No default plural marker in Modern High German

Eugen Zaretsky[1], Hans-Helge Müller[2], Benjamin P. Lange[3]

[1] *Department of Phoniatrics and Pediatric Audiology, University Hospital of Frankfurt am Main* <yevgen.zaretsky@kgu.de>
[2] *Institute of Epidemiology and Medical Biometry, Philipps-University of Marburg* <Hans-Helge.Mueller@staff.uni-marburg.de>
[3] *Department of Media Psychology, Faculty of Human Sciences, Julius Maximilian University of Wuerzburg* <benjamin.lange@uni-wuerzburg.de>

In the current article, 24 nonce words with or without rhymes in the German language were analyzed in respect to the distribution of plural allomorphs in the pluralizations of native speakers. The influence of several intralinguistic variables on the choice of plural markers was assessed: grammatical gender, word final phonemes, classification of nonce words as those having or not having rhymes in German, plural markers of the rhyming real words, unusual orthography, final-obstruent devoicing, and the possibility of umlauting. Also, inter-individual differences between test subjects as well as their age were included as independent variables. In generalized linear mixed models with plural allomorphs as dependent variables, grammatical gender and presence of vowels that can be subject to umlauting tended to yield significant results (ps < .05). The study reanalyzed the results presented in the well-known article by Marcus et al. ("German inflection: The exception that proves the rule". *Cognitive Psychology* 29, 1995, 189-256) by means of utilization of the same test items, but with a different study design and a new sample of adult German native speakers (N = 585). Contrary to Marcus et al. (1995), the present study allows to draw the conclusion that single-route models can account better for the distribution of plural markers than dual-route models.

KEY WORDS: plural allomorphs, German language, single-route, dual-route, default form, nonce words

1. Introduction

In the morphology of the German language, a wide range of pluralization patterns is utilized: apart from the plural markers *–e* (with or without umlaut), *–(e)n* (without umlaut), *–s* (without umlaut), *–er* (with umlaut or without umlaut if the vowel is not umlautable), and umlaut alone, German nouns can be pluralized by zero markers, several markers borrowed from other languages (e.g., *Numerus* 'number' → *Numeri*) as well as various irregular forms with modifications of the stem (e.g., *Stadion* 'stadium' → *Stadien*) (Mugdan 1977). Further plural allomorphs can be found in spontaneous reactions to

 (received July 2015)

nonce words, as was demonstrated by Zaretsky et al. (2013a) both for German children and adults on the basis of eight nonce nouns from the widely used, validated language test SETK 3-5 (Grimm 2001). Not only ungrammatical combinations of the umlaut with plural markers (e.g., umlaut with *–s*: *Tulo* → *Tülos*), but also numerous double plural markers (e.g., *Kland* → *Kländern*) and pseudo-markers such as *–el* (e.g., *Klandel*) were identified. Pluralization patterns were governed by a complicated constellation of intra- and extralinguistic factors such as frequency of the plural markers and age of (preschool, but not adult) test subjects (Zaretsky & Lange 2014). Both children and adults tended to prefer the markers *–(e)n*, *–e*, and *–s* (all three without umlaut) in their plural forms.

Almost all previous studies on plural acquisition worked with elicitation tasks and/or analyses of spontaneous speech (Clahsen et al. 1992; Korecky-Kröll & Dressler 2009; Szagun 2001; Vollmann et al. 1997). Only seldom studies with plausibility scales (Marcus et al. 1995) or judgments (Korecky-Kröll et al. 2012) were conducted. Different study designs might result in somewhat different findings such as a higher percentage of zero forms in elicitation tasks compared to spontaneous speech (Clahsen et al. 1992). Due to the nature of elicitation tasks, namely a forced choice of only one plural form, they might be less sensitive to the subtle differences in the pluralization patterns in comparison with plausibility scales. In the latter case, test subjects can estimate the appropriateness of every plural allomorph, which, again, might result in different findings compared to elicitation tasks and spontaneous speech.

In the present study, the influence of the study design on its results was examined on the basis of the well-known article by Marcus et al. (1995). These authors demonstrated by means of the plausibility scales a statistically significant preference for *s*-forms in comparison with all other plural markers in a sample of German adults, whereas in most other studies (e.g., Elsen 2001; Mugdan 1977; Szagun 2001; Wegener 1994), three plural forms dominated, namely *–s*, *–(e)n*, and *–e* (all three without umlaut), both in the answers of children and adults. The present study used a design comparable to Marcus et al. (1995) (the same test population, namely adults, and the same nonce words), but with several modifications which were assumed to result in quantitatively or even qualitatively different findings: elicitation tasks instead of plausibility scales, regressions instead of analysis of variance (ANOVA), another classification of plural markers, and a much larger sample size. Due to the peculiarities of plausibility scales (described above), it was expected that in the

present study with its standard elicitation tasks, test subjects would actively use those three plural allomorphs which were identified as the most frequent ones in Zaretsky et al. (2013a) and in many other studies, namely *–s*, *–(e)n*, and *–e* (all three without umlaut), instead of the preference for *–s* only. The use of these three plural markers, governed by such characteristics of German nouns as word final phonemes and grammatical gender, would evidence so called single-route models of plural acquisition rather than dual-route models.

Generally speaking, proponents of the dual-route models (Clahsen 1999; Marcus et al. 1995, Niedeggen-Bartke 1999, Pinker 1999) divide plural allomorphs into two groups, default and irregular ones. *–s* is considered to be the only representative of the first group (sometimes *–(e)n* is also classified as default, but rather as a result of its misinterpretation by preschool children), all other plural markers belong to the second group. The default plural marker is believed to be added in emergency cases, that is, when nouns do not evoke associations with the acquired vocabulary and are thus treated as new material that demands a special marker. Because of the limited vocabulary size and, consequently, limited associative networks at preschool age, such emergency cases occur quite often resulting in a large number of *s*-forms.

According to the dual-route models, the addition of *–s* is governed by a symbolic pluralization rule, whereas the addition of irregular plural markers is rather a matter of reproduction of acquired plural forms, instead of an application of some internalized rules, or a matter of analogy-based formation. The attempt to transfer the dual-route models that were originally developed for English, with its very few exceptions in the pluralization (e.g., *ox* → *oxen*) and, indeed, dominant *–s*, to the German language resulted in the hypothesis that a comparatively seldom German equivalent of the supposed English default plural marker must function as a more or less universal plural allomorph for any kind of unusual or unfamiliar language material. The evidence for this hypothesis, however, remained scarce. On the contrary, according to numerous reports (e.g., Bittner & Köpcke 2001), the German plural allomorph *–s* possesses not a dominant, but rather an equivalent position among two other plural allomorphs, *–(e)n* and *–e* (all three without umlaut), in the pluralization patterns with unusual, foreign-looking, and seldom used language material.

In contrast to the dual-route models, single-route models—Natural Morphology (Dressler et al. 1987; Mayerthaler 1981; Wurzel 1984), Cognitive Morphology (Bybee 1985, 1988; Köpcke 1993)—do not subdivide German plural markers into two groups, but focus on

the characteristics of plural allomorphs and nouns trying to find regularities behind pluralization patterns not in the dichotomy of the default plural vs. irregular ones, but, rather, in the frequency, perceptibility, productivity, (poly)functionality, and other characteristics of the plural allomorphs, as well as in some characteristics of the pluralized nouns such as word final phonemes, suffixes, and application of the schwa deletion rule (forbidding schwas in two adjacent syllables). The notion of the default plural form becomes superfluous or even wrong in this interpretation. According to the single-route models, in the process of grammar acquisition, the most obvious and frequent cues are extracted first from the input language, the most frequent German plural marker being *–(e)n*, followed by *–e*, or vice versa depending on the calculation method and corpus. Various constellations of plural markers and nouns are tried out, gaining complexity and involving a growing range of phonological, semantic, and morphological factors at the advanced stages of language acquisition. New cues constantly extracted from the adult language and conflicting priorities of features such as iconicity, productivity, and frequency of plural markers contribute to the modifications and fitting of the overgeneralization patterns.

The article by Marcus et al. (1995) was probably one of the most influential studies on the default plural form *–s* in the German language, thus delivering evidence for the dual-route models. Other plural allomorphs were classified as irregular and received, according to Marcus et al. (1995), lower plausibility values in the unusual language material, that is, nonce words having no rhymes in Modern High German as well as nonce words presented as names and borrowings, in comparison with the "normal" language material, that is, nonce words having rhymes in Modern High German and also nonce words presented as real German nouns ("roots").

At the moment (February 17, 2016), Google Scholar (https://scholar.google.com/) finds 550 citations of the article by Marcus et al. (1995). Although widely cited, the article has methodological flaws which, to our knowledge, have not been commented on up to now. First, the quality of the data should meet several requirements in order to be examined in an analysis of variance (ANOVA). The authors did not mention whether the data were normally distributed and whether the homogeneity of variance was checked (which is, however, very common in psycholinguistic studies). Both requirements are almost never fulfilled in linguistic data. As Micceri (1989) demonstrated by means of a retrospective analysis of 440 large-sample studies utilizing various psychometric measures, that is, measures related to total scores

of different tests, which is comparable to the study of Marcus et al. (1995), normally distributed data did not occur at all (cf. Schüller 2015: 252). Also, plausibility scales cannot always be treated as metrical, the scale required by the analysis of variance, and, furthermore, the sample in the study by Marcus et al. (1995) was far too small for an ANOVA (N = 48). In case of the study design utilized by these authors (two independent variables with two categories in each variable), such an ANOVA would have required a sample of at least N = 128 (α error probability .05, power .80, medium effect size .25) according to an analysis conducted by the power analysis software G*Power 3.1. A sample size of N = 48 must have resulted, according to the same software, in a power (i.e., the probability that the test correctly rejects the null hypothesis when the alternative hypothesis is true) of only .40 instead of .80 (Cohen 1988). Underpowered statistical tests are exposed to the danger of not only missing statistical significance, but also of overestimating the influence of some factors due to the flawed probability values that became statistically significant only by chance due to a low sample size, as was shown for the pluralization patterns in German by Zaretsky and Lange (2015) in a series of retrospective analyses of data collected in several studies on the language test development (cf. Schüller 2015: 267). None of the issues mentioned above can be considered absolutely critical, but their combination surely did not contribute to the reliability of the ANOVA results of the Marcus et al. study.

In the present study, some aspects of the study design by Marcus et al. (1995) were scrutinized with a large sample of adult German native speakers. All 24 nonce words—both rhymes (test items having rhymes in Modern High German) and non-rhymes (test items without such rhymes in Modern High German)—from the study of Marcus et al. (1995) were presented to our participants in a written form as real German nouns and then compared in respect to the distribution of plural allomorphs. Instead of a plausibility scale, participants were asked to actively produce plural forms because the chosen plural allomorph is obviously the most plausible one for the test subjects. We consider ordinal plausibility scales as not very appropriate for the analysis of internalized pluralization strategies because often one can construct several plural forms of a nonce word depending on personal intra- and extralinguistic associations, priming, creativity, and motivation. In the present study, test subjects had to decide in favor of only one certain plural form in the production tasks, and they were asked to write down the very first form that crossed their mind in order to retrieve their internalized pluralization strategies, and not the whole spectrum of their associations or creativity.

For instance, several plural forms of the nonce word *die Kland* are theoretically possible: *Klanden* because of a close association between the plural form *–(e)n* and nouns of feminine gender, *Kländе* because of associations with the high-frequency nouns of feminine gender *Hände* 'hands' and *Wände* 'walls' (cf. *Bände* 'volumes' of masculine gender), *Kländer* because of another high-frequency noun *Länder* 'countries, lands' (neuter gender), *Klands* because *–s* occurs frequently with foreign words and neologisms (Zaretsky et al. 2011). Also, associations with the suffix *-ant* in nouns like *Praktikant* 'intern' cannot be excluded but are rather improbable due to other factors such as a comparatively high number of syllables in typical nouns with this suffix. These associations result in a high variability in the answers of adults (Zaretsky et al. 2013a): A large sample of monolingual German adults produced 12 different plural forms of this nonce word (excluding some deformations without recognizable plural markers), and 63% of these forms were "wrong" according to the test manual of the language test SETK 3-5, a test for German preschoolers where this item was taken from (Grimm 2001). However, in spite of this variability of results, each adult had to decide in favor of one certain, most plausible plural form, which made clear that the form *Kländе* was the most probable answer, by analogy with the highly frequent noun *Hände* 'hands', followed by *Klanden*, *Klande*, and *Kländer*, whereas *Klands* (the form predicted by some dual-route models) occurred comparatively seldom. Hence, the analysis of only one plural form per item might make the results more reliable because it excludes numerous other forms which would never be actively produced by the test subject and which are acceptable only because they are not completely unacceptable.

Because other statistical methods are used in the current paper than in Marcus et al. (1995), the present study is not a mere replication of the results by Marcus et al., but rather, an analysis of the same test items and of a comparable test sample with a somewhat different study design, which might be more appropriate to answer the question of the original study, namely whether the distribution of the German plural markers can be better explained by single-route (Dressler et al. 1987; Köpcke 1988; Korecky-Kröll & Dressler 2009) or dual-route models (Clahsen 1999; Clahsen et al. 1992; Marcus et al. 1995). We consider such a re-analysis necessary because even after decades of heavy debates and criticism, proponents of both single-route and dual-route models did not arrive at any clear conclusion apart from declaring that the arguments of their respective counterparts must be wrong (cf. Clahsen 1999).

In the present study, the plural marker *–s* was not considered to be a universally applicable or the most plausible plural allomorph for non-rhymes. We hypothesized that German adults would prefer plural markers *–s*, *–(e)n*, and *–e* (all three without umlaut), both with rhyming and non-rhyming nonce words; the first one (*–s* without umlaut) because of its high compatibility with borrowings including many "non-rhyme" neologisms (i.e., neologisms without clear phonotactic analogies in German) and word final phonemes, the latter two (*–(e)n* and *–e* without umlaut) because of their high frequency in Modern High German (Zaretsky et al. 2011). These three plural markers are characteristic of the answers of German preschoolers in nonce word tasks (Zaretsky et al. 2013a, b). The assumption that adults would stick to the same pluralization patterns does not mean that they are not capable of analyzing unknown language material in more detail compared to children, but the test items chosen by Marcus et al. (1995) deliver very few cues on possible plural forms, which may force adults to utilize the simplest pluralization strategies. We also hypothesized that adults would choose the same three plural markers significantly more often for non-rhymes than for rhymes because other associations with semantics and phonology are missing in case of non-rhymes. This would contradict the results of Marcus et al. (1995) and would rather support the single-route models. Further, plural allomorphs which are mostly ignored by children (umlaut, *–e* with umlaut, *–er*) were expected to be used by adults with non-rhymes significantly less often than with rhymes due to missing phonological associations with existing words as well as due to the low iconicity and/or productivity of these plural markers (Zaretsky et al. 2011).

2. Methods

Test subjects were 585 adult German native speakers: age range 18-96 years (median 24); 207 males (35.4%), 369 females (63.1%), and nine participants with unknown gender (1.5%). They were recruited mostly in the universities of the German state of Hesse (predominantly in Frankfurt/Main and Marburg) during the years 2011-2013.

Study participants were asked to fill out questionnaires with plural forms of the items given in singular (see Appendix). All 24 items, 12 rhymes and 12 non-rhymes, were taken from the study by Marcus et al. (1995) without any modifications and were presented as real German nouns (cf. "roots" in the Marcus et al. study). The rhymes were supposed to elicit clear associations with widely used real German nouns (information on the most frequent types and, for comparison, tokens associated with the

test items can also be found in the Appendix), however, with the exception of the item *Pund* (cf. two almost equally frequent associations with different plural markers: *Gründe* 'reasons', *Pfunde* 'pounds'). Comparisons with the same items presented as names or borrowings (also utilized in the original publication) were not the subject of this article.

Because the grammatical gender in the study by Marcus et al. (1995) was dichotomized into feminine and non-feminine (since there are hardly any differences in the use of plural allomorphs between nouns of masculine and neuter gender, as was stated by Marcus et al.), our test items were also presented as two gender groups. We expected that adults would use *–e* and probably also *–er* with non-feminine gender and *–(e)n* with feminine gender because these associations are clearly represented in Modern High German (Zaretsky et al. 2013b; cf. Wegener 1994). Following Marcus et al. (1995), the gender shift was applied, that is, nouns presented as feminine ones to one half (50%) of the test subjects were presented as non-feminine ones to the second half of test subjects. The gender shift helps to control whether dichotomized gender influences the choice of plural allomorphs.

The plural suffixes chosen by Marcus et al. (1995)— *–s* with or without umlaut, *–er* with umlaut, *–er* without umlaut, *–(e)n* with or without umlaut, *–e* with umlaut, *–e* without umlaut, umlaut—neither correspond completely to those applied in Modern High German (*–er* without umlaut is ungrammatical), nor do they represent in full detail possible combinations of plural markers with umlaut (ungrammatical combinations of *–s* and *–(e)n* with umlaut were not taken into account). In the current study, only plural markers of Modern High German were accounted for in the categorization of plural allomorphs: *–s*, *–er*, *–(e)n*, *–e*, *–e* with umlaut, umlaut. Zero plural was excluded from the analysis due to the practical impossibility of the distinction between zero plural forms and repeated singular forms. Marcus et al. (1995) also excluded it for comparable methodological reasons although data on zero plural plausibility had been collected.

First, a homogeneity analysis by means of alternating least squares (HOMALS) was conducted to examine associations between plural markers chosen by the test subjects and the following characteristics of the test items:

- umlauting in the test items (that is, whether vowels can be subject to umlauting during pluralization, as was shown for the nonce word *Kland* → *Klände* in the Introduction),
- dichotomized grammatical gender (feminine vs. non-feminine nouns),
- word final phonemes without any categorization,
- rhyme vs. non-rhyme,

- the most probable and second most probable associations with plural markers of real words for rhymes (types, according to the calculations by Ruoff (1981) cited in Marcus et al. (1995), e.g., *Pind* → *Pinder* following the model of *Kind* → *Kinder* 'children'),
- usual or unusual orthography (some of the items used by Marcus et al. (1995) contained uncommon grapheme combinations <hk> and <hf>), and
- final-obstruent devoicing (also called terminal devoicing), that is, a systematic devoiced pronunciation of voiced obstruents.

In the latter case, final-obstruent devoicing, a phonological process that has very few exceptions in German (here: in the word final position) might influence the choice of plural allomorphs, if they are linked to a certain phoneme, due to the discrepancy between the word final grapheme and its pronunciation. Not only types (see above) but also tokens were analyzed in respect to the associations with the test items. According to the token list with 100,000 entries compiled by the Institute of the German language of Mannheim University, Germany (Institut für Deutsche Sprache 2009a), in nine out of twelve rhymes the same plural markers were associated with test items as in case of types, that is, both most frequent and second most frequent types and tokens are pluralized with the same plural markers in most cases (see Appendix). Therefore, plural markers of the most frequent nouns associated with rhymes according to the ranking of tokens were not included as additional variable(s) in the statistical analyses.

Also, characteristics not only of nouns, but also of plural allomorphs (iconicity, productivity, cue validity, etc.) could have been accounted for in separate variables. However, following Marcus et al. (1995), analysis or quantification of characteristics of plural allomorphs were not the subject of the study.

The relevance of the most chosen characteristics for the distribution of plural markers has already been shown in previous studies (Fakhry 2005; Mugdan 1977), but not with the HOMALS method and not on the basis of the chosen nonce words. A short distance between two points on the HOMALS visualization (see Figure 1) indicates a close association between the corresponding variable values (e.g., between the nouns of non-feminine gender and the choice of the plural marker *–e*). Dimensions calculated by the HOMALS for the visualization are often of abstract nature but can be interpreted as associated with some of the included variables. This and further statistical analyses were carried out in SPSS 21.

According to the hypothesis, plural markers *–s*, *–(e)n*, and *–e* were preferred to other plural markers with rhymes and, even more

so, with non-rhymes. This was analyzed by Wilcoxon tests for two paired groups (because both rhymes and non-rhymes were produced by the same test subjects). Exact *p*-values calculated with the Monte Carlo method are reported. Also, the percentage of uses of each plural marker was compared to a combined percentage of other plural markers, separately for rhymes and non-rhymes, in a clustered bar graph.

However, univariate methods do not account for a complex constellation of various interdependent factors such as unusual orthography, word final phonemes, etc., that might be positively or negatively associated with each other. Therefore, in the next step, multivariate statistics were applied to examine whether the variable "rhymes vs. non-rhymes" has any considerable influence on the distribution of plural allomorphs in comparison with other characteristics of test items. For a dichotomized classification of plural allomorphs (e.g., *–s* vs. all other plural markers), an ANOVA, a method of choice in Marcus et al. (1995), cannot be conducted. Therefore, the regularities in the distribution of plural allomorphs were assessed, apart from the HOMALS analysis, by a generalized linear mixed model, namely binary logistic regressions with fixed and random factors (cf. Korecky-Kröll et al. 2012). Dichotomized classifications of plural markers served as dependent variables, test subjects and test items as random factors, and characteristics of test items as well as age of test subjects as fixed factors. Table 2 gives a detailed overview of dependent and independent variables utilized for the regressions. Contrary to HOMALS, three further variables were included in the regressions: test items, test subjects and their age. Due to a high number of categories, these variables would have overloaded the HOMALS visualization. A total of 13,476 pluralizations without word deformation (96%) and 128 pluralizations with word deformation (1%) were the subject of the statistical analysis, the other 3% being various avoidance strategies or, rarely, missing data.

The sample sizes (*N*s) in the regressions were higher than the number of test participants because the subject of the analyses, that is, the cases in our SPSS data set, were not participants but plural forms. However, participants were included as random factors in the regressions to avoid an inflation of statistical power.

3. Results

First, associations between plural allomorphs and characteristics of test items were visualized in Figure 1 with the homogeneity analysis by means of alternating least squares (HOMALS).

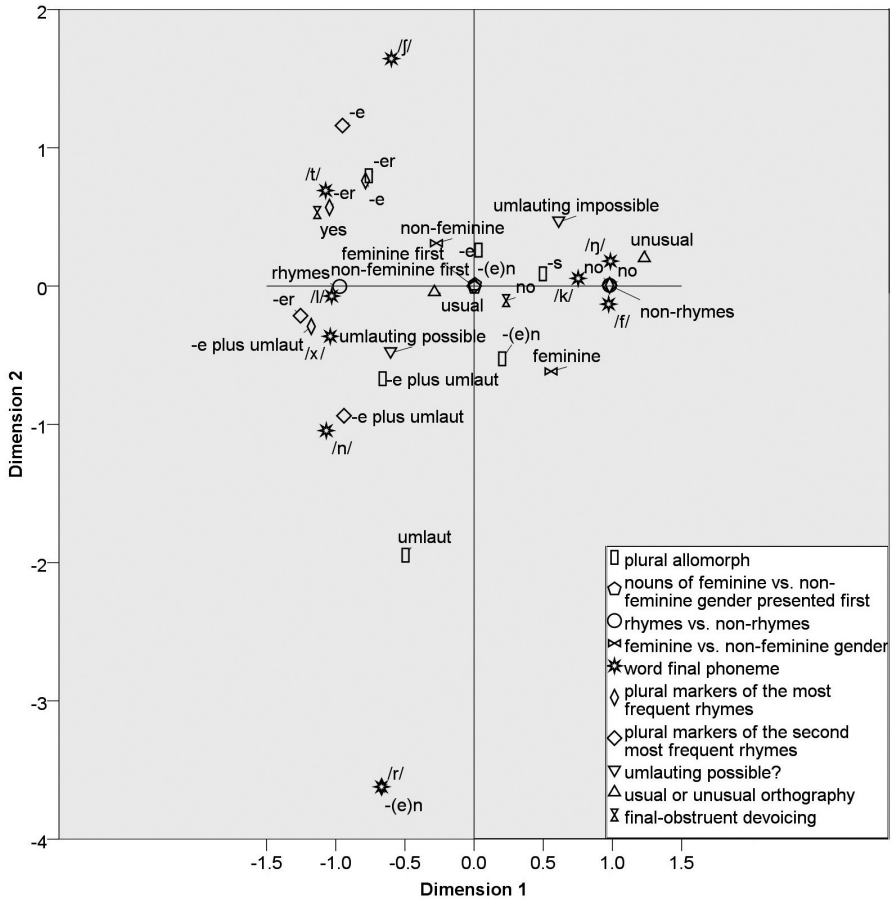

Figure 1. Homogeneity analysis by means of alternating least squares: associations between (a) plural markers *–(e)n*, *–e*, *–e* with umlaut, umlaut, *–s*, *–er* and (b) nine characteristics of test items.

According to the discrimination measures (dimensionwise variances of the quantified variables), dimension 1 refers to the plural markers of the first and second most frequent rhymes (real nouns) of the nonce words (.967 and .953). Dimension 2 refers to the word final phonemes (.806).

According to Figure 1, nouns of the feminine gender were closely linked to the plural marker *–(e)n*, nouns of the non-feminine gender to *–e* and, more loosely, to *–er*. The variable "umlauting possible?" was

Table 1. Wilcoxon tests (*Z*), mean values (*M*), and standard deviations (*SD*) of plural allomorphs used with rhymes (R) and non-rhymes (NR); *N*s = 585.

	–S	*–(E)N*	*–E*	*–E* + UMLAUT	*–ER*	UMLAUT
M/*SD* R	0.89/1.67	2.35/2.48	5.28/2.82	1.72/1.92	1.36/1.60	0.02/0.18
M/*SD* NR	1.84/2.50	3.22/3.50	5.51/3.40	0.75/1.06	0.32/1.06	0.01/0.12
Z	-9.97***	-6.31***	-1.80*	-11.24***	-13.38***	n. s.

Note. * $p < .05$, *** $p < .001$, n. s. = not significant

associated with the use of the plural markers containing umlaut and with rhyming real words that can be subject to umlauting. The plural allomorphs chosen by the test subjects and those required by the most and second most frequent rhymes tended to cluster. Unusual orthography was linked to the non-rhymes because, indeed, the nonce words *Fnöhk*, *Bnöhk*, *Fnähf*, and *Pnähf* do not have rhymes among real German nouns. Final-obstruent devoicing was associated with word final /t/ because this phenomenon occurs in items like *Spand* in which final <d> is pronounced voiceless.

According to Wilcoxon tests for two paired groups, *–s*, *–(e)n*, and *–e* taken together occurred more frequently than other plural markers both in rhymes (Z = -19.62, $p < .001$, N = 585, mean/M = 8.51, standard deviation/SD = 2.64 vs. M = 2.06, SD = 2.14) and in non-rhymes (Z = -21.12, $p < .001$, N = 585, M = 10.56, SD = 1.82 vs. M = 1.08, SD = 1.44); *N*s = 585. Other results of the Wilcoxon tests are presented in Table 1.

According to Table 1, plural markers *–s*, *–(e)n*, and *–e* occurred more frequently in non-rhymes than in rhymes, whereas *–e* with umlaut and *–er* were used more frequently in rhymes than in non-rhymes. One-tailed *p*-values were calculated because of our predictions (s. Introduction). Umlaut occurred only 14 times in the sample and could not deliver reliable results in the Wilcoxon test. The difference between umlaut uses in rhymes and non-rhymes was not statistically significant but it occurred eleven times in rhymes and only three times in non-rhymes.

The preference for *–s*, *–(e)n*, and *–e* in non-rhymes compared to rhymes as well as the preference for *–s* and *–e* with umlaut in rhymes compared to non-rhymes are visualized in Figure 2, where the percentages of the uses of each plural marker with rhymes and non-rhymes out of all its uses are presented. Although umlaut was not excluded from the visualization, its low frequency makes any comparison questionable.

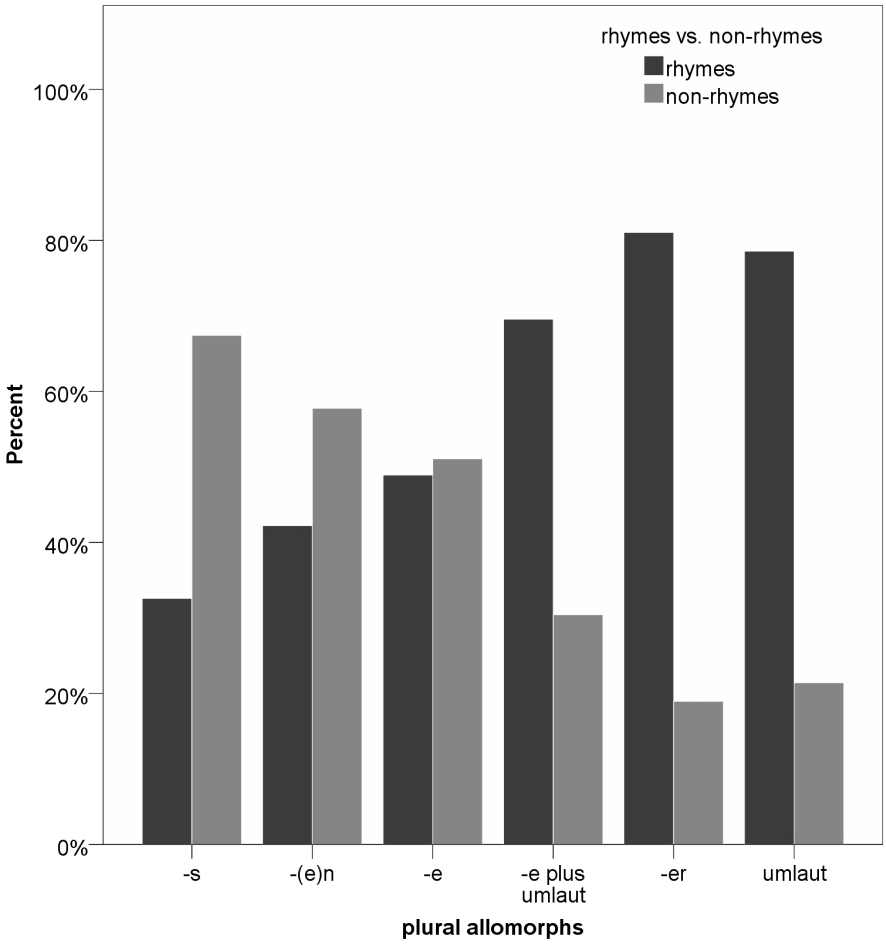

Figure 2. Frequency of plural allomorphs with rhymes and non-rhymes (percentage, calculated with total for each x-axis category as denominator).

No evidence was found that *–s* dominated with non-rhymes in comparison with other plural markers. Among non-rhymes, percentages of the most actively used plural allomorphs were 16% (out of all plural allomorphs used with non-rhymes) for *–s*, 28% for *–(e)n*, and 47% for *–e* (cf. 7% for *–e* with umlaut, 3% for *–er*, 0% for umlaut). Among rhymes, the percentage of *–s* out of all used plural allomorphs was even smaller, namely 8% (cf. 20% for *–(e)n*, 45% for *–e*, 15% for *–e* with umlaut, 12% for *–er*, 0% for umlaut). The plural markers *–er*,

Table 2. Generalized linear mixed model: binary logistic regressions with dichotomized plural markers as dependent variables (e.g., *–s* vs. all other plural markers), test items and test subjects as random factors, and ten characteristics of test items as well as age of test subjects as fixed factors (binomial probability distribution; link function: logit; "other plural markers" as reference category in the dependent variables; *N*s = 13,397).

	Description	*–S*	*–ER*	*–E*	*–E* + UMLAUT	*–(E)N*
Fixed effects: *F*						
Rhyme vs. non-rhyme	Dichotomous variable: whether the test item does or does not have a rhyming real noun	n. s.	n. s.	n. s.	n. s.	n. s.
Grammatical gender	Dichotomous: feminine vs. non-feminine, following Marcus et al. (1995)	4.24*	5.19*	32.61***	n. s.	90.85***
Gender shift	Dichotomous: two item sets, with nouns of feminine or non-feminine gender presented first	5.57*	n. s.	n. s.	n. s.	n. s.
Word final phoneme	Categories: nine word final phonemes (consonants) in the test items	n. s.	n. s.	n. s.	n. s.	4.28*
Plural markers of the most frequent rhymes (real words), types	Categories *–s*, *–(e)n*, *–er*, *–e*, *–e* with umlaut, umlaut, none; rhymes taken from Marcus et al. (1995), based on the frequency list of types by Ruoff (1981)	n. s.	n. s.	n. s.	n. s.	n. s.
Plural markers of the second most frequent rhymes (real words), types	Categories *–s*, *–(e)n*, *–er*, *–e*, *–e* with umlaut, umlaut, none; rhymes taken from Marcus et al. (1995), based on the frequency list of types by Ruoff (1981)	n. s.	n. s.	4.72*	6.62**	18.34***
Umlauting possible?	Dichotomous: whether the vowel(s) in the test item can be subject to umlauting during pluralization	n. s.	6.58*	n. s.	38.16***	n. s.

Usual or unusual orthography	Dichotomous: usual vs. unusual (items *Fnö**hk***, *Bnö**hk***, *Fnä**hf***, *Pnä**hf***) orthography	n. s.	n. s.	n. s.	n. s.	n. s.
Final-obstruent devoicing	Dichotomous: whether the item ends in a voiced consonant and thus is subject to the final-obstruent devoicing	n. s.	n. s.	n. s.	n. s.	n. s.
Age	Metrical: age of test subjects in years	n. s.	n. s.	n. s.	5.05*	n. s.
Random effects (estimate/standard error/Z)						
Test subjects	Categories: 576 test subjects (9 excluded due to missing data)	2.61/0.22/ 12.09***	1.88/0.18/ 10.49***	1.13/0.09/ 12.72***	1.63/0.15/ 10.86***	2.67/0.21/ 12.96***
Test items	24 test items	n. s.	n. s.	n. s.	n. s.	n. s.
Other model characteristics						
Information criterion: Bayesian		76,456	83,108	61,087	139,139	69,156
Information criterion: Akaike corrected		76,441	83,123	61,072	139,124	69,141
Accuracy (%)		90.1	94.2	73.4	92.0	83.4

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, n. s. = not significant

umlaut, and *–e* with umlaut taken together were used more often with rhymes (75% out of all their uses) than with non-rhymes (25%), whereas the proportions of the markers *–s*, *–(e)n*, and *–e* taken together were more equally distributed in rhymes (45%) and non-rhymes (55%), being more frequent in the latter group.

In the next step, binary logistic regressions were calculated for each plural marker as dependent variable and item characteristics as well as age of test subjects as independent variables (see Table 2). In each calculation, two random effect blocks were included: one with test items and one with study participants as subject specification (covariance structure: variance components). Fixed coefficients for significant results of fixed factors presented in Table 2 are given for each plural marker separately in Table 3. Positive or negative values of the coefficients in the second column of Table 3 indicate positive or negative associations with the value label of the independent variables listed in the first column. For instance, in case of the plural marker

Table 3. Fixed coefficients for significant results of fixed effects in binary logistic regressions presented in Table 2.

Model term	Coefficient	Standard error	*t*	95% confidence interval for coefficient	
				lower	upper
–S					
Gender = feminine	-0.19	0.08	-2.36*	-0.34	-0.03
Gender shift = nouns of feminine gender presented first	-0.33	0.16	-2.06*	-0.64	-0.02
–ER					
Gender = feminine	-0.37	0.16	-2.28*	-0.68	-0.05
Umlauting possible? – Yes	-1.33	0.52	-2.57*	-2.54	-0.11
–E					
Gender = feminine	-0.31	0.05	-5.71***	-0.42	-0.20
-E with umlaut					
Umlauting possible? – Yes	6.59	1.07	6.18***	4.46	8.71
Age	-0.01	0.01	-2.25*	-0.02	0.00
–(E)N					
Plural markers of the second most frequent rhymes (real words), types = *–e*	-1.31	0.39	-2.91*	-3.32	-0.50
Word final phoneme = /ŋ/	-1.45	0.55	-2.65*	-2.69	-0.21
Gender = feminine	0.62	0.07	9.53***	0.49	0.75

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, n. s. = not significant

–er, a negative coefficient value (-0.37) for the value label "Gender = feminine" means that *–er* tended to occur in the nouns not of feminine, but of non-feminine gender.

According to Table 2, the use of plural markers was not significantly associated with the classification of test items as rhymes or non-rhymes. No significant fixed coefficients could be calculated for the second most-frequent associations with rhymes for the dependent variables *–e* and *–e* with umlaut. However, *–e* tended to occur in nonce words with rhymes demanding *–e* (58% of all *e*-occurrences: 1,785 out of 3,086), whereas *–e* with umlaut tended to occur in nonce words with rhymes demanding

–e with umlaut (67%: 672 out of 1,006). The random factor "test items" yielded marginally significant results ($p \leq .08$) in case of *–e* ($p = .054$) and *–s* ($p = .058$). No calculations were possible for umlaut due to its low frequency. Some other models were tried out but dismissed due to higher (= worse) information criterion values or other issues.

Because Marcus et al. (1995) differentiated between *–er* with and without umlaut, an attempt was made to calculate binary logistic regressions for these two plural markers (the latter being ungrammatical) separately. For *–er* with umlaut, the same two independent variables yielded significant results as in Table 2, that is, the use of *–er* was negatively associated with nouns of feminine gender and with the possibility of umlauting. For *–er* without umlaut, no model was found, which is, however, not surprising due to its low frequency: Umlauting was not applied, in spite of the presence of vowels that can be umlauted, in 164 cases of *er*-use out of 388 (42%), a sample that obviously did not suffice for a regression with such a high number of factors. Theoretically, a differentiation between *–s* and *–(e)n* with and without umlaut would also have been possible, although the combination of umlaut with these two plural markers is ungrammatical. However, only 1% of *s*-uses (8 out of 561) and 6% of *(e)n*-uses (104 out of 1,684) contained an umlaut in nouns with vowels that can be subject to umlauting, which made the utilization of ungrammatical variants of *s*- and *(e)n*-forms for binary logistic regressions impossible due to their low frequency.

4. Discussion

According to Marcus et al. (1995), a preference for *s*-forms on a plausibility scale with non-rhyming nonce words in comparison with rhyming ones suggests a default status of *–s* with unusual language material. In the present study, the same test items—24 nonce words rhyming or not rhyming with real German nouns—were used in order to investigate the findings of Marcus et al. from a different perspective. Instead of a plausibility scale, German native speakers were asked to produce plural forms of nouns presented in singular. It was expected that instead of using *–s* as the default plural marker and also instead of a clear preference for *–s* in the plural forms, adults would utilize the same three plural markers which are typical of preschoolers, namely *–s* (as the most compatible one in a phonotactic respect), *–(e)n*, and *–e* (as the most frequent ones in Modern High German) (Bittner & Köpcke 2001; Köpcke 1988; Wegener 1994).

Indeed, the most important finding of the current study was that German adults preferred the plural markers *–s*, *–(e)n*, and *–e* both with rhymes and, especially, with non-rhymes compared to *–er*, umlaut, and *–e* with umlaut according to the univariate analyses. The HOMALS method does not calculate significance values for included factors but it also demonstrated the same tendencies in the visualization (Figure 1). In more sophisticated multivariate analyses, binary logistic regressions with fixed and random factors, the statistical significance of the differentiation between rhymes and non-rhymes was not identifiable at all, which might indicate that *–s*, *–(e)n*, and *–e* dominated in plural forms irrespective of presence or absence of associations with existing German nouns (apart from those associations that were assessed in other independent variables).

According to Marcus et al. (1995), only the plausibility of the "regular" plural marker *–s* with nonce words was higher for non-rhymes than for rhymes (mean 3.5 vs. 3.8, with 5 meaning "perfectly natural" and 1 meaning "perfectly unnatural"), whereas the plausibility of *–e* and *–(e)n* was lower (3.8 vs. 3.4 and 2.6 vs. 2.4, respectively). The plausibility of umlaut remained on the same level for both word groups. The values of *–er* were somewhat higher for rhymes than for non-rhymes both with and without umlauting (1.9 vs. 1.7 and 2.5 vs. 2.2, respectively). *–e* with umlaut was less plausible with non-rhymes, although the difference was minimal (2.8 vs. 2.7). However, if one measures the plausibility not by means of a plausibility scale but by means of active pluralizations, as was done in the current study, other tendencies emerge in the same "roots" (i.e., nonce words presented as real German words). Not only the frequency of *–s*, but also the frequency of *–(e)n* and *–e* were higher for non-rhymes than for rhymes according to the Wilcoxon test. The plural marker *–s* occurred less often than *–(e)n* and *–e* with non-rhymes as well as less often than *–(e)n*, *–e*, *–e* with umlaut, and *–er* with rhymes, which can hardly be expected of the plural marker considered as the only default one. An extension of the term "default" to the plural marker *–(e)n* would also not account for the pluralization patterns in the current study, first and foremost for the high frequency of *e*-forms in non-rhymes.

Some findings of the current study, however, do support those by Marcus et al. (1995) described above. The frequency of umlaut was not significantly different between rhymes and non-rhymes (namely almost non-existent in both cases), and *–e* with umlaut as well as *–er* indeed occurred significantly less often in non-rhymes, probably because these not very productive plural markers are predominantly used by analogy with the rhyming real words. However, again, in the

current study such differences could only be found in comparatively simple descriptive and univariate statistics and disappeared in the binary logistic regressions, which means that umlaut, *–er*, and *–e* with umlaut occurred comparatively seldom irrespective of the presence or absence of rhyming real nouns.

The plural allomorph *–e* without umlaut made out about a half of all pluralizations both with rhymes and non-rhymes but occurred only 2% less often with the former than with the latter (45% vs. 47% of all pluralizations). At first sight, this difference might appear marginal and negligible in spite of its statistical significance. However, one can hardly call this result qualitatively different from those for *–s* (8% vs. 16% of all pluralizations) and *–(e)n* (20% vs. 28%) since each of them made out only 8% more pluralizations with non-rhymes than with rhymes, that is, only 6% more than in case of *–e* without umlaut. Of special interest in this respect is the choice of test items by Marcus et al. (1995). According to the type frequency list by Ruoff (1981), the reference used by Marcus et al. (see Appendix), rhyming real German nouns demanded *–e* in nine cases out of 24, *–e* with umlaut in eight cases, *–(e)n* in only one case, *–er* in four cases, *–s* in zero cases (and two further items had no second most frequent rhymes). It is highly probable that if plural markers in the rhyming nouns had been distributed equally, instead of demanding *–e* with or without umlaut in most cases, than the difference in *e*-uses between rhymes and non-rhymes would have been larger, and the difference in *s*- and *(e)n*-uses smaller.

Three most frequently used plural markers in the current study, *–s*, *–(e)n*, and *–e*, have already been described as the most productive ones in nonce words pluralized by German children, with preference for *–s* in linguistically more advanced groups and preference for *–(e)n* in linguistically weaker groups (Mugdan 1977; Zaretsky et al. 2013c). Obviously, German adults made use of the pluralization strategies comparable to those of German children. Also, adult learners of German with advanced German skills (language contact of 18+ months) are known to prefer the plural allomorph *–s*, whereas learners with a relatively limited command of German (language contact less than 18 months) overuse *–(e)n*, with *–e* being an actively used plural marker in both groups (Mugdan 1977). This might indicate the universality of error patterns in the linguistically weak and advanced groups, with a high percentage of *(e)n*-pluralizations in the former, a high percentage of *s*-pluralizations in the latter, and *–e* in between. The same tendencies were also demonstrated, for instance, for two subgroups of German preschoolers with immigration background—

Russians (linguistically more advanced in German) and Turks (linguistically weak)—by Zaretsky et al. (2013c).

The variable "Umlauting possible?" yielded two statistically significant results in the regressions. First, *–e* with umlaut occurred in nouns with vowels that can be subject to umlauting, simply because it cannot occur in nouns without such vowels. A negative association between the plural marker *–er* and umlauting might appear contra-intuitive at first sight because *–er* always demands umlauting. However, this phenomenon can be considered a consequence of (a) non-differentiation between *–er* with and without umlaut, and (b) of the constellation of test items. Out of all *er*-uses, 393 were registered in nouns containing vowels that can be subject to umlauting (40%) and 588 in the nouns without such vowels (60%). Thus, indeed, *–er* occurred more frequently in nouns where umlauting was not possible, probably due to the tendency to prefer this plural marker with nouns of non-feminine gender.

Since all test subjects had acquired German as their first or only language, the pluralization patterns such as co-occurrence of umlauting with certain plural allomorphs—patterns without exceptions—must have been acquired at preschool or primary school age (cf. Korecky-Kröll et al. 2012). Hence, the motivation behind the wrong use of umlauting is nebulous. In case of *–(e)n*, some test subjects might have been misled by non-nominative forms in which umlauting does occur (e.g., *Fuß* 'foot' → *mit den Füßen* 'with/by feet', with a Dative marker *–n*). In case of *–er*, the study participants might have been influenced by innumerable German nouns ending in the suffix *–er* that do not contain umlauting and do not change their form in plural (e.g., *Macher* 'maker(s)', *Lacher* 'laugher(s)'). Also, an attempt to build hypercorrect plural forms cannot be excluded, that is, to highlight plurality by additional umlauting because umlauting is closely linked to pluralization. More probable, however, is an attempt to demonstrate one's creativity by means of deliberate and conscious violation of the native language rules. The same phenomenon was described for the schwa deletion rule, also one of the simplest regularities related to pluralization, a rule that has no exceptions and is acquired at very young age. In the comparison of two large German samples, preschoolers (including immigrants) and monolingual Germans, only one violation of this rule forbidding schwas in two adjacent syllables was found in the answers of children, whereas 18 such violations were found in the answers of adults, although the sample of children was 3.5 times larger (Zaretsky et al. 2013a).

Although the dependence of the choice of plural markers on the inter-individual characteristics of the study participants was not the subject of this study, the fact that such differences did exist was shown by a statistically significant *p*-value of the corresponding random factor in all regressions. The age of the test subjects did yield a statistically significant result as well, but only in one case, *–e* with umlaut (less such plural markers in the answers of older participants), and with a confidence interval reaching the coefficient level of 0.00 (to be precise, -0.002), that is, a level extremely close to zero. While children indeed tend to prefer different plural markers in different age groups (cf. Korecky-Kröll et al. 2012; Zaretsky & Lange 2014), results on adults remain non-conclusive in this respect and seem to achieve (or not to achieve) statistical significance depending on the study design (cf. Zaretsky & Lange 2014).

A negative association between word final /ŋ/ and the plural marker *–(e)n* was found in one of the binary logistic regressions. Indeed, the only test item with this word final phoneme, *Pröng*, was predominantly pluralized by *–e* when it was presented both as a noun of non-feminine gender (62%: 172 out of 276) and as a noun of feminine gender (61%: 171 out of 282), although nouns of feminine gender were clearly associated with the plural marker *–(e)n* in the current sample. This preference for *–e* can be traced back to the fact that among frequently used one-syllable German nouns one can hardly find examples of word final /ŋ/ followed by the plural marker *–(e)n* or any other plural marker except *–e* with or without umlaut. Apart from several borrowings such as *Song* 'song' (pl. *Songs*) and *Gong* 'gong' (pl. *Gongs*), the type frequency list DeReWo (Institut für Deutsche Sprache 2009b) attests only nouns demanding *–e* or *–e* with umlaut: *Gang* 'walk', *Fang* 'catch', *Rang* 'ranking', *Klang* 'sound', *Ding* 'thing', and their numerous derivatives with various prefixes as well as several nouns with the suffix *–ling* such as *Schützling* 'protégé'. Provided that adults are capable of differentiating between the suffix *–ung* (that also ends in /ŋ/, consists of at least two syllables, and always demands *–(e)n*, e.g. *Lösung* 'solution', pl. *Lösungen*) and unsuffixed one-syllable nouns that almost never demand *–(e)n*, the tendency to pluralize the test item *Pröng* with *–e* in the current study is not surprising.

The significant result of word final phonemes demonstrates that German adults retrieve information on the possible plural marker on the basis of some kind of frequency analysis of compatibility of word final consonants and plural allomorphs. It should be taken into account that word final phonemes are, on their part, more or less

closely linked to other factors such as grammatical gender (Zaretsky et al. 2013b).

It could not be excluded that the presentation of the test items in a written form might have influenced the choice of plural markers due to the misinterpretation of the word final phonemes in such items as *Pund* (/…t/) where the so called final-obstruent devoicing occurs, that is, voiced obstruents become voiceless in the word final position. No association between this variable and certain plural markers was found in the current sample. However, even if the regression results for this factor would have been significant, this misinterpretation was probably common among adult German test subjects in other studies including Marcus et al. (1995) as well, so that the comparability of the studies would not have been affected. A further influence of orthography could have been expected in the test items *Fnöhk*, *Bnöhk*, *Fnähf*, and *Pnähf*: Combinations of graphemes <hk> and <hf> occur seldom and might have disoriented some test subjects in the choice of the plural allomorphs. Again, the influence of this variable on the choice of plural markers turned out to be not statistically significant.

Although the target language differentiates between nouns of masculine and neuter gender, with somewhat different pluralization patterns, as was shown for child-directed speech as well (Ravid et al. 2008), the current study followed the study design of Marcus et al. (1995) in respect to non-differentiation between these two grammatical genders. It was predicted that *–(e)n* would occur more often with nouns of feminine gender, whereas *–e* and probably also *–er* would be used with nouns of non-feminine gender because such tendencies are typical of Modern High German (Mugdan 1977; Zaretsky et al. 2011; Zaretsky & Lange 2014). These tendencies were indeed found, but also a less expected tendency to prefer *–s* with the nouns of non-feminine gender. This tendency has also been demonstrated both for Modern High German (Zaretsky et al. 2011) and child-directed speech (Ravid et al. 2008), but as a comparatively weak one. Of interest in regard to gender is also a negative association between the use of *–(e)n* and rhymes demanding *–e* in one of the binary logistic regressions. This association is probably motivated by a close link between, on the one hand, *–e* and nouns of non-feminine gender and, on the other hand, *–(e)n* and nouns of feminine gender.

The only statistically significant result of the gender shift, less *s*-uses when nouns of feminine gender were presented first, obviously shows that test subjects sometimes tended to apply different pluralization strategies depending on the gender of the same test items. Avoidance of *–s* after, probably, several produced *(e)n*-plurals,

might indicate a kind of self-priming of test subjects, when those who began to use *–(e)n* with nouns of feminine gender kept on using it with nouns of non-feminine gender presented later, which resulted in a lower proportion of *s*-uses (*–s* is associated with nouns of non-feminine gender). This assumptions is supported by the following descriptive statistics: When nouns of feminine gender were presented first, uses of *–(e)n* made out a larger proportion of all plural markers (26%: 1,747 out of 6,783) than under condition of nouns of non-feminine gender presented first (22%: 1,509 out of 6,814). In the pluralizations of nonce words by preschoolers, on the contrary, gender plays a minor role in comparison with the frequency of plural markers in the language input (Zaretsky et al. 2013a).

About 3% of the answers had to be excluded from the analysis because they lacked any plural forms or the test item was omitted. Some answers, excluded from the analyses in the Results section, contained re-etymologizations. Only one item was clearly re-etymologized by the test subjects: *Kach* → *Kachel(n)* 'glazed tile(s)' (13 occurrences). However, the pseudo-suffix *–el* was found at least once with most other items as well (a total of 14 occurrences such as *Pläkel*, *Bneikel*, *Pröngel*, *Pischel*, *Vagel*, *Pindel*), probably because a number of German substantives ending in *–el* is pluralized by not iconic plural allomorphs (cf. umlauting: *Vogel* 'bird' → *Vögel*, zero plural: *Hobel* 'slicer' → *Hobel*). In such cases, the suffix *–el* (usually used for the production of diminutive forms such as *Greta* (name) → *Gretel*) is obviously re-interpreted as a plural marker. The same phenomenon was found in the answers of both children and adults with other nonce words as well (Zaretsky et al. 2013a).

The limited ecological validity of nonce words as test items has already been demonstrated with SETK 3-5 plural items for a large sample of German preschoolers (Zaretsky et al. 2013a; cf. Webb 2007) and was confirmed here for German adults. Although adults delivered relatively few zero plurals or no answer at all in comparison with children (cf. Schrödl et al. 2015; Zaretsky et al. 2013a), they tended to produce malformed "creative" plural forms or phantasy words not related to any pluralization patterns of the standard language or its colloquial variants. Nevertheless, the use of nonce words still represents some advantages compared to real words. First and foremost, it allows to avoid the reproduction of memorized plural forms and enforces the activation of internalized pluralization strategies.

To sum up, HOMALS and Wilcoxon tests demonstrated that certain differences in the distribution of plural markers depending on the classification of nouns as rhymes or non-rhymes did exist, although

this variable played a minor role (or no statistically significant role at all according to the binary logistic regressions) in comparison with the grammatical gender (including gender shift), word final phonemes, and associations with existing German words as well as the presence of monophthongs or diphthongs that can be subject to umlauting. No evidence was found that *–s* was used as the default plural marker in non-rhyming German nonce words and that other plural markers can be considered to be irregular. In fact, *–s* was used only in 16% of plural formations with non-rhymes, which was 8% more than with rhymes but still not enough to speak of a dominant role. Apart from *–s*, in non-rhymes, compared to rhymes, a significantly higher frequency of *–(e)n* and *–e* was identified: *–(e)n* also made out 8% more of all pluralizations with non-rhymes than with rhymes, and *–(e)*, in spite of the difference of only 2% between non-rhymes and rhymes, accounted for almost a half of all pluralizations with both kinds of nonce words. This is not just a quantitative, but a qualitative difference from the results of Marcus et al. (1995). All three markers (*–s*, *–(e)n*, and *–e*) are iconic, productive, and the latter two are also the most frequent ones in Modern High German (Zaretsky et al. 2011). All three markers do not require umlauting, which allows to avoid (potentially wrong) modifications of the stems of unknown words. The plural allomorph *–s*, although infrequent, is phonotactically highly compatible and semantically associated with any unusual language material, which might have increased its frequency in non-rhymes. Obviously, with language material like the nonce words chosen by Marcus et al. (1995), that is, nouns with very few cues on possible plural forms, there is no considerable difference between pluralization schemata of children and adults because children are known to prefer the same three plural markers with nonce words (Zaretsky et al. 2013c). Other plural markers (*–er*, umlaut, *–e* with umlaut) are hardly productive in German and therefore it is not surprising that they occur comparatively rarely in the pluralizations of both children and adults.

Differences between the results presented here and those in the article by Marcus et al. (1995) can be traced back to two factors: first, a very limited sample size and some other more or less problematic issues in the statistical analysis by Marcus et al. (1995); second, plausibility tasks in Marcus et al. (1995) versus active plural production in the study presented here, the latter factor probably being more relevant. Plausible forms are not necessarily the forms preferred by test subjects. Therefore, active pluralization might deliver not only quantitatively, but also qualitatively different results in respect to internalized pluralization rules and strategies. The results presented

here demonstrate that plural forms produced by German adults can be explained in terms of single-route models, without subdivision of plural markers into default and irregular ones. The same explanation was found for another set of plural items taken from the language test SETK 3-5: As was shown by Zaretsky et al. (2013a), both German children (including children with immigration background) and adults apply in SETK 3-5 nonce words the same pluralization strategies. These strategies were based, first and foremost, on frequency of plural markers in the target language, namely either on the general frequency of the plural markers in the input (*–e*, *–(e)n*) or on the frequency of their occurrence after certain word final phonemes (*–s*).

Bibliographical References

Bittner, Dagmar & Köpcke, Klaus-Michael 2001. The acquisition of German plural markings: A case study in natural and cognitive morphology. In Schaner-Wolles, Chris; Rennison, John & Neubarth, Friedrich (eds.), *Naturally! Linguistic Studies in Honour of Wolfgang Ulrich Dressler Presented on the Occasion of his 60th Birthday*. Turin: Rosenberg & Sellier. 47-58.

Bybee, Joan 1985. *Morphology: A study of the Relation between Meaning and Form*. Amsterdam: John Benjamins.

Bybee, Joan 1988. Morphology as lexical organization. In Hammond, Michael & Noonan, Michael (eds.), *Theoretical Morphology*. San Diego: Academic Press. 119-141.

Clahsen, Harald 1999. Lexical entries and rules of language: A multidisciplinary study of German inflection. *Behavioral and Brain Sciences* 22(6). 991-1060.

Clahsen, Harald; Rothweiler, Monika; Woest, Andreas & Marcus, Gary F. 1992. Regular and irregular inflection in the acquisition of German noun plurals. *Cognition* 45(3). 225-255.

Cohen, Jacob 1988. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale: Erlbaum.

Dressler, Wolfgang U.; Mayerthaler, Willi; Panagl, Oswald & Wurzel, Wolfgang U. 1987. *Leitmotifs in Natural Morphology*. Amsterdam: John Benjamins.

Elsen, Hilke 2001. The acquisition of German plurals. In Bendjaballah, Sabrina; Dressler, Wolfgang U.; Pfeiffer, Oskar E. & Voeikova, Maria D. (eds.), *Morphology 2000: Selected Papers from the 9th Morphology Meeting, Vienna, 24-28 February 2000*. Amsterdam: John Benjamins Publishing Company. 117-128.

Fakhry, Salah A. 2005. *Die Entwicklung des deutschen Pluralsystems im 20. Jahrhundert*. Ph.D. dissertation. Philipps-University of Marburg, Germany.

Grimm, Hannelore 2001. *SETK 3-5. Sprachentwicklungstest für drei- bis fünfjährige Kinder*. Göttingen: Hogrefe.

Institut für Deutsche Sprache 2009a. Korpusbasierte Wortformenliste DeReWo, v-100000t-2009-04-30-0.1, mit Benutzerdokumentation.

Mannheim: Institut für Deutsche Sprache, Programmbereich Korpuslinguistik. <http://www.ids-mannheim.de/kl/projekte/methoden/derewo.html> (November 20, 2015).

Institut für Deutsche Sprache 2009b. Korpusbasierte Grundformenliste DeReWo, v-40000g-2009-12-31-0.1, mit Benutzerdokumentation. Mannheim: Institut für Deutsche Sprache, Programmbereich Korpuslinguistik. <http://www.ids-mannheim.de/kl/derewo/> (November 20, 2015).

Köpcke, Klaus-Michael 1988. Schemas in German plural formation. *Lingua* 74(4). 303-335.

Köpcke, Klaus-Michael 1993. *Schemata bei der Pluralbildung im Deutschen*. Tübingen: Gunter Narr.

Korecky-Kröll, Katharina & Dressler, Wolfgang U. 2009. The acquisition of number and case in Austrian German nouns. In Stephany, Ursula & Voeikova, Maria D. (eds.), *Development of Nominal Inflection in First Language Acquisition: A Cross-Linguistic Perspective*. Berlin: Walter de Gruyter. 265-302.

Korecky-Kröll, Katharina; Libben, Gary; Stempfer, Nicole; Wiesinger, Julia; Reinisch, Eva; Bertl, Johannes & Dressler, Wolfgang U. 2012. Helping a crocodile to learn German plurals: Children's online judgment of actual, potential and illegal plural forms. *Morphology* 22(1). 35-65.

Marcus, Gary F.; Brinkmann, Ursula; Clahsen, Harald; Wiese, Richard & Pinker, Steven 1995. German inflection. The exception that proves the rule. *Cognitive Psychology* 29(3). 189-256.

Mayerthaler, Willi 1981. *Morphologische Natürlichkeit*. Wiesbaden: Athenaion.

Micceri, Theodore 1989. The unicorn, the normal curve, and other improbable creatures. *Psychological Bulletin* 105(1). 156-166.

Mugdan, Joachim 1977. *Flexionsmorphologie und Psycholinguistik*. Tübingen: Gunter Narr.

Niedeggen-Bartke, Susanne 1999. Flexion und Wortbildung im Spracherwerb. In Meibauer, Jörg & Rothweiler, Monika (eds.), *Das Lexikon im Spracherwerb*. Tübingen: Francke. 208-228.

Pinker, Steven 1999. *Words and Rules: The Ingredients of Language*. London: Weidenfeld & Nicolson.

Ravid, Dorit; Dressler, Wolfgang U.; Nir, Bracha; Korecky-Kröll, Katharina; Souman, Agnita; Rehfeldt, Katja; Laaha, Sabine; Bertl, Johannes; Basbøll, Hans & Gillis, Steven 2008. Core morphology in child directed speech: Crosslinguistic corpus analyses of noun plurals. In Behrens, Heike (ed.), *Corpora in Language Acquisition Research: History, Methods, Perspectives*. Amsterdam: John Benjamins. 25-60.

Ruoff, Arno 1981. *Häufigkeitswörterbuch gesprochener Sprache*. Tübingen: Max Niemeyer.

Schrödl, Christina; Korecky-Kröll, Katharina & Dressler, Wolfgang U. 2015. Pluralmorphologie im österreichischen Deutsch: Dialekt und Erstspracherwerb. In Lenz, Alexandra N., Ahlers, Timo & Glauninger, Manfred M. (eds.), *Dimensionen des Deutschen in Österreich. Variation und Varietäten im sozialen Kontext*. Frankfurt a. M.: Peter Lang. 165-188.

Schüller, Katharina 2015. *Statistik und Intuition*. Berlin, Heidelberg: Springer-Verlag.

Szagun, Gisela 2001. Learning different regularities: The acquisition of noun plurals by German-speaking children. *First Language* 21. 109-141.

Vollmann, Ralf; Sedlak, Maria; Müller, Brigitta & Vassilakou, Maria 1997. Early verb inflection and noun plural formation in four Austrian children: The demarcation of phases and interindividual variation. *Papers and Studies in Contrastive Linguistics* 33. 59-78.

Webb, Stuart 2007. The effects of repetition on vocabulary knowledge. *Applied Linguistics* 28(1). 46-65.

Wegener, Heide 1994. Variation in the acquisition of German plural morphology by second language learners. In Tracy, Rosemarie & Lattey, Elsa (eds.), *How Tolerant is Universal Grammar? Essays on Language Learnability and Language Variation*. Tübingen: Max Niemeyer. 267-294.

Wurzel, Wolfgang U. 1984. *Flexionsmorphologie und Natürlichkeit*. Berlin: Akademie-Verlag.

Zaretsky, Eugen; Lange, Benjamin P.; Euler, Harald A. & Neumann, Katrin 2013a. Differences in plural forms of monolingual German preschoolers and adults. *Lingue e Linguaggi* 10. 169-180.

Zaretsky, Eugen; Lange, Benjamin P.; Euler, Harald A. & Neumann, Katrin 2013b. Acquisition of German pluralization rules in monolingual and multilingual children. *Studies in Second Language Learning and Teaching* 3(4). 551-580.

Zaretsky, Eugen; Neumann, Katrin; Euler, Harald A. & Lange, Benjamin P. 2013c. Pluralerwerb im Deutschen bei russisch- und türkischsprachigen Kindern im Vergleich mit anderen Migranten und monolingualen Muttersprachlern. *Zeitschrift für Slawistik* 58(1). 43-71.

Zaretsky, Eugen & Lange, Benjamin P. 2014. Influence of intra- and extralinguistic factors on the distribution of plural allomorphs in German. *California Linguistic Notes* 39(1). 73-114.

Zaretsky, Eugen & Lange, Benjamin P. 2015. Deep grey zone: Why statistical results follow a hypothesis, exemplified by studies on the plural acquisition in German. Presentation at the conference „Methods and Linguistic Theories“, Bamberg, Germany, 27.-28. November 2015.

Zaretsky, Yevgen; Lange, Benjamin P.; Euler, Harald A. & Neumann, Katrin 2011. Pizzas, Pizzen, Pizze: Frequency, iconicity, cue validity, and productivity in the plural acquisition of German preschoolers. *Acta Linguistica* 5(2). 22-35.

Appendix. Test items

- Non-rhymes: *ein(e) Bnaupf*, *ein(e) Pläk*, *ein(e) Plaupf*, *ein(e) Snauk*, *ein(e) Bneik*, *ein(e) Pleik*, *ein(e) Fnöhk*, *ein(e) Bröhk*, *ein(e) Pröng*, *ein(e) Fnähf*, *ein(e) Pnähf*, *ein(e) Fneik*
- Rhymes, with the most probable associations, based on frequency lists of types (Ruoff 1981) and tokens (Institut für Deutsche Sprache 2009a):

Test item	Most frequent rhymes among existing German nouns (singular – plural; types)	Second most frequent rhymes among existing German nouns (singular – plural; types)	Most frequent rhymes among existing German nouns (singular – plural; tokens)	Second most frequent rhymes among existing German nouns (singular – plural; tokens)
ein(e) Pisch	*der Tisch* 'table' – *Tische*	*der Fisch* 'fish' – *Fische*	*der Tisch* 'table' – *Tische*	*der Fisch* 'fish' – *Fische*
ein(e) Bral	*das Tal* 'dale' – *Täler*	*das Mal* 'time, mark' – *Male*	*das Mal* 'time, mark' – *Male*	*der Saal* 'hall' – *Säle*
ein(e) Pind	*das Kind* 'child' – *Kinder*	*der Wind* 'wind' – *Winde*	*das Kind* 'child' – *Kinder*	*der Wind* 'wind' – *Winde*
ein(e) Kach	*das Dach* 'roof' – *Dächer*	*der Bach* 'stream' – *Bäche*	*das Dach* 'roof' – *Dächer*	*der Bach* 'stream' – *Bäche*
ein(e) Pund	*der Grund* 'reason' – *Gründe*	*der Pfund* 'pound' – *Pfunde*	*der Grund* 'reason' – *Gründe*	*der Bund* 'union, alliance' – *Bünde*
ein(e) Klot	*das Brot* '(loaf of) bread' – *Brote*	*die Not* 'need' – *Nöte*	*die Not* 'need' – *Nöte*	*das Boot* 'ship' – *Boote*
ein(e) Vag	*der Tag* 'day' – *Tage*	*der Schlag* 'strike' – *Schläge*	*der Tag* 'day' – *Tage*	*der Schlag* 'strike' – *Schläge*
ein(e) Spert	*der Wert* 'value' – *Werte*	*das Pferd* 'horse' – *Pferde*	*der Wert* 'value' – *Werte*	*das Pferd* 'horse' – *Pferde*
ein(e) Mur	*die Uhr* 'watch' – *Uhren*	*die Schnur* 'cord' – *Schnüre*	*die Uhr* 'watch' – *Uhren*	*die Spur* 'trace' – *Spuren*
ein(e) Raun	*der Zaun* 'fence' – *Zäune*	—	*der Zaun* 'fence' – *Zäune*	—
ein(e) Nuhl	*der Stuhl* 'chair' – *Stühle*	—	*der Stuhl* 'chair' – *Stühle*	—
ein(e) Spand	*die Hand* 'hand' – *Hände*	*das Land* 'country' – *Länder*	*das Land* 'country' – *Länder*	*die Hand* 'hand' – *Hände*