are acquired relatively late (Mennen, Levelt, & Gerrits, 2006; Trommelen, 1984). Stem+/kjə/ combinations might therefore be harder to produce than stem+/pje/ combinations. An effect of token frequency might also be apparent. Even though every attempt was made to control for token frequency, we could not always control for the lexical frequencies of the diminutive forms. The token frequency of the diminutive forms taking /kjə/ could either not be found, i.e., they were not represented in the database, or were as low as 0.02 instances per million (taken from the SUBTLEX-NL database). Experimental evidence has shown that token frequency, the number of times a specific item appears, influences past tense marking of both regular and irregular verbs (Matthews & Theakston, 2006; Oetting & Horohov, 1997; Rispens & de Bree, 2014). Stems taking the /kjə/ allomorph are thus rather infrequent in their diminutive form in child (-directed) speech, e.g., the diminutive form of *verwarming* 'heater' – *verwarminkje* 'heater-DIM' is not something children hear on a daily basis. Finally, as also mentioned in the introduction, stems taking /kjə/ consist of two or more syllables, as only stems that have stress on the penultimate syllable can take this allomorph. This makes these stems more complex compared to the other segmental stems. In sum, the low type frequency of /kjə/, the low token frequency of stem and /kjə/ combinations, the late and more complex acquisition of the velar nasal, and the fact that the stems always consisted of more than one syllable most probably caused the difficulties children had with appropriately using /kjə/. Thus, although this confirms our second hypothesis (Hypothesis 2a), the relative difficulty with /kjə/ is not exclusively due to this allomorph's low type frequency as was expected, but was also, and possibly mostly, due to the phonologically more complex characteristics of the stems that give rise to this allomorph.

The substitution analyses indicated that /tjə/ most often replaced /kjə/. This confirms our third hypothesis and follows the type frequency account, as the children thus replaced /kjə/ with the allomorph with the highest type frequency for stems ending in a sonorant. Especially the older children appeared to be strongly influenced by type frequency. Note that the children adhered to the obstruent–sonorant distinction and did not replace /kjə/ with /jə/, which, although it has a higher type frequency than /tjə/, only comes after stems ending in an obstruent.

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

As hypothesised (Hypothesis 2a), low production accuracies for /ətjə/ were also found for both real and nonce items. Although this allomorph does not have a very low type frequency, it is used by inserting a sjwa+'tje' rather than assimilation or t deletion (see the 'Introduction'). In addition, in a previous study testing diminutive production in adults, it was found that adults did not always apply /ətjə/ in nonce nouns in the way predicted, but often replaced it with /tjə/, /pjə/, and /kjə/ based on place assimilation between the final phoneme of the stem and the first phoneme of the allomorph (Boersma, 2018). In the current study we found that most substitutions for /ətjə/ were allomorphs that assimilated with the final phoneme of the stem, i.e. **vompje* instead of the target *vommetje* (as predicted in Hypothesis 3). This was the case for both the real and the nonce items and was already apparent in the youngest children. Nonetheless, the nonce items were clearly more difficult as even the oldest children still had relatively many answers that could be classified as 'other'. Surprisingly, the children even replaced /ətjə/ with /kjə/, although they found this latter allomorph difficult to use in a target-like manner. Apparently, when phonological characteristics are complex, children will rely on the phonologically less complex characteristics even if they are infrequent. In general, these findings suggest that although type frequency does influence production accuracies, the complexity of the phonological characteristics that determine the allomorph appear to have a bigger influence on the production accuracies.

As mentioned above, in the study referred to in Boersma (2018) non-target forms based on place assimilation were only found for nonce nouns, but adults performed at ceiling when inflecting real nouns. The adults seemed to have stored real stem +/ətjə/ combinations in their lexicon. In this study, production accuracies for /ətjə/ improved with age for the real diminutive (in accordance with Hypothesis 1) – i.e., the older the children, the higher the production accuracies for the real items – but decreased with the nonce diminutive. Based on these findings and on previous studies showing effects of vocabulary size (Boersma *et al.*, 2018; Marchman & Bates, 1994; Paradis *et al.*, 2016; Rispens & de Bree, 2014), it can be argued that the older the children the more instances of real stem+/ətjə/ combinations are stored as a whole in the children's lexicon.

In relation to this, a limitation of this study is that we do not know whether children learn diminutive forms in general as surface forms, or whether they first learn the base form and then assemble the diminutive via the base noun and the allomorph. A study by Kempe, Brooks, and Gillis (2005) suggests that Dutch diminutives contain features that aid word segmentation. Studying the acquisition of diminutives in a less lab-based experiment may shed light on this question.

Conclusion

This study investigated the production of the Dutch diminutive in five- to ten-year-old typically developing children. We examined whether and to what extent the phonological characteristics of the stems that give rise to the allomorphs, phonotactic frequency of the stem+allomorph combinations, and type frequency of the allomorphs influence Dutch diminutive production accuracies.

An age-effect was found in that the older the children had higher accuracy scores (research question and Hypothesis 1). However, no improvement with age was found for production of real and nonce nouns that take /ətjə/. This allomorph, which is based on the phonologically most complex characteristics of the noun stems, was

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

found to have significantly lower production accuracies than the other allomorphs (second research question and Hypothesis 2a). Additionally, although it was hypothesised that /kjə/ and /pjə/ would have lower production accuracies due to their low type frequencies (Hypothesis 2a), this was only the case for /kjə/, which was most probably to a large extent due to the more complex phonological characteristics of the stems it attaches to. No effect of phonotactic frequency was found (Hypothesis 2b). In addition, an age-effect was found with respect to the substitution of /ətjə/. The older the children the more adult-like their performance was in terms of their substitutions for /ətjə/, i.e., substitutions were based on place assimilation with the final phoneme of the stem (research question and Hypothesis 3). Erroneous productions for stems that should receive /kjə/ were mostly productions with the allomorph with the highest type frequency for stems ending in a sonorant, namely the allomorph /tjə/ (Hypothesis 3). Children of all ages were able to generalise to nonce items and their performance with nonce nouns also improved with age.

In conclusion, this study has shown that, from the age of five onwards, children are sensitive to the morphophonological patterns of Dutch. The phonological characteristics of the stems and type frequency of the allomorphs were found to be related to not only appropriate but also erroneous diminutive productions. However, complexity of the phonological characteristics of the stems appeared to have a bigger impact than type frequency. The findings indicate that both the frequency of the allomorphs and the phonological characteristics of the stems are important when learning the morphophonological properties of a language, but that, for five- to ten-year-old children, especially the phonological complexity of the morphophonological patterns impacts on the ability to correctly produce diminutive allomorphs.

Author ORCIDs. Tiffany BOERSMA, 0000-0002-0429-6481

Acknowledgements. We thank all the schools, children, and parents who have participated in this study. We would also like to thank the research assistants on this project for their help with testing the children. This research received no grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

Adriaans, F. (2006). *PhonotacTools* (Test version ed.). Utrecht: Utrecht Institute of Linguistics OTS.

Bakema, P., Defour, P., & Geeraerts, D. (1993). De semantische structuur van het diminutief. *Forum der letteren*, 121–37.

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). lme4: linear mixed-effects models using Eigen and S4. R package version 1.1–7. 2014.

Berko, J. (1958). The child's learning of English morphology. *Word*, *14*, 150–77.

Blom, E. (2003). *From root infinitive to finite sentence: the acquisition of verbal inflections and auxiliaries* (PhD). Available from LOT Publications (LOT Number 70).

Blom, E., & Paradis, J. (2013). Past tense by English second language learners with and without language impairment. *Journal of Speech, Language, and Hearing Sciences*, *56*, 281–94.

Blom, E., Paradis, J., & Duncan, T. S. (2012). Effects of input properties, vocabulary size, and L1 on the development of third person singular -s in child L2 English. *Language Learning*, *62*(3), 965–94.

Boersma, T. A. (2018). *Variability in the acquisition of allomorphs: the Dutch diminutive and past tense* (PhD). Universiteit van Amsterdam. Available from LOT publications (LOT Number 489).

Boersma, T., Rispens, J. E., Baker, A., & Weerman, F. (2018). The effects of phonological skills and vocabulary on morphophonological processing. *First Language*, *38*(2), 111–28.

Booij, G. (1995). *The phonology of Dutch*. Oxford University Press.

Brus, B. T., & Voeten, M. J. M. (1979). *EMT (one minute real word reading test)*. Amsterdam: Pearson.

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Buckler, H., & Fikkert, P. (2016). Using distributional statistics to acquire morphophonological alternations: evidence from production and perception. *Frontiers in Psychology*, *7*(540), 1–16. doi.org/10.3389/fpsyg.2016.00540

Bybee, J. L. (1985). *Morphology: a study of the relation between meaning and form*. Amsterdam/Philadelphia: John Benjamins Publishing Company.

Bybee, J. L. (2007). *Frequency of use and the organization of language*. New York: Oxford University Press.

Bybee, J. L., & Slobin, D. I. (1982). Rules and schemas in the development and use of the English past tense. *Language*, *58*(2), 265–89.

Dahl, Ö. (2004). *The growth and maintenance of linguistic complexity*. Philadelphia, PA: John Benjamins.

Damhuis, R. (1992). *Woordenlijst voor 4- tot 6-jarigen. een streeflijst voor kleuters*. Rotterdam: Projectbureau OVB.

de Bree, E., & Kerkhoff, A. (2010). Bempen or bemben: differences between children at-risk of dyslexia and children with SLI on a morpho-phonological task. *Scientific Studies of Reading*, *14*(1), 85–109.

Den Os, E., & Harder, R. (1987). De verwerving van de regels voor meervouds- en verkleinwoordsvorming in het nederlands [The acquisition of plural and diminutive rules in Dutch). *De Nieuwe Taalgids*, *80*, 240–50.

Jarmulowicz, L., & Hay, S. E. (2009). Derivational morphophonology: exploring errors in third graders' productions. *Language, Speech, and Hearing Services in Schools*, *40*(3), 299–311.

Jolly, H. R., & Plunkett, K. (2008). Inflectional bootstrapping in 2-year-olds. *Language and Speech*, *51*(1/2), 45–59.

Kempe, V., Brooks, P. J., & Gillis, S. (2005). Diminutives in child-directed speech supplement metric with distributional word segmentation cues. *Psychonomic Bulletin & Review*, *12*, 145–51.

Kerkhoff, A. (2007). *Acquisition of morphophonology: the Dutch voicing alternation*. Doctoral Dissertation, LOT.

Kerkhoff, A., & de Bree, E. (2004). Acquisition of morpho-phonology in children with specific language impairment and typically developing children. In A. Kerkhoff, J. de Lange, & O. S. Leicht (Eds.), *Utrecht Institute of Linguistics OTS, yearbook 2004* (pp. 37–52).

Keuleers, E., Brysbaert, M., & New, B. (2010). SUBTLEX-NL: a new frequency measure for Dutch words based on film subtitles. *Behavior Research Methods*, *42*(3), 643–50.

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

Marchman, V. A., & Bates, E. (1994). Continuity in lexical and morphological development: a test of the critical mass hypothesis. *Journal of Child Language*, *21*(2), 339–66.

Marchman, V. A., Wulfeck, B., & Weismer, S. E. (1999). Morphological productivity in children with normal language and SLI: a study of the English past tense. *Journal of Speech, Language, and Hearing Research*, *42*, 206–19.

Marshall, C. R., & Van der Lely, H. K. J. (2006). A challenge to current models of past tense inflection: the impact of phonotactics. *Cognition*, *100*, 302–20.

Matthews, D. E., & Theakston, A. L. (2006). Errors of omission in English-speaking children's production of plurals and the past tense: the effects of frequency, phonology and competition. *Cognitive Science*, *30*, 1027–52.

Mealings, K. T., Cox, F., & Demuth, K. (2013). Acoustic investigations into the later acquisition of syllabic -es plurals. *Journal of Speech, Language, and Hearing Research*, *56*, 1260–71.

Mennen, I., Levelt, C., & Gerrits, E. (2006). Acquisition of Dutch phonology: an overview. In J. M. Scobbie, I. Mennen, & J. Watson (Eds.), *QMUC Speech Science Research Centre Working Paper WP10* (pp. 1–15). Retrieved from https://eresearch.qmu.ac.uk/handle/20.500.12289/152.

Oetting, J. B., & Horohov, J. E. (1997). Past-tense marking by children with and without specific language impairment. *Journal of Speech, Language, and Hearing Research*, *40*, 62–74.

Oostdijk, N. (2000). The spoken Dutch corpus: outline and first evaluation. In M. Gravilidou, G. Caravannis, S. Markantonatou, S. Piperidis, & G. Stainhaouer (Eds.), *Proceedings of the Second International Conference on Language Resources and Evaluation (LREC)* (pp. 887–94).

Paradis, J., Tulpar, Y., & Arppe, A. (2016). Chinese L1 children's English L2 verb morphology over time: individual variation in long-term outcomes. *Journal of Child Language*, *43*, 553–80.

Peelaerts, C. (2008). *Van kleine boot tot scheepje: Experimenteel onderzoek naar de diminutiefvorming bij Vlaamse kinderen* [From 'kleine boot tot scheepje': experimental research on diminutive production in Flemish children). Unpublished manuscript.

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Pierrehumbert, J. B. (2003). Phonetic diversity, statistical learning and acquisition of phonology. *Language and Speech*, *46*(2/3), 115–54.

Raven, J., Raven, J. C., & Court, J. H. (2003). *Manual for Raven's Progressive Matrices and Vocabulary Scales*. San Antonio, TX: Harcourt Assessment.

Rispens, J. E., & de Bree, E. H. (2014). Past tense productivity in Dutch children with and without SLI: the role of morphophonology and frequency. *Journal of Child Language*, *41*(1), 200–25.

Royle, P., & Stine, I. (2013). The French noun phrase in preschool children with SLI: morphosyntactic error analyses. *Journal of Child Language*, *40*, 945–70.

RStudio Team (2015). *RStudio: Integrated Development for R*. RStudio, Inc., Boston, MA. Online http://www.rstudio.com/.

Snow, C. E., Smith, N. S. H., & Hoefnagel-Höhle, M. (1979). The acquisition of some Dutch morphological rules. *Journal of Child Language*, *7*, 539–53.

Song, J. Y., Sundara, M., & Demuth, K. (2009). Phonological constraints on children's production of English third person singular -s. *Journal of Speech, Language, and Hearing Research*, *52*, 623–42.

Tomas, E., Demuth, K., & Petocz, P. (2017a). The role of frequency and predictability in learning morphophonological alternations: implications for children with SLI. *Journal of Speech, Language, and Hearing Research*, *60*(5), 1316–29.

Tomas, E., Demuth, K., Smith-Lock, K. M., & Petocz, P. (2015). Phonological and morphophonological effects on grammatical development in children with specific language impairment. *International Journal of Language and Communication Disorders*, *50*(4), 516–28.

Tomas, E., van de Vijver, R., Demuth, K., & Petocz, P. (2017b). Acquisition of nominal morphophonological alternations in Russian. *First Language*, *37*(5), 453–74.

Trommelen, M. (1984). *The syllable in Dutch*. Dordrecht: Foris Publications.

Van de Weijer, J. (2002). An Optimality Theoretical analysis of the Dutch diminutive. *Linguistics in the Netherlands*, *19*(1), 199–209.

Van Den Bos, K. P., Spelberg, L. H. C., Scheepstra, A. J. M., & De Vries, J. R. (1994). *KLEPEL* [two minute pseudo word reading task]. Amsterdam: Pearson.

Zamuner, T. S., Kerkhoff, A., & Fikkert, P. (2006). Acquisition of voicing neutralization and alternations in Dutch. *Proceedings of the Annual Boston University Conference on Language Development*, *2*, 701–12.

Zamuner, T. S., Kerkhoff, A., & Fikkert, P. (2012). Phonotactics and morphophonology in early child language: evidence from Dutch. *Applied Psycholinguistics*, *33*, 481–99.

Appendix A

Final most explanatory models linear mixed effects analysis

Table 5. Optimal models predicting production real and nonce diminutive

Production				
Predictor variable	Estimate (*β*)	SE (*β*)	Z	*P*
Diminutive real (/ətjə/)				
Intercept	2.74	0.28	9.85	<.001
Age	0.02	0.01	2.00	.05
Raven	0.55	0.28	2.01	.05
Allomorph (/ətjə/ vs. others)	−2.52	0.48	−5.27	<.001
Age * Allomorph	−0.02	0.008	−2.31	.02
Diminutive nonce (/ətjə/)				
Intercept	1.51	0.20	7.57	<.001

(*Continued*)

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Table 5. (*Continued.*)

Production				
Predictor variable	Estimate (β)	SE (β)	Z	P
Age	0.01	0.006	2.40	.02
Raven	0.43	0.18	2.43	.02
Allomorph (/ətjə/ vs. others)	−3.08	0.38	−8.12	<.001
Age * Allomorph	−0.04	0.008	−4.97	<.001
Diminutive real (/kjə/)				
Intercept	2.38	0.28	8.45	<.001
Age	0.01	0.009	1.56	.1
Raven	0.54	0.28	1.96	.05
Allomorph (/kjə/ vs. others)	−2.37	0.70	−3.39	<.001
Age * Allomorph	−0.01	0.01	−1.43	.2
Diminutive nonce (/kjə/)				
Intercept	0.90	0.26	3.40	<.001
Age	0.003	0.006	0.53	.6
Raven	0.41	0.17	2.36	.02
Allomorph (/kjə/ vs. others)	−1.28	0.72	−1.78	.08
Age * Allomorph	0.003	0.009	0.36	.7

Appendix B
Test items

Table 6. Items real diminutive

Item	Target diminutive	Lexical freq noun	Lexical freq dim	Phonotactic freq stem
Vowel length				
Bol	Boll-etje	9.81	0.75	−1.2505
Snor	Snorr-etje	9.95	0.55	−1.2925
Vlam	Vlamm-etje	7.94	0.37	−1.4301
Schoen	Schoen-tje	13.45	0.48	−1.0530
Schaal	Schaal-tje	9.74	0.59	−1.1450
Ballon	Ballonn-etje	5.28	0.07	−1.1274
Klem	Klemm-etje	10.47	not found	−1.3897
Zaal	Zaal-tje	15.41	0.25	−1.3097
Boer	Boer-tje	14.77	0.8	−1.2614
Teen	Teen-tje	7.39	2.17	−1.0876

(*Continued*)

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Table 6. (*Continued.*)

Item	Target diminutive	Lexical freq noun	Lexical freq dim	Phonotactic freq stem
Sonorant type				
Worm	Worm-pje	9.1	0.09	−1.2351
Zalm	Zalm-pje	5.28	0.05	−1.4150
Riem	Riem-pje	14.16	0.05	−1.4831
Bezem	Bezem-pje	3.8	not found	−1.2213
Pruim	Pruim-pje	1.12	0.11	−1.3773
Helm	Helm-pje	11.09	0.09	−1.1348
Scherm	Scherm-pje	13.68	0.18	−1.3767
Kraam	Kraam-pje	1.14	0.14	−1.3156
Raam	Raam-pje	70.84	2.24	−1.4117
Duim	Duim-pje	10.79	0.8	−1.3293
Stress				
Kring	Kring-etje	3.48	0.32	−1.1535
Verwarming	Verwarmin-kje	4.96	not found	−1.3794
Leerling	Leerling-etje	12.99	not found	−1.2024
Woning	Wonin-kje	13.38	0.02	−1.1337
Wandeling	Wandeling-etje	8.46	1.65	−0.8940
Wang	Wang-etje	8.46	1.65	−0.8940
Tekening	Tekening-etje	8.92	0.18	−1.1777
Botsing	Botsin-kje	3.32	0.02	−1.2706
Pudding	Puddin-kje	4.94	0.02	−1.4538
Ontploffing	Ontploffin-kje	4.46	not found	−1.3551
Obstruent				
Wieg	Wieg-je	4.12	0.46	−1.4665
Vos	Vos-je	7.59	0.14	−1.3122
Koek	Koek-je	3.27	8.12	−1.3868
Schep	Schep-je	4.26	0.59	−1.3108
Knoop	Knoop-je	9.51	0.55	−1.5531
Dwerg	Dwerg-je	8.99	0.16	1.3557
Stok	Stok-je	14.48	3.06	−1.1726
Zeep	Zeep-je	14.22	0.14	−1.4798
Schaap	Schaap-je	6.54	0.18	−1.2989
Vaas	Vaas-je	4.57	0.05	−1.4899

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Table 7. Items nonce diminutive

Item	Target diminutive	Phonotactic freq stem
Vowel length		
Keen	Keen-tje	−1.4192
Loen	Loen-tje	−1.3104
Vom	Vomm-etje	−1.1536
Gol	Goll-etje	−1.3139
Raal	Raal-tje	−1.3448
Poer	Poer-tje	−1.4971
Neel	Neel-tje	−1.0242
Zam	Zamm-etje	−1.3768
Hil	Hill-etje	−1.3759
Nan	Nann-etje	−1.0250
Sonorant type		
Zuim	Zuim-pje	−1.5922
Liem	Liem-pje	−1.4119
Reem	Reem-pje	−1.4225
Zaam	Zaam-pje	−1.3766
Doom	Doom-pje	−1.1681
Leem	Leem-pje	−1.3130
Koem	Koem-pje	−1.5470
Tuim	Tuim-pje	−1.4590
Buim	Buim-pje	−1.3652
Gaam	Gaam-pje	−1.1975
Stress		
Ming	Ming-etje	−1.0038
Tukking	Tukkin-kje	−1.2364
Loving	Lovin-kje	−1.2347
Ting	Ting-etje	−1.1347
Ning	Ning-etje	−1.0935
Moging	Mogin-kje	−1.2360
Boning	Bonin-kje	−1.2236
Witting	Wittin-kje	−1.1556
Sing	Sing-etje	−1.0372
Jing	Jing-etje	−1.1287
Obstruent		

(*Continued*)

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047

Table 7. (*Continued.*)

Item	Target diminutive	Phonotactic freq stem
Lop	Lop-je	−1.2792
Voes	Voes-je	−1.3823
Poek	Poek-je	−1.4294
Mip	Mip-je	−1.3787
Tiek	Tiek-je	−1.1908
Foop	Foop-je	−1.0836
Koep	Koep-je	−1.5289
Moek	Moek-je	−1.0179
Woeg	Woeg-je	−1.5053
Ries	Ries-je	−1.3314

Cite this article: Boersma T, Rispens J, Weerman F, Baker A (2019). Acquiring diminutive allomorphs: taking item-specific characteristics into account. *Journal of Child Language* **46**, 567–593. https://doi.org/10.1017/S0305000919000047

Downloaded from https://www.cambridge.org/core. UVA Universiteit van Amsterdam, on 23 Mar 2020 at 10:39:53, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0305000919000047