On the acquisition of nasals in Dutch and German

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1. Introduction

Nasals are among the first segments to be acquired in English (e.g., Stoel-Gammon 1985), German (e.g., Elsen 1991) and Dutch (e.g., Fikkert 1994). Nevertheless they show slightly different developmental patterns in Dutch and German. Fikkert (1994) points out that nasals follow stops in the acquisition of Dutch. In contrast, Elsen (1991) provides data showing that nasals precede stops in the acquisition of German. Bearing in mind that German and Dutch are closely related, the question arises why these differences show up.

Handbook descriptions of Dutch (Booij 1995) and German (Wiese 1996) suggest that the phonologies of the two languages strongly resemble each other with respect to syllabic structure and phoneme inventory. Two striking differences between Dutch and German are (a) the fact that German allows syllabic sonorant consonants, but standard Dutch does not, and (b) German has a more complex system of obstruents than Dutch. The first point is illustrated by the realization of /-ən/ endings: Dutch usually deletes the nasal, while the schwa is retained. In contrast, in German the schwa is often deleted while the nasal is kept. The examples in (1) illustrate this difference:

(1) a. Dutch: /lo.pən/ → [lo.pə] *lopen* 'to run'
    b. German: /la͡ʊ.fən/ → [la͡ʊ.fn̩] *laufen* 'to run'

In German as well as in Dutch the /-ən/ suffix is very frequently used in noun declension as well as in verb conjugation. Thus, the different realizations of underlying /-ən/ affixes result in a higher overall frequency of nasals in German compared to Dutch. This frequency difference only resides in unstressed syllables, as in stressed syllables German and Dutch have a similar frequency of nasals, in both onset and postvocalic position (Baayen et al. 1993).

Frequency has been argued to play an important role in acquisition (Boersma 1998; Levelt et al. 2000 for Dutch syllable structure). It is well established that

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infants are sensitive to probabilistic patterns in the language that they learn (for an overview see Gómez, to appear). Recent work has shown that frequency also has an impact on children's production. Zamuner et al. (2005) show that frequency differences in child speech reflect frequency differences in the ambient input language. Moreover, it has been shown in both perception and production studies that children initially ignore unstressed syllables (Jusczyk et al. 1999 for perception; Bernhardt & Stemberger 1998 for production). This has mostly been shown for pretonic unstressed syllables. It is less clear whether this also holds for posttonic unstressed syllables. Whereas Taelman (2004) notes that children also frequently delete posttonic syllables, Fikkert (1994) reports that the deletion of posttonic syllables is substantially lower than that of pretonic syllables. However, even if they are not frequently deleted, it may still be the case that posttonic unstressed syllables are not very salient and hence, their segmental content would not contribute much to frequency effects. If indeed children use the salient stressed syllables for building up a system of segmental contrasts, we expect to find no difference in the production of nasals between German and Dutch child speech. As there is no frequency difference for nasals in German and Dutch stressed syllables, there should be no difference in the children's production of nasals.

On the other hand, if unstressed syllables are taken into consideration from the beginning, a difference in the production ratio of nasals between German and Dutch should show up. The first part of the paper addresses the role of nasals in unstressed position for acquisition in Dutch and German. It turns out that an account based on frequency alone cannot account for the attested distribution of nasals in child language. In the second part of the paper we argue that the role of frequency has to be seen within the phonological system as a whole.

2. Data

2.1 Method

To test the hypotheses regarding the role of posttonic unstressed syllables for the acquisition of nasals we analysed data of four German and eight Dutch children. The Dutch data is taken from the CLPF-corpus (Fikkert 1994, Levelt 1994). The German data comes from the Grijzenhout & Joppen (1998) database and the Grimm database (Grimm, in preparation).[1] For all children we examined the development of nasals between 1;0 and 2;1, in as far as data was available for this period.[2] Every nasal in every utterance was coded with respect to the following criteria: (a) whether it is part of a schwa syllable, which ends in a schwa followed by a nasal in the underlying form, or of a syllable with full vowel; (b) whether it is an onset or a coda, where nasals following a schwa in a schwa syllable are kept distinct from nasals in codas; and (c) whether it occurs in word-initial, word-medial or word-final position. Each nasal is assigned to a unique category. Furthermore, for each nasal, it was noted whether it was produced correctly as a nasal in the appropriate position or not. Errors in place of articulation were ignored.

2.2 Results

Analysis of the intake

We analyzed all nasals that appeared in the target words that children attempted, which we refer to as the intake. In total, we coded 13,865 nasals for German and 6,000 nasals for Dutch. The distribution of target nasals over the different syllabic positions is shown in Figure 1. A Chi-square test revealed that there is no significant difference between the two languages in the distribution of attempted nasals over the different prosodic positions.

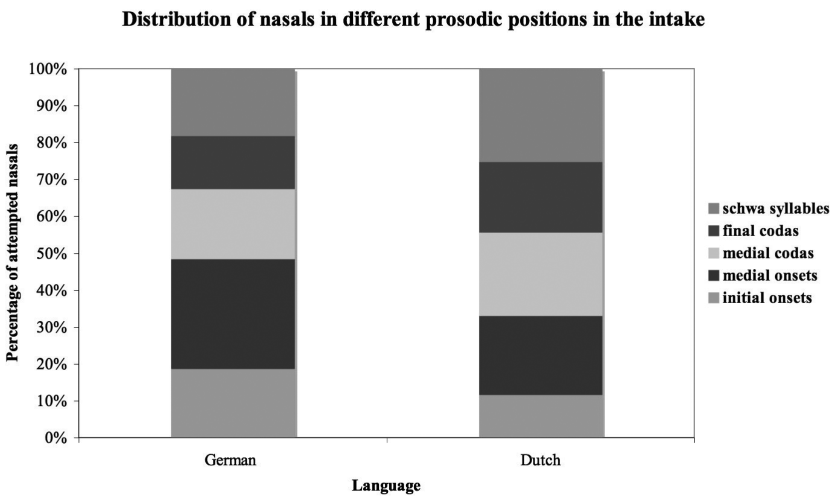

Figure 1. Distribution of attempted nasals in different prosodic positions in German and Dutch.

A slightly different pattern shows up if we collapse nasals in onsets in word-initial and word-medial position and codas in word-medial and word-final position (leaving nasals in schwa syllables aside), as displayed in Figure 2.[3] In German 48.42% of the nasals in the intake are in onset positions; 33.37% in coda positons of full syllables; 18.21% are part of schwa syllables and thus also form codas/rhymes. Given that nasals in schwa syllables are usually produced in German, the nasals in the intake are almost evenly distributed over onsets and codas (rhymes) in German. In contrast, in Dutch only 33.02% of the nasals are in onsets; 41.78% are in codas of full syllables; 25.20% are part of schwa syllables.[4] In sum, Dutch has many more nasals in coda position than in onset position, even when we ignore the schwa syllables. A Chi-square test revealed that this difference in distribution between the two languages is significant ($X^2 = 4.7$; $p < .05$).

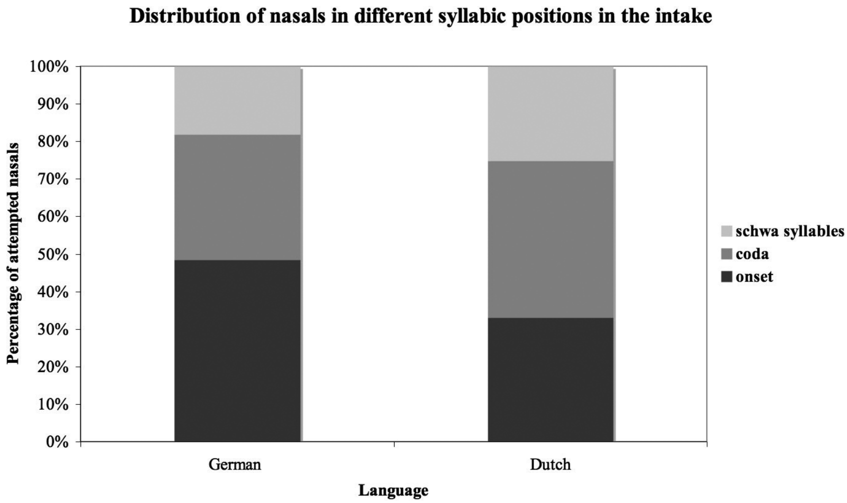

Figure 2. Distribution of attempted nasals in different syllabic positions in German and Dutch.

Analysis of child production data

We will now turn to the distribution of nasals in the children's productions. The percentage of target nasals that are actually produced as nasals collapsed over all syllabic positions is 80.41% for German and 55.78% for Dutch. A Wilcoxon test revealed that the difference in production between the Dutch and German children is significant ($t(14) = 3$; $p < .01$). Separating the different prosodic positions, it becomes evident that this effect is mainly due to nasals in schwa syllables and onsets. German children perform significantly better than Dutch children on nasals in onsets ($t(14) = 2$; $p < .01$) and schwa syllables ($t(10) = 8$; $p = .05$), but do not perform better on nasals in coda position, as shown in Figure 3.

So far we only discussed the overall patterns found in the data collapsed over the whole period of investigation. We will now turn to developmental patterns. The development of nasals in onset position shows a similar trend in Dutch and German. There is a strong increase in the production of nasals up to about 1;4. Afterwards the production rate rises just slightly, as shown in Figure 4. During the whole period German children produce more nasal onsets than Dutch children.

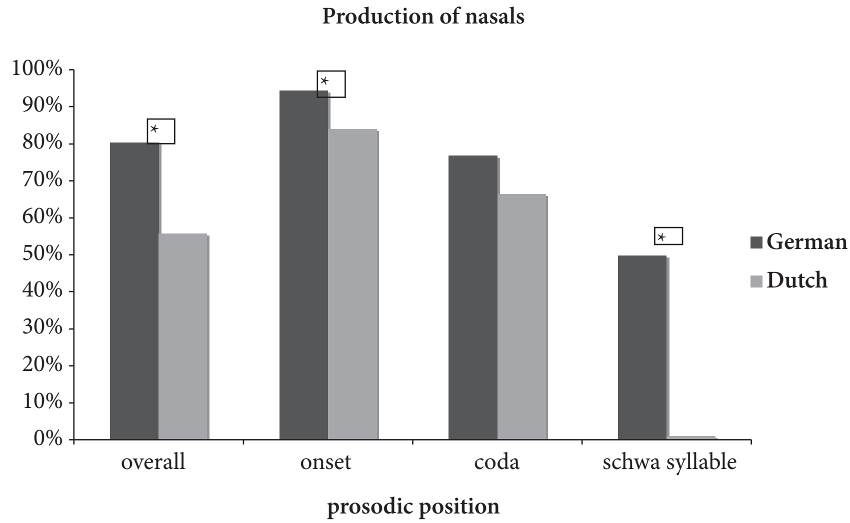

Figure 3. Production of nasals in different prosodic positions by German and Dutch children.

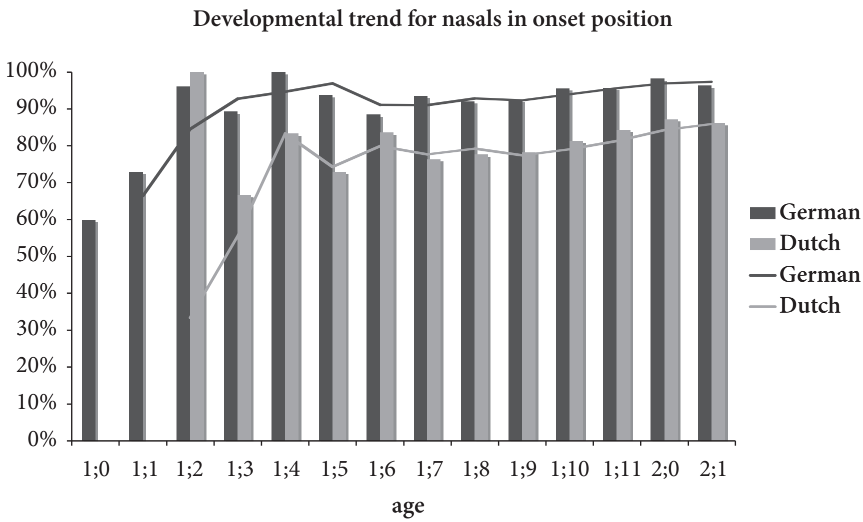

Figure 4. Developmental trend for nasals in onset position for German and Dutch

The development of nasal production in coda position is displayed in Figure 5. The developmental trend shows a constant rise in production for German as well as for Dutch.[5] From the age of 1;8 the performance rate of the German children is considerably higher than the performance rate of the Dutch children. When comparing the production of nasals in onset and coda position it is evident that both German and Dutch children produce more nasals correctly in onset than in coda position.

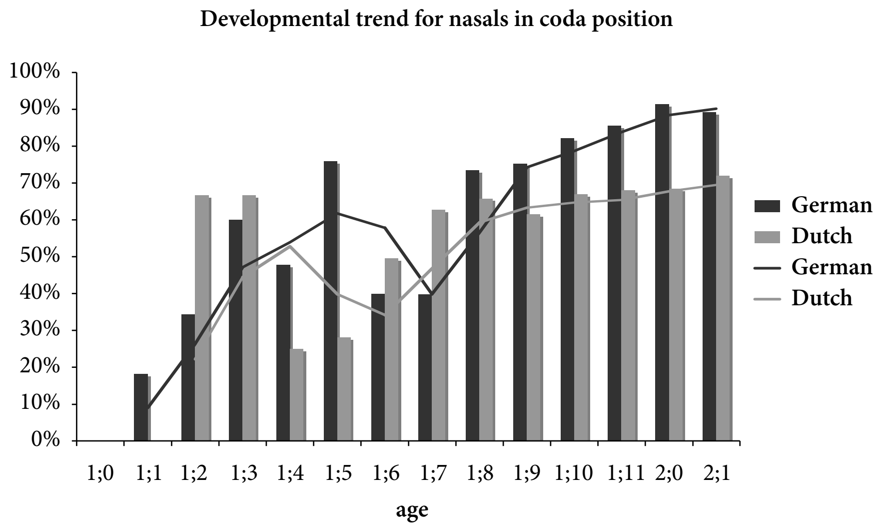

Figure 5. Developmental trend for nasals in coda position for German and Dutch

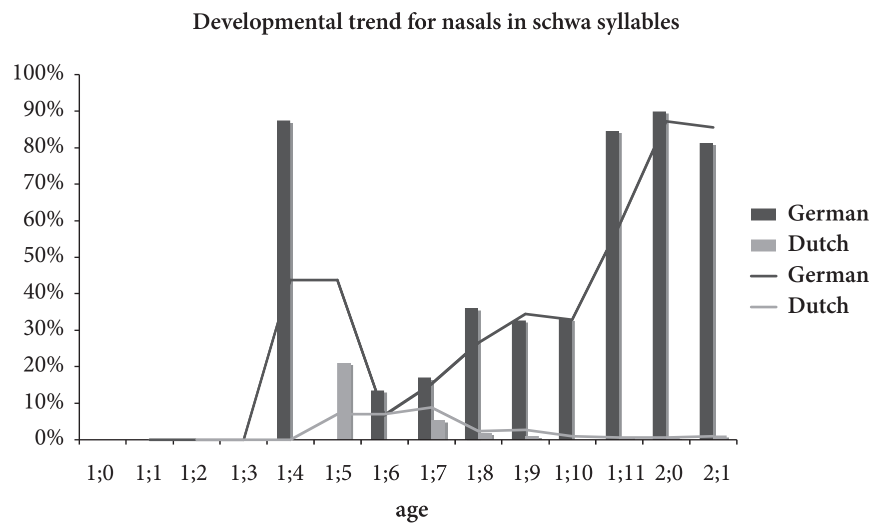

Figure 6. Developmental trend for nasals in schwa syllables for German and Dutch

The development of nasals in schwa syllables shows an exceptional pattern compared to onset and coda development, as can be seen in Figure 6. Up to 1;7 there is no substantial difference in the production ratio of nasals in schwa syllables between Dutch and German children: the performance rates are equally low for both languages. For Dutch this does not change in the course of development. In contrast, the German children start to produce more nasals in general after 1;7. And at this age they also start to produce syllabic nasals, although they still are infrequent in the children's output. At 1;10, when nasals in coda position are produced correctly in over 80% of the time, the developmental trend regarding nasals in schwa syllables displays a sudden leap in the production of syllabic nasals for German children. Moreover, at 1;11 syllabic nasals become nearly as frequent in German child speech as in adult speech and the German children correctly produce nasals in schwa syllables approximately with the same frequency as nasals in syllables with a full vowel.

To sum up, there are several results that are worth mentioning. Concerning the distribution of nasals in the intake, German and Dutch show different patterns: In German the target nasals are evenly distributed over onsets and codas if nasals in schwa syllables are regarded as codas. In Dutch the number of nasals in coda position outnumbers the number in onset position, even if schwa syllables are ignored. If we compare children's productions of nasals also different patterns appear for Dutch and German. First, the overall performance on nasals is better in German children than in Dutch children. This difference is mainly due to differences in the realisation of nasals in onset position. For nasals in coda position (excluding schwa syllables) German and Dutch show similar production patterns. After 1;8 the performance of nasals in coda position becomes better for German in comparison to Dutch children. Second, the performance of nasals in schwa syllables shows an exceptional pattern compared to the development of nasals in onsets and codas. Up to 1;7 children acquiring Dutch as well as children acquiring German hardly produce any nasals in a schwa syllable. Afterwards there is an strong increase in the production of nasals for German children, so that they perform almost equally well for nasals in schwa syllables and in syllables with a full vowel at 1;11. As expected, Dutch children do not change their behaviour. As nasals following schwa are usually not produced in Dutch, children will not receive positive evidence and hence are not triggered to change their behaviour.

3. Discussion

German children produce significantly more nasals than Dutch children. This suggests that the frequency difference in children's productions reflects the frequency difference in the ambient input languages. Bearing in mind that the overall frequency difference in nasals between German and Dutch resides in unstressed syllables, it appears that this result supports the hypothesis that the segmental content of unstressed syllables is taken into account by children. However, the pattern is not as clear-cut. For nasals in onset position the production rate is higher in German than in Dutch, reflecting the frequency in the ambient language. However, Dutch and German children do not show a different pattern regarding nasals in coda position, despite the fact that the target languages differ in this respect. How can we account for the different patterns in the different prosodic positions?

As stated in § 2.2, there is a significant difference in the intake frequency of nasals in onsets and codas in German compared to Dutch.[6] In syllables containing a full vowel in stressed position, the Dutch children attempt more nasals in coda than in onset position. For German children the pattern is reversed. Taking all syllables into account (thus also unstressed syllables), the distributional pattern changes: for Dutch there are still more nasals attempted in coda position than in onset position, but in German the attempted nasals are evenly distributed over onsets and codas. Table 1 summarizes the distribution of nasals in the intake in stressed syllables and stressed and unstressed syllables combined, respectively.

Table 1. Distribution of nasals in the intake in German and Dutch

	German		**Dutch**[7]	
	Stressed syllables	**All syllables**	**Stressed syllables**	**All syllables**
Onset	59%	49%	44%	33%
Coda	41%	51%	56%	67%

The different frequency patterns lead to different expectations: If children initially only take segmental contrasts in stressed syllables into account, then Dutch children should perform better on nasals in coda than in onset position while for German children the opposite is predicted. In contrast, German children should perform equally well on nasals in onset and coda position, if unstressed syllables are also taken into account from the beginning. Table 2 shows the production pattern for Dutch and German child language. As expected by the 'stressed syllables only'-hypothesis, German children perform better on nasals in onset than in coda position; but so do Dutch children, contrary to the hypothesis.

Table 2. Distribution of correct use of nasals in the children's productions in German and Dutch

	German	**Dutch**
Onset	94%	84%
Coda	66%	77%

Thus, the data leads to the conclusion that neither the frequency pattern in stressed syllables only, nor the frequency pattern in all syllables can explain the results found. In addition, two more questions remain. First: why is the intake different in Dutch and German while the input (i.e. the distributions based on CELEX) is very similar in both languages? And second: why do German children produce nasals earlier than plosives while Dutch children show the reverse acquisition order (see Elsen 1991 and Fikkert 1994)?

In the following, we discuss the directions in which we expect to find answers to these questions. So far we only considered the distribution of nasals independently of other segments. As mentioned before, although German and Dutch are closely related languages, there are some important differences in the phonologies of the two languages. A major difference between the segmental inventories in the two languages is the system of contrast within the class of obstruents. The German phoneme inventory contains stops, fricatives and affricates while Dutch lacks affricates. Looking at possible onset and coda consonants, both languages allow plosives, fricatives and nasals to form onsets and codas. In addition, German allows affricates in these positions (Booij 1995 for Dutch, Wiese 1996 for German). Due to a number of historical processes (such as the second consonant shift) many originally voiceless stops turned into fricatives or affricates, depending on their position (cp. Dutch *appel*, *schip* — German *Apfel*, *Schiff*). As a result, there are fewer unmarked plosives and more marked fricatives/affricates in German than in Dutch (e.g. Wright 1906). Put differently, German has more marked obstruents compared to Dutch. This may have consequences for acquisition.

In our preliminary analysis of word-initial segments in the intake we found a striking difference between Dutch and German: Dutch children attempted eight times more obstruents than nasals, whereas German children only attempted twice as many obstruents as nasals. This suggests that nasals are less marked in the German system compared to the Dutch. Given that children start with the least marked option with respect to manner of articulation[8] when acquiring the system of phonological contrast, this finding is in accordance with the observation that nasals are acquired earlier in German compared to Dutch. It is also in conformity with the observation that German children select more nasals in the intake than Dutch children. Hence, we feel that looking at the distribution of nasals without considering the rest of the phonological system leads to an incomplete analysis. In order to understand the mechanism that underlies the acquisition of nasals we have to take the whole system of phonological contrasts into account.

We are currently analysing the data with respect to two questions. First, what are the patterns for the production of plosives, affricates and fricatives, respectively? And second, if nasals are not produced correctly, does the error pattern give cues to markedness? Having examined a random selection of the data, the preliminary results seem to reveal an important point: the German children only rarely substitute a nasal with an obstruent. In general the nasal is either produced correctly or deleted. In contrast, the Dutch children often replace the nasal with a plosive, particularly at early stages of development. Further evidence comes from the production of obstruent-nasal clusters: Dutch children tend to produce the obstruent, while German children show a greater tendency to produce the nasal.

4. Conclusion

The production data of German and Dutch children shows a number of interesting differences: First, despite similar distributions in stressed syllables of the intake, German children (a) target more words with initial nasals for production than Dutch children, (b) German children produce significantly more nasals correctly in the early stages of word production than Dutch children; (c) initially neither German nor Dutch children produce nasals in unstressed syllables, but once they appear in the speech of German children, this correlates with an increase in correct nasal production in both schwa syllables and codas. We further hypothesized that the development cannot be seen independently from the phonological system that the child is building up, and hence the position of nasals in the system of phonological contrasts. This will be the focus of our future investigation of differences and similarities in the phonological development of Dutch and German.

Notes

1. We thank Janet Grijzenhout and Angela Grimm for sharing their data with us and we also thank two anonymous reviewers.

2. Recordings of the children started at different ages. However, there are at least two children recorded at the different time points for both languages.

3. Here we assumed ideal phonological forms of target words, i.e. if the target form has a nasal, we assume that it is realized. Because this often is not the case for nasals following a schwa in Dutch, these are considered a separate category.

4. Nasals in schwa syllables are usually deleted in Dutch. Since the nasals are not produced, language learners will not hear them. Therefore we do not expect Dutch children to produce nasals in schwa syllables at any point in development.

5. The only exception to this trend is a remarkably high value at 1;2 and 1;3 for Dutch and at 1;3 and 1;5 for German. These values give the impression of a U-shaped developmental curve. However, we assume that they are accidental and not systematic. For Dutch they come from one child only. For German they are only due to the correct productions of the word *nein* ('no').

6. The assumptions on the frequency distribution of nasals over the different syllabic positions rely on frequency data in the intake. Although we have not been able to test this with actual child directed speech databases, we do not expect that these will show a different pattern.

7. We included nasals in schwa syllables for the intake percentage in Dutch because they are underlying present. However, one should bear in mind that this percentage is much lower if it would be based on surface forms in which nasals in unstressed are typically not realized.

8. One reviewer suggested that the laryngeal system of German is less marked than that of Dutch, and hence that German plosives are less marked and would be acquired earlier than in Dutch. Although it is the case that the laryngeal contrast based on aspiration (German) is acquired before that based on voicing (Dutch), the laryngeal contrast appears much later than the contrast between plosives and nasals.

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