



Influences of rhythm on word order in German

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Abstract

We report three series of experiments exploring the influence of rhythm on word order in German, which were conducted in the course of the DFG-funded project *The prosodic syntax of German*. First, a picture-based elicitation study shows that rhythmic well-formedness influences the order of isolated conjuncts in German children and adults, as long as a semantic constraint plays no role. Second, a sentence memorizing study reveals no influences of rhythm on the choice between introduced and un-introduced embedded sentences in German. Third, a binary forced choice questionnaire study with written stimuli shows that participants prefer object and adverbial pronouns in canonical word order; non-canonical word orders are accepted when the resulting sequence of stressed and unstressed syllables is rhythmically alternating. Finally, we introduce an experiment on picture-based sentence elicitation we are currently conducting, which explores the placement of the German object pronoun. Our results suggest that rhythmic influences on word order in German speech are notable but do not extend a. the subsentential level and b. do not override semantic constraints.

Index Terms: speech production, word order, rhythm, German

1. Introduction

The transmission of thought into speech involves the retrieval of appropriate lexical items and their ordering according to the rules of syntax. Syntax, however, does not fully determine word order; instead, speakers often have to decide between possible word order variants when formulating their message. Semantic as well as phonological constraints are known to affect such word order decisions in speech production, and they do so to varying degrees. In normal, spontaneous language use, semantic constraints presumably control word order more immediately and to a stronger degree than phonological constraints. This follows from the logical directionality of language production, in which the semantic content of the message governs lexical choice and the assignment of syntactic function; phonology and rhythm can exert their role and endow the structure with sound only once a syntactic scaffold has been constructed (Levelt, 1989). Nevertheless, rhythmic influences on word order are on record (see, e.g. Anttila, 2016 for a review), but they appear to be rather limited in scope (Kentner & Franz, 2019).

A phenomenon, which received considerable attention, is the propensity for an alternating rhythm in speech (Principle of Rhythmic Alternation, Selkirk, 1984). In German, as in English, the underlying trochaic pattern of prosodic word structure often yields this alternation of stressed and unstressed syllables in spoken language. Ideally, this alternation is not disturbed.

However, in everyday speech, disruptions of this rhythmic structure are inevitable and do occur naturally. Rhythmic deviations may appear as stress clashes or stress lapses (Selkirk, 1984; Hayes, 1995); the former denoting an encounter of two or more stressed syllables, the latter a sequence of two or more unstressed syllables. A prosodic constraint in speech, *CLASH, requires that sequences of stressed syllables should be avoided. Conversely, another prosodic constraint, *LAPSE, requires that sequences of unstressed syllables should be avoided.

Accordingly, one could assume that binarity is found in two dimensions: The vertical dimension, where elements are either strong (i.e. stressed) or weak (i.e. unstressed), and the horizontal dimension, where these strong and weak elements must alternate – otherwise disruptions are assumed. This rather strict account of binarity in rhythm, which is only considering the foot as an important domain, might work as a rule of thumb in relation to some linguistic structures in speech, but it certainly misses potentially important distinctions (Nolan 2014; Vogel et al., 2015). First, considering the vertical dimension, already at the level of the phonological word, a finer grained differentiation of prominences is commonly assumed, with a (at least fourfold) distinction between unstressable, unstressed, stressed, and accented syllables (Eisenberg, 1991). Higher levels of the prosodic hierarchy give rise to even more degrees of stress (cf. the infinite stress view, Anttila et al., 2019). Consequently, the difference of strength between syllables may be considered a gradual one. Second, on the horizontal dimension, assuming strict binarity, a sequence of syllables is only considered rhythmically optimal when prominence alternates after every syllable (as the trochaic pattern would predict). Evidently, there are studies that show this tendency. But apart from that, there is also evidence that at least dactylic rhythm is considered well-formed in German and is therefore promoted (Eisenberg, 1991; Noel, 2003).

In our project on the “prosodic syntax of German”, we set out to explore how rhythmic wellformedness affects word order decisions in German. We report on three series of experiments which suggest that first, rhythm notably influences word order, and second, these influences seem to be limited to syntactic projections that are lower than a clause. Further, the impact of rhythm is often overshadowed by semantic constraints. Finally, we introduce an experiment we are currently conducting.

2. Ordering isolated conjuncts – a picture naming study

Research on child language production suggests a preference for an alternating rhythm in speech, with a particular avoidance of structures involving stress lapse (Gerken, 1996). Furthermore, animate referents are preferably produced before inanimate ones. An influence of this animacy constraint

(ANIM) was shown (among others) by Drenhaus and Féry (2008). Our study investigated the interaction of these constraints and their impact in the speech production of German children and adults. We provide evidence that, in two varieties of German speakers, animacy strongly affects conjunct order, and that the prosodic effect of stress lapse avoidance only emerges when the animacy distinction between the conjuncts plays no role. In Experiment 1, we tested 18 children from kindergarten aged three to six years, and a control group of 32 young adults. In a picture naming task, participants were instructed to produce coordinated bare noun phrases (e.g. ‘dolphin and planet’) without any prespecified order of the conjuncts. Target items were bisyllabic nouns with stress pattern (trochaic, iambic) and animacy (animate, inanimate) systematically varied in a 2x2 design. Stimuli were diagonally arranged picture pairs presented on screen with one item placed lower left and the other upper right. To examine the influence of ANIM and *LAPSE on ordering the nouns within the coordinated phrase, we analyzed the sequences the participants produced in response to the picture stimuli, yielding either violations of *LAPSE (Rátte und Planét, ‘rat and planet’), or ANIM (Planét und Rátte, ‘planet and rat’), or both (Hóse und Delfin, ‘trousers and dolphin’) or none (Delfin und Hóse, ‘dolphin and trousers’).

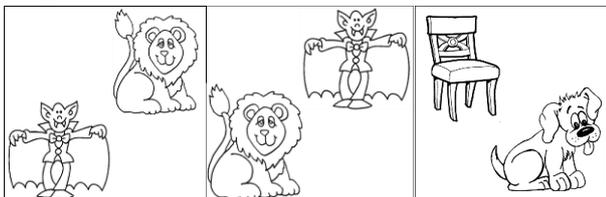


Figure 1. Stimulus arrangements in item pair pictures. The left and middle panel show an example of an experimental item pair in the two spatial orders and the right panel shows a filler pair.

Overall, the preschoolers preferably produced animate nouns before inanimate ones, attesting a significant influence of ANIM on word order ($z = 4.654$, $p < 0.001$). The prosodic constraint also showed some impact on the linear order such that *LAPSE constructions were avoided. *LAPSE only significantly affected word order in the subset where animacy didn’t vary – that is, those item pairs with either two animate or two inanimate items ($z = 2.423$, $p = 0.0154$). For the adult group, the effects were very similar, with animacy dominating prosody. Interestingly, spatial arrangement of the pictures was important for both groups and across all experimental conditions: Children preferred to name the upper right picture first, while adults preferred the lower left one, in line with Knudson and colleagues (2014) who found that the left-right bias increases with age.

In Experiment 2 we used the same material but a different conjunction in the target phrase (bisyllabic *oder*, ‘or’, instead of monosyllabic *und*, ‘and’). With the conjunction *oder* in Experiment 2, neither of the two linearizations of nouns yielded a rhythmically well-formed sequence. Therefore, the items’ stress pattern should have no impact on word order – which was confirmed in our results.

To conclude, the influence of rhythm on word order seems to be relatively weak but stable across German preschoolers and adults, whereas animacy is a very strong and stable factor for the serialization of conjuncts. Our findings support the prosodic licensing hypothesis (Demuth, 2007), according to which children show a propensity for prosodically well-formed

structures; however, our results do not suggest a decline of this preference in the course of acquisition. In summary, our results suggest the ranking ANIM >> *LAPSE for German speaking children and adults, consistent with findings by McDonald and colleagues (1993) for English speaking adults. The following experiments will focus on the influence of rhythm in the production of complete sentences.

3. The optional complementizer in German – a sentence recall study

In this series of experiments (for details, see Kentner & Franz 2019), we investigated whether the use of the German complementizer *dass* (that) is influenced by local linguistic rhythm, as was found for the English optional complementizer ‘that’ (Jaeger, 2007; Lee & Gibbons, 2007). In a quasi-replication of Lee & Gibbons (2007), we created sentences like (1a) and (1b) with the stress structure of the embedded subjects (iamb / trochee) and the (non)occurrence of *dass* as varying factors. In contrast to English, presence or absence of *dass* in German leads to a difference in complement clause structure (V-final with *dass*, V2 without *dass*). Following Lee & Gibbons (2007), we predicted a preference for rhythmically alternating structures, i.e. the presence of unstressed *dass* when directly followed by a subject with initial stress, and, conversely, absence of unstressed *dass* when the embedded subject starts in a likewise unstressed syllable.

(1a) Péter gláubt, dass Mára / Maríe das Geschírr gespúlt hat.

(1b) Péter gláubt, Mára / Maríe hat das Geschírr gespúlt.

Peter thinks (that) Mary has washed the dishes.

Procedure: All in all, 64 participants read the sentences ($n=32$) silently and recalled and produced them after a distractor task. **Results:** Evaluating presence of *dass* and stress pattern of the embedded subject in the recalled sentences, we did not find a systematic influence of rhythm on *dass*-occurrence. To the contrary, a Bayes Factor analysis suggests that a “Null”-model (in which the factor stress pattern is eliminated) fares considerably better than the model that entails the rhythmic predictor. Based on these results, we suggest that rhythmic influences on syntactic encoding are clause-bound, i.e. cannot affect the overall structure of the clause (V2 vs V-final structure) but only locally touch upon the sequence of words within the clause. We further assume that presence or absence of the English complementizer does not affect the syntactic encoding of the complement clause but is regulated in the phonology. Under this view, contrary to assumptions by Lee & Gibbons, the rhythmic effect on the presence of the complementizer would be entirely non-syntactic.

4. Placing pronouns – a binary forced choice questionnaire study

To identify some of those phenomena, that actually show some effect of rhythm on syntactic encoding, we chose eight structures and created a questionnaire study with binary preference judgements in silent reading. Two of them are reported here, both concerning non-canonical fronting of function words. Participants, 74 German adults, chose one of two sentences (presented in writing) which varied w.r.t word order and rhythmic well-formedness.

The first phenomenon concerns the order of the object pronoun ‘ihn’, *him* and the embedded subject (2) in subordinate clauses. Apart from the order (varying factor in one sentence pair), we manipulated the stress of the embedded subject (iambic or trochaic) between the pairs. Over and above a strong bias for SO-sentences (2a), participants preferred the object pronoun to be fronted ($z = 2.15, p < 0.01$), when this promoted a rhythmic sequence – that is, in sentences with a trochaic embedded subject.

(2a) Péter ságt, dass Márkus/Marcél ihn árgert.

(2b) Péter ságt, dass ihn Márkus/Marcél árgert.

Peter says that Markus/Marcel is nettling him.

(3a) Da kónnte der Stéffen Konfétti/Lúftschnagen draus básteln.

(3b) Da kónnte der Stéffen draus Konfétti/Lúftschnagen básteln.

There Steffen could make confetti/streamers from.

The second phenomenon replicates findings by Vogel et al. (2015) who examined the relative order of objects and pronominal adverbs in sentence production. The rhythmic manipulation concerns stress on the trisyllabic object (initial stress vs penultimate stress). Participants showed a strong bias for the sentences with the adverb following the object (3a). Also, fronted adverbs were more likely when the object featured initial stress ($z = -4.31, p < 0.0001$), promoting a dactylic rhythm.

Both studies show clear influences of rhythm on syntactic choices. With rhythm influencing word order preferences, one could argue that this strengthens bidirectionality between syntax and phonology in speech. However, as there was no time limit, our results could also be explained by a monitoring loop in an originally unidirectional process (Levelt, 1983). The experiments also show that both, dactylic and trochaic patterns, are important in German (see also Noel, 2003). The relevant factor seems to be a balanced distance between the prominent syllables, not necessarily a binary alternation.

5. Placing the German object pronoun – picture-based elicitation of sentences

The questionnaire study with written stimuli confirmed that a non-canonical order of object pronouns is more accepted when rhythmically well-formed. With the study we are currently conducting, we want to find out, whether this effect also holds for sentence production. A positive result would strengthen a bidirectional account of syntactic and phonological processing in speech production.

We constructed 32 sentences (5ab) that are structured similarly to the ones we used in the questionnaire study described above. Stimuli pictures are 64 black and white drawings and were designed by a professional illustrator. Each picture consists of a left part symbolizing the matrix sentence (‘der Junge ságt’, *the boy says*) and a right part symbolizing the embedded sentence (‘dass Markus ihn auslacht’, *that Markus is laughing at him*). The right parts of the pictures were mirrored (yielding 128 stimuli) to avoid word order effects due to spatial order. Participants, 50 German young adults, will be familiarized with characters, verbs and the target structure in advance.

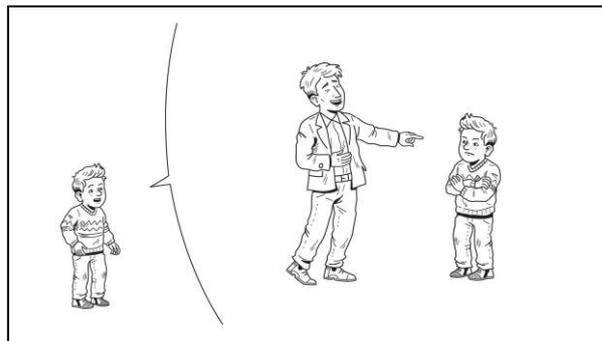


Figure 2. Stimulus example for the target sentence ‘Der Junge ságt, dass Markus ihn auslacht. / Der Junge ságt, dass ihn Markus auslacht’, *The boy says that Markus is laughing at him.*

Varying factors were the stress pattern of the embedded subject (iambic, trochaic) and of the embedded verb (initial stress, no initial stress). Additionally, animacy varies as a between items factor with the matrix-sentence subject being human or non-human.

(4a) Der Júnge ságt dass ihn Márkus belúgt. (OS)

(4b) Der Júnge ságt dass Márkus ihn belúgt. (SO)

(5a) Der Junge ságt dass ihn Márkus áuslacht. (OS)

(5b) Der Júnge ságt dass Márkus ihn áuslacht. (SO)

They boy says that Markus is laughing at him / lying to him.

(6a) Der Júnge ságt dass ihn Marcél belúgt. (OS)

(6b) Der Júnge ságt dass Marcél ihn belúgt. (SO)

(7a) Der Júnge ságt dass ihn Marcél áuslacht. (OS)

(7b) Der Júnge ságt dass Marcél ihn áuslacht. (SO)

They boy says that Marcel is laughing at him / lying to him.

The examples in (6) and (7) show that, with the iambic subjects, the fronted pronoun ‘ihn’, *him* yields a rhythmically less balanced structure than with the trochaic subject in (4) and (5). Further, the embedded verb with no initial stress, as in (4) and (6) promotes a prefixed unstressed pronoun (4a, 6a) in order to achieve a balanced rhythm. Thus, we predict, that trochaic embedded subjects and verbs with no initial stress promote sentences with a fronted pronoun.

Additionally, a combination of a trochaic embedded subject and a verb with final stress, which yields three unstressed syllables in the SO order (4b), might lead to a higher prominence of the object pronoun compared to the other conditions. In a phonetic analysis of the spoken sentences, we will analyze syllable duration, pitch and intensity (see Vogel et al., 2015, who showed such an effect, arguably provoked by the Rhythm Rule, for the unstressed neuter pronoun ‘es’, *it* in German).

Finally, the variation in the degree of animacy, which is realized by exchanging ‘Der Junge’, *the boy*, in the examples above with a non-human referent ‘der Hase’, *the rabbit*, will shed some light on whether, in speech production, the degree of a referent’s animacy influences the position of the pronoun referring to it. To our knowledge, there are no studies addressing this issue.

6. Discussion

While some results are yet to come in, the synopsis of the studies reported here points to a weak and limited, but nevertheless systematic influence of linguistic rhythm on word order decisions in German. In general, the influence of rhythm on syntax in language production seems to be rather local: higher order units of syntactic planning (the clause or sentence) appear to be immune to prosodic-phonological tampering (as suggested by the lack of rhythmic effects in the case of complement clause structure choice). This particular null result is in line with cascading models of language production (e.g. Bock and Levelt, 1994) that do not envisage a feedback from phonological encoding to syntactic encoding. However, the null result is not predicted by accounts (of grammar or processing) that assume phonological filtering among a (potentially large) set of syntactic structures generated in parallel (Anttila et al., 2010; Anttila, 2016). If, under such an approach, a complement clause with complementizer was pitted against a complement clause without, the phonological component should chose depending on the resulting rhythm – our results suggest otherwise. Similarly, the proposal by Vogel et al. (2015), who state that “rhythm is a syntactic constraint”, does not provide a limit to the scope of this constraint. As far as we are aware, our own results, and the results of others who have studied the interaction of rhythm and syntax (Vogel et al., 2015; Shih et al., 2015), are compatible with the view that rhythm affects word order within units of syntactic planning but not across these units. In normal speech, the largest unit of planning appears to be the clause. In other modes of language use, as e.g. writing or poetry, offline-planning involving a phonological loop might apply and promote more extensive rhythm-syntax interactions.

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