Two Sides of the Same Coin?  
Investigating Iambic and Trochaic Timing and Prominence in German Poetry

Petra Wagner

Fakultät für Linguistik und Literaturwissenschaft, Universität Bielefeld, Germany

petra.wagner@uni-bielefeld.de

Abstract

This paper examines the acoustic and perceptual properties of iambic vs. trochaic meter in a large corpus of read German poetry. Psychoacoustic evidence of metrical grouping is not straightforwardly applicable to speech, due to the complex interaction of the involved acoustic parameters in prominence expression. It is possible that grouping effects in (poetic) speech are merely an artifact of listeners’ expectations based on rhythmic alternations previously heard. Empirical findings show small but significant duration differences between iambic and trochaic feet. Furthermore, it was found that stressed and unstressed syllables are produced with a stable phase relationship of 3:2, independent of meter. Experience in poetry reading plays a role in production style. On the level of prosodic prominence, only subtle differences can be traced. Our findings do not provide convincing evidence for meter specific prosodic shapes and are compatible with an affordance based dynamic view of rhythmic structure.

Index Terms: grouping, rhythm, prominence, meter

1. Introduction

Even if the prominence structure of a prosodic phrase is known, its grouping into rhythmic feet is ambiguous if both iambic and trochaic (or other) patterns are allowed (cf. Figure 1): E.g., an alternating weak-strong-pattern could be perceived as

- a sequence of iambics
- a sequence of trochees starting with an unstressed anacrusis syllable
- an initial amphibrach followed by a series of iambs.

This ambiguity is not necessarily found on other levels of prosodic organization: Most if not all languages indicate the ends rather than the beginnings of prosodic phrases by final lengthening (e.g., [3]). On foot level, however, phonological analyses have determined language specific preferences for either trochaic or iambic grouping, the former building feet starting with a stressed syllable, the latter preferring feet ending with a stressed syllable.

Psychoacoustic investigations have shown that listeners use different acoustic cues to identify iambic vs. trochaic structures: Intensity increases tend to be interpreted as group beginnings while increases in duration tend to be interpreted as group ends [1]. Perhaps most strikingly, Hay and Diehl found out that these grouping preferences take place independent of the listeners’ native language rhythm. However, listener judgements were strongly influenced by the initial pattern of a longer sequence of rhythmic stimuli: If an alternating sequence started long-short or loud-soft, listeners would preferably hear trochees. They would preferably hear iams if the initial patterns were in a different order. Similar effects are reported for speech [2]. Attempts to integrate phonological and psychoacoustic evidence failed [4], since lengthening and intensity variations tend to correlate positively with each other and with other acoustic prosodic parameters such as f0 and voice quality in signaling prosodic prominence, even though the individual contribution of each parameter may be language specific (e.g., [5]). It is possible that there is actually little or no acoustic prosodic difference between the different meters other than the initial grouping within a prosodic phrase: If the first two syllables in this phrase compose an iamb, we may continue to expect an iambic pattern and vice versa. Another explanation would be that even if listeners are not influenced by their native language when perceiving non-speech stimuli, they might use their native expectations when perceiving speech [6, 7].

It has often been assumed that poetic speech shows a more systematic rhythmic structure compared to prose (e.g., [8]). [9] could show that listeners can easily distinguish between identical texts spoken in poetic and in prose style. Also, poetic meter is a strong indicative of the metrical pattern of the language the poetry is written in [10] and reacts to language change [11]. German poetry knows both iambic and trochaic meter, even though German has usually been analyzed as having trochaic stress [12]. Thus, German poetry provides a nice test case for an investigation of meter distinctions in production and perception.
2. Prosody of Poetic Rhythm

Previous investigations unveiled meter specific phonetic variation: Iambic patterns are characterized by a stronger relative lengthening of the stressed syllable in Swedish and German poetry [9, 13] and exhibit a larger fundamental frequency difference between stressed and unstressed syllable [14, [15] found out that fundamental frequency plays an important role in the perception of rhythmicity – but their investigation treated iambic and trochaic patterns as equal, so no conclusions with respect to rhythmic grouping can be drawn. Furthermore, [9] provided evidence that – other than often assumed – German poetry shows no signs of compensatory shortening when comparing feet or phrases containing different numbers of syllables. Thus, even a weak version of the isochrony hypothesis could eventually be falsified – even for highly rhythmic speech.

Summing up, while we have some indications on what constitutes trochaic vs. iambic grouping in the speech signal. It is still unclear, wether and how these differences are perceptually relevant.

3. Empirical Study: Investigating Rhythmic Grouping in German Poetry

Previous analyses have indicated that iambic and trochaic structures indeed show language dependent differences in duration, intensity and fundamental frequency. However, the relationship between prominence structure and meter has to our knowledge not been investigated in detail. Furthermore, it has not been resolved whether the acoustic prosodic differences between iambic and trochaic grouping also effect relative prominence and perceived grouping. If there is a robust correlation between perceptual and acoustically expressed prominence, meter specific rhythmic adjustments ought to affect prominence patterns as well as perceived grouping. Thus, we will test the following hypotheses:

• There are meter specific rhythmic adjustments of acoustic prosodic correlates (H1)
• These adjustments depend on the type of the speakers’ experience and speaking style (H2)
• These adjustments are reflected in perceptual prominence (H3)

These hypotheses are investigated in a large corpus of German poetry based on analyses of duration, relative timing and perceptual prominence.

3.1. The APROPOS Corpus

The examined corpus [9] contains read speech by 6 professional actors trained in reciting poetry (henceforth: actors) and 6 nonprofessional singers in a jazz choir (henceforth: singers). Each speaker read 3 trochaic, 4 iambic, 2 dactylic and 2 poems with variable numbers of syllables per foot (“lied”). The poems had been checked by a university lecturer for literature for the intended metronome. The texts were read in two conditions by each speaker: In the first recording condition, the poem was typeset like “normal” prose, and followed standard punctuation rules (prose condition), the second version was typeset following the original verse structure chosen by the authors (poetic condition). Speakers were instructed to pay attention to meter in the poetic condition. Recordings were supervised by a trained percussionist who checked that the intended meter was audibly realized by all speakers in the poetic condition. Generally, it was found that the singers produced a much more rigid rhythmic style, often ignoring the poems’ semantic content and overemphasizing meter, while the actors clearly realized meter but were able to avoid the impression of monotony. The following analyses are only based on the poetic recording condition and concentrates on iambic and trochaic meter. Some analyses of dactyls are introduced later.

3.2. Duration Analyses

In line with previous analyses, small but clear systematic differences (cf. Section 1) were found in the absolute durations between iambic and trochaic patterns. Iambs show stronger lengthening of stressed syllables relative to the unstressed syllable in a foot. These differences are highly significant for pooled speaker groups (Welch two-sample t-tests, p < 0.0001) and look similar in both speaker groups, actors and singers, even though actors show an overall faster production style (cf. Table 1). Compared to trochees, iambs are characterized by slightly stronger lengthening of the stressed syllable relative to the unstressed one in both speaker groups (cf. Table 2). It is unclear, though, whether this truly reflects a difference in metrical organization or is the influence of a more frequent insertion of phrase boundaries, increasing final lengthening effects. Furthermore interesting is the higher amount of duration variation present in unstressed trochaic feet indicating less stability during iambic foot production (F-test, F = 1.32; df = 29/11, p < 0.0001).

3.3. Relative Phases in Poetic Feet

From an affordance based point of view, rhythmic timing is expressed as more or less stable phase relationships between oscillating systems (e.g. [17]). If the duration results above are interpreted in this view, beginnings of stressed and unstressed intervals in poetic feet can be described as having the same frequency and standing in a phase relationship of roughly 3:2 in
both iambic and trochaic feet: Relative timing between stressed and unstressed syllables is rather similar for both meters. We can now say that after the beginning of each stressed syllable in a binary poetic group, we “count to three” until the unstressed syllable is produced, during which we “count to two” (cf. Figure 2). It is important to notice that this counting is a metaphor describing the attractors of relative timing and does not imply an isochronous reference interval. The phase relationships are similar for both speaker groups, despite tempo differences, i.e. the actors speak faster than the singers (cf. Section 3.2). However, singers seem to obey the proposed simple phase relationships quite rigidly in iambic feet. Their stressed syllable starts after 39% of the foot interval has elapsed (= 0.39 median phase). The actors tend to a relative timing that results in less contrast between stressed and unstressed syllable (= 0.43 median phase). Interestingly, the 2:3 relationship also holds for a ternary poetic meter, namely dactylic groups (cf. Figure 2), even though these tend to be longer than both iambics and trochees [9]. Again, similar patterns are found for both speaker groups. The main difference between binary and ternary rhythms is the reversed prominence distribution, i.e. the relative timing between an unstressed and a following stressed interval in a trochee/iamb is similar to the timing between a stressed and a following unstressed interval in a dactyl (cf. Figures 3, 4).

3.4. Prominence Analyses

Prominences were annotated for the nonprofessional speakers by a graduate student of phonetics using the 31-level scale suggested by [16], i.e. a syllable with a label above 20 can be assumed to be prominent, below 10 as lacking prominence. Prominence patterns show small differences between iambic and trochaic grouping. Unstressed syllables are perceived as slightly more prominent when appearing in iambic feet (median prominence values 5.1 vs. 3.7). Stressed syllables are perceived as marginally more prominent when appearing in trochaic feet (median prominence 26.1 vs. 25.8; cf. Figure 5). While these subtle differences are statistically significant for both unstressed (Wilcoxon, W = 4517428, p < 0.0001) and stressed syllables (Wilcoxon, W = 4873073, p < 0.0001), it is unclear whether they are perceptually relevant, since the prominence scale employed may be too fine grained [18]. However, the measurable tendencies are contrary to expectations based on the duration analyses above: Differences between unstressed and stressed were stronger in iambic feet compared to trochaic ones. The prominence analyses show that on the level of perception, the contrast between stressed and unstressed syllables is slightly less strong in iambic feet. Thus, the prominence analysis reveals that the duration patterns cannot be interpreted as 1:1 correlates of prominence.

4. Discussion

H1 stated that we expect meter specific duration adjustments. These were found in a slightly stronger lengthening of iambic stress. Taking into account the smaller prominence contrast between unstressed and stressed syllables in iambic feet, the stronger lengthening observable in iambics may be necessary in order to sustain the prominence contrast between the stressed and unstressed syllable. Another reason for the stronger lengthening may lie in the higher frequency of phase final lengthening of stressed iambic syllables. However, a re-analysis of the data shows that the effect is robust against phrase final lengthening. The significant differences in stressed syllable durations remain (Welch two sample t-test, t = 10.6969, df = 5739.891, p < 0.0001). However, with an average of 18ms additional duration in iambic stressed syllables and given an average reference interval of 280ms, that difference would be only
largely determined by the initial pattern of a poetic line; meter
the same coin” – both on the dimension of prominence, absolute
interpretation that trochees and iambs are indeed “two sides of
While the data reveals slight meter specific patterns in both du-
stress status”. Hence, it is unclear whether H1 can be accepted.
A striking examination was that the 3:2 relationship was
more stable in actors’ productions, who tended to fall into a
very rhythmic, unnatural and monotonous speaking style. This
speaker group was also the less experienced but highly trained
in rhythmic production during singing. They obviously exag-
erated a poetic speaking style by obeying the poetic timing
relationships more rigidly, while actors took more liberties in
their productions. We have clear evidence that various kinds of
productions are compatible with an affordance based point of
view.

6. Acknowledgements
I would like to thank Jörg Bröggelwirth who compiled and or-
organized the data annotation of the APROPOS corpus and one
anonymous reviewer for very helpful comments.

7. References
ing: Testing the iambic/trochaic law, Perception & Psychophys.,
local syllable prominence. Phonetica, 66 (1-2), 95–112.
Prosody, Models and Measurements. A. Cutler and D.R. Ladd
of constraint interaction. Doctoral dissertation, HIL dissertation
Prosodic Typology. In: Proc. of INTERSPEECH 2005, Lisbon,
1830–1833.
able Prominence by Listeners with and without Competence in
URN: urn:nbn:de:hbz:5-12053
tion, 50, 79–81.
Müller: Leipzig.
Press.
terns in poetry reading. In: Nordic Pros-ody VI, Stockholm, 123–
135.
Reflect Perceived Rhythm? Phonetica 66 (1-2), 78–94.
of Swedish prose reading and reading style. STL-QPSR (2/1989),
1–83.
suring perceived prominence. In Proc. of INTERSPEECH 2005,
Lisbon, 2385–2388.
JASA, 51, 1219–1223.

5. Conclusion
While the data reveals slight meter specific patterns in both du-
rater and prominence, it is unclear whether these are percep-
tually relevant. Thus, our results are still compatible with an
interpretation that trochees and iambs are indeed “two sides of
the same coin” – both on the dimension of prominence, absolute
durations and relative timing. Meter perception would then be
largely determined by the initial pattern of a poetic line; meter

Figure 5: Shown are perceived prominence values for un-
stressed (=us) and stressed (=st) syllables in iambs and trochees
for both actors (=pro) and singers (=lay).