

# THE STATUS OF THE RHYTHM RULE WITHIN AND ACROSS WORD BOUNDARIES IN GERMAN

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## ABSTRACT

German as well as other languages show a preference for rhythmical alternation, a phenomenon mostly discussed as the Rhythm Rule. This rule has mainly been explored on the word level, although it can also occur on a phrasal level. This study shows that it operates regularly on both levels. In contrast to its assumed appearance in English, the RR exists not only on the perceptual level but is also used as an articulatory strategy to avoid rhythmically disharmonic stress clashes. Syllable duration turned out to be the main indicator for the perception and production of stress shifts. The results of this study suggest that the RR plays an important role in German prosodic phonology.

**Keywords:** Rhythm Rule, stress perception, Metrical Phonology, acoustic correlates of stress shift, German stress clash environments

## 1. INTRODUCTION

Metrical phonology deals with a phenomenon which is entitled as Rhythm Rule (RR) [5]. This rule expresses that adjacent stressed syllables have to be separated from each other in order to avoid a so-called stress clash. Therefore, the RR can operate in two different ways: Either by shifting the weaker of the involved stresses onto another stressable syllable (Reversal Analysis: RA) or by destressing of the weaker syllable (Deletion Analysis: DA) [8]. Both options obtain a rhythmically alternating sequence of stressed and unstressed syllables. Thus, the pursuit of rhythmically well-formedness seems to motivate the application of the RR in different languages, concededly in varying degrees. According to the theory, the RR operates mainly in German compounds, but can also trigger stress shifts on a phrasal level [4, 10] (see Figure 1).

Since the RR is described as an optional process, the aim of this paper is to explore possible differences in its application on word and phrasal level. It is further investigated whether its occurrence is a purely perceptual phenomenon or

reflected by phonetic alternations in German speech production. These questions seem to be of major importance since previous studies [6, 9] do not provide a definitive answer.

**Figure 1:** Application of the RR in German compounds (a) and phrases (b).

a)  $\overset{1}{\text{Bahnhof}} \rightarrow \overset{1}{\text{Haupt}}\overset{3}{\text{bahn}}\overset{2}{\text{hof}}$   
b)  $\overset{1}{\text{absagen}} \rightarrow \overset{1}{\text{Termin}}\overset{3}{\text{abs}}\overset{2}{\text{agen}}$

## 2. BACKGROUND AND PREVIOUS STUDIES

The phenomenon of the RR was mostly investigated on English data. These studies showed that the dominant form of the RR seems to be the DA, i.e. although a proper stress shift can be perceived by listeners, there is no acoustic evidence which speaks for a real shift of prominence within a potential stress shift item [2, 8]. Thus, the clash context rather leads to a stress reduction, i.e. a shortening of the duration and a lowering of F0 of the affected syllable [8]. Although previous studies do not fully agree on matters of the realization of the RR and its acoustic correlates, they all show that stress shifts are regularly perceived by English listeners. Hence, the RR plays an important role in English phonology. For German on the contrary, the occurrence and importance of the RR is not conclusive so far. While [6] classifies the RR as a regular albeit purely perceptual phenomenon, the study of [9] showed that stress shifts are not only perceived but also produced in German compounds. However, they conclude that its application is rather the exception than the rule and therefore not as important as in English [9]. The cited studies investigated exclusively compounds. However, the RR's appearance is also described beyond external word boundaries, i.e. on a phrasal level [4, 7, 10] (cf. Figure 1b). The present study extends the investigation of the importance of the RR and its nature to this phrasal level and tries to find experimental support for the hypothesis that the

phenomenon of a rhythmically motivated stress shift operates within and beyond word boundaries not only on a perceptual but also on a production level.

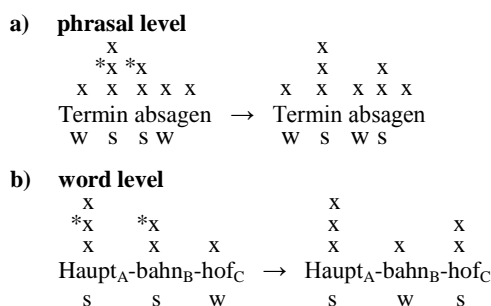
### 3. STUDY 1: PERCEIVED STRESS DISTRIBUTION IN STRESS CLASH ITEMS

A production and perception study was performed in which listeners were asked to evaluate the position of primary, secondary and tertiary stress in different contexts of potential stress clash environments. The crucial question was whether the presence of clashing adjacent syllables across word boundaries affects the distribution of primary and secondary stress in the same way as within words.

#### 3.1. Method

As stimuli, we chose phonological phrases consisting of a disyllabic noun followed by a three-syllable phrasal verb which is initially stressed when uttered in isolation (e.g. *absagen* ‘to cancel’;  $\triangle$ potential shift target). The noun preceding the target is either stressed on its first (e.g. *Fâer* ‘party’;  $\triangle$ non-clash context) or on its final syllable (e.g. *Term ñ* ‘appointment’;  $\triangle$ clash context). Thus, the clash-context noun triggers a stress shift in the following phrasal verb. In total, four phrases were tested per condition. Additionally, 11 A(BC)-compounds of the stimuli investigated in [9] were chosen. All A- and B-constituents of these compounds are monosyllabic, whereas the C-constituent of seven compounds consists of two syllables. In these cases, the final syllable contains an unstressable schwa-vowel (e.g. *Stadt-spar-kasse*: /ʃtat.ʃpa : r.ka.sə/). In all stimuli containing a clash context, the secondary stress should shift rightwards onto the next possible syllable, i.e. secondary and tertiary stress should undergo a rhythmic reversal (cf. Figure 2).

**Figure 2:** Stress clash and expected stress shift in the used stimuli.<sup>1</sup>

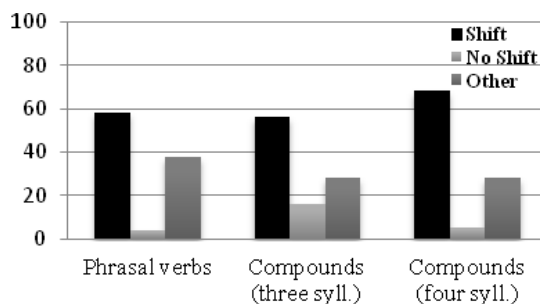


All stimuli were embedded into different carrier sentences. For the compounds, their original newspaper context was chosen. The form of the carrier sentences ensured that each critical stimulus was neither especially highlighted nor at the end of a prosodic phrase in order to avoid the influence of sentence final boundary tones (same design as in [9]). All sentences were read by 13 non-professional speakers. For the stress perception task, all critical stimuli were extracted from their carrier sentence. The stress distribution in the critical compounds and phonological phrases produced by each speaker was evaluated by four linguistically trained listeners each. Neither the speakers nor the listeners were informed about the underlying purpose of this task.

#### 3.2. Results

While all phonological phrases were taken into account, 35 compounds had to be excluded from analysis because these forms were realized with primary stress on the B-constituent or pronounced erroneously. Overall, the evaluation of 52 phonological phrases per condition (clash vs. non-clash context), 43 compounds consisting of three syllables, and 65 quadrisyllabic compounds was analyzed. In the phonological phrases with stress clash context, almost 60% of the phrasal verbs were perceived as stressed on the second syllable, i.e. with a stress shift. According to the listeners, only two of the analyzed 52 phonological phrases contained a real stress clash (<4%). In the remaining cases, the judgment of the four listeners was not definite or the phrasal verb was perceived as bearing phrasal stress. These results show that the RR operates regularly beyond word boundaries in German. The inspection of the two compound types suggests that the number of syllables does not seem to be a factor for the application of stress shift: Over 56% of the trisyllabic compounds and even 68% of the quadrisyllabic compounds were judged as stress-shifted, with a stressed C-constituent. However, the number of perceived stress clashes is somewhat higher for three-syllable compounds compared to quadrisyllabic compounds (16% vs. 5%). Overall, the results of this perception study illustrate the importance of the RR in German within and across word boundaries and make clear that it is a regularly used strategy to avoid stress clashes (cf. Figure 3).

**Figure 3:** Prominence perception results for study 1 (%).



#### 4. STUDY 2: THE ROLE OF CONTEXTUAL INFLUENCE

The results of various studies with regard to the shift triggering context suggest that its impact varies for German and English. While the perception of potential stress shifts decreases in English when heard without their triggering context [2], German listeners are still able to evaluate stress shifts accurately even when the context is removed [9]. To verify this result for German, the compounds which were identified as shifted in the first study were also presented without the shift-triggering A-constituent.

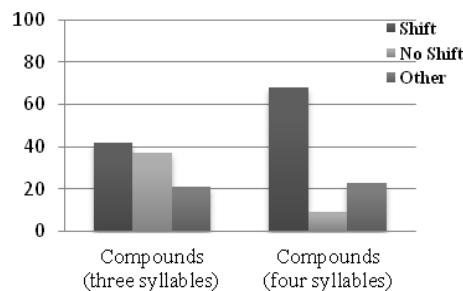
##### 4.1. Method

The syllable of the A-constituent was deleted from the affected items (24 trisyllabic and 44 quadrisyllabic compounds) and the listeners (same subjects as in study 1) had to evaluate the prominence distribution in the remaining (BC)-compound without knowing that this compound originally contained a preceding constituent.

##### 4.2. Results

The validation of stress perception in this study reveals a slightly changed picture regarding the importance of the number of syllables. Without the triggering context, judging the stressed syllable seems to become more complicated in compounds originally consisting of three syllables. In only 42% of the cases, listeners still perceived the C-constituent as the more prominent one, whereas 37% now observe primary stress on the B-constituent. In contrast, the results for the originally quadrisyllabic compounds show that the first syllable of the C-constituent can still clearly be identified as the most prominent one within the (BC)-compound, namely in over 68% of the cases. Only 9% are perceived as being realized with a more prominent B-constituent (cf. Figure 4).

**Figure 4:** Prominence perception results for study 2 (%).



Hence, the realization of a stress shift articulates itself so clearly in quadrisyllabic compounds that it can still be perceived when heard without its shift triggering context. These findings confirm the results found in [9].

#### 5. RELATION OF PERCEPTION AND PRODUCTION

In order to find out whether the prevailing perception of stress shift is purely motivated by rhythmic expectancies, we investigated whether there is acoustic evidence which attests the application of the RR in these stimuli.

##### 5.1. Method

An acoustic analysis was carried out for all phrasal verbs which were identified as shifted in the clash context condition and their corresponding control verbs. For each of the three syllables, its duration (ms), intensity (dB), and fundamental frequency F0 (Hz) were measured (measured from the whole syllable). A Wilcoxon signed rank test for paired samples was conducted to inspect possible differences between the syllables of the shifted items and the syllables of the identical unshifted control verbs. Therefore, the identical syllable positions of each verb from both conditions were compared with each other.

##### 5.2. Results

The comparison of the two conditions shows that there is a significant difference only between the duration measures of the initial syllables ( $Z = -2.045$ ,  $p = 0.040$ ) while no significant differences between the second and final syllables exist. Each syllable pair does neither differ in F0 nor intensity. The significant duration difference for the initial syllables alone suggests that there is no real prominence reversal but an adjustment of the syllables in phrasal verbs affected by a potential stress clash. Since the second syllables do not differ from each

other, this result rather implicates a stress reduction (DA) than a complete stress shift (RA) as the dominant form of the RR on a phrasal level. In order to confirm this assumption, an acoustic analysis of the initial and second syllables within a phrasal verb in both context conditions is necessary but could not be performed here due to the small stimuli number by each speaker.

Comparing the acoustic parameters of the two perceived stress clash phrases from study 1 with the two shifted phrases produced by the same speaker, one can see that these data speak for a RA in the two shifted verbs. The initial syllables in the shifted items are not only shorter than the other two syllables of the verb but also shorter than the initial syllables of the two verbs perceived as unshifted. In the clash items, the initial syllables are clearly longer than the two other syllables (see Table 1).

**Table 1:** Syllable durations (in ms) for each syllable of the phrasal verbs (underlined) given in the table.

Syllables	S1	S2	S3
<b>Shift:</b>			
1. Term ín <u>ab-sa-gen</u>	144	244	194
2. Rom án <u>vor-le-sen</u>	164	223	186
<b>CLASH:</b>			
1. Vertr ág <u>ab-ge-ben</u>	245	153	146
2. Kapl án <u>ein-la-den</u>	244	217	168

Overall, the results suggest that syllable duration is significantly involved in the perception and realization of the RR in German on the phrasal level. Moreover, the phonetic realization of the RR can take various shapes. The findings about the importance of syllable duration are in line with previous studies that highlight the importance of duration for a syllable's prominence status [1, 3, 6]. Whether DA is also the dominant form of the RR in compounds has to be awaited, since an acoustic investigation was not possible in this study due to the small number of stimuli.

## 6. GENERAL DISCUSSION

The results of this study reveal that stress shifts are regularly perceived in German compounds as well as in phrasal verbs. The RR seems to operate on a regular basis in order to prevent stress clashes and hence rhythmically irregular structures. This result is in contrast to the findings of [9] which suggest that stress shifts are rather rare in German compounds. Their observation that the appearance of the RR depends on the number of syllables is

supported by our findings since especially quadrisyllabic compounds can still be perceived as shifted even when the triggering context is removed. For trisyllabic compounds on the other hand, the accurate evaluation becomes more complicated when heard without the triggering context. The received acoustic data show that, on the phrasal level, a clash is mainly avoided via stress reduction by means of syllable shortening. This probably leads to the perception of a real reversal of prominence. Thus, these data provide important information about the identity of the main acoustic correlate of the RR in German. Moreover, they support the proposition of [9] that stress shifts in German are not only a perceptual phenomenon based on rhythmic expectancies by the listener but also a production strategy to avoid stress clashes.

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<sup>1</sup> The displayed grid notation is reduced to the crucial levels for the illustration of a stress clash in these examples.