Phonetic Correlates of German Weak Pronoun Cliticization*

Judith Fiedler

1. Introduction

Analysis of the behavior of function words plays an important role in prosodic theory. One of the distinguishing characteristics of function words is their status as subminimal prosodic constituents. Unlike lexical words, function words typically project no structure above the level of the syllable, and must be incorporated into phrasal structure via attachment to a host constituent. Several means of function word incorporation have been proposed in the literature: they may attach at a lower or higher level of the prosodic hierarchy, their incorporation may produce either a flat or a recursive structure, and the directionality of their attachment may be restricted either to the left or the right. The examination of function word behavior is thus a means of analyzing the fine-grained internal architecture of prosodic structure, and of identifying the range of cross-linguistically licit structure-building operations.

A significant line of research in this field is devoted to the study of language-specific function word prosody. This paper is concerned with one such case: the prosodic behavior of weak pronouns in Standard German. Various analyses of German function word prosody use as diagnostics phonological processes or phonotactic constraints which are known to apply within a specific prosodic category. If, for example, syllabification is a process which takes the prosodic word as its domain of application, then a function word and a lexical word which are syllabified together belong to the same prosodic word. A function word which is not syllabified with an adjacent lexical word may be understood to be associated to a distinct prosodic unit.

The results of this research have been inconclusive, and analysts have come to opposite conclusions about the prosodic structure of utterances containing German weak pronouns: some analysts argue that weak pronouns encliticize (Kleinhenz 1996, Gärtner & Steinbach 2003; see also Hall 1999), while others argue that they procliticize (Vogel 2004; see also Itô & Mester 2009). As the phonological evidence has not provided conclusive evidence in this case, it may be that another type of diagnostic tool will prove useful in identifying prosodic structure. This is the question with which this paper is concerned.

The paper will present the results of a phonetic production experiment designed to examine one aspect of the prosodic behavior of German weak pronouns: the directionality of cliticization. The acoustic characteristics of a segment show systematic variations which are correlated with the segment’s prosodic position. This fact suggests a means of identifying where the pronoun is located in the prosody. If a pronoun procliticizes to a phrase-edge, it will be

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phrase initial; if it encliticizes, it will be phrase final. The basis of the experiment is to examine the characteristics of the segments which comprise a weak pronoun, and of the immediately adjacent segments, as a means of determining the pronoun’s phrasal position. As will be detailed in section 5, experimental results indicate that speakers procliticize weak pronouns; there are, however, also indications of inter-speaker variation in the direction of cliticization.

In the next section, I introduce background information on sentential prosodic structure and phonetic evidence of this structure. In Section 3, the experimental design is presented; methods are discussed in Section 4. The results derived from analysis of data pooled across speakers, as well as of individual subject data, are the subject of Section 5. Section 6 examines some unexpected data produced by the experiment and its possible significance to future research in this area. A brief summation is given in Section 7.

2. The prosody of German weak pronouns

2.1 The prosodic hierarchy

It has been broadly accepted in phonological theory that the mapping from syntax to prosody involves the structuring of sentential material into hierarchically organized prosodic categories, and that these categories form the domains within which phonological rules apply, and within which phonotactic constraints hold.

The basic unit of the syntax-prosody mapping is the prosodic word; this is the category projected by lexical words. Prosodic words are dominated by phonological phrases, and these in turn are dominated by intonational phrases.

\[
\text{IP} \rightarrow \text{Intonational Phrase}
\]
\[
| \quad \phi \rightarrow \text{Phonological Phrase}
\]
\[
| \quad \omega \rightarrow \text{Prosodic Word}
\]

**Figure 1: The Prosodic Hierarchy**

The example sentence (1) consists of four lexical words. A typical prosodic structure for (1) is illustrated in (1a). Each lexical word forms a prosodic word (pword); the pword formed on the syntactic subject is dominated by a phonological phrase, and the three pwords of the VP are parsed into a second phonological phrase. These two phonological phrases are dominated by a single intonational phrase, which in this instance is coextensive with the entire sentence.

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1 Prosodic levels below the word are not relevant to the discussion here, and are therefore not included.
1. Timo sieht sieben Schafe.
   *Timo sees seven sheep.*

1a. \[ ((Timo)_{\omega})_{\varphi} ((sieht)_{\omega})_{\varphi} ((sieben)_{\omega})_{\varphi} ((Schafe)_{\omega})_{\varphi} ]_{\text{IP}}.\]

Unlike lexical words, function words, such as determiners and weak pronouns, do not project a prosodic category above the syllable level (or possibly the foot level, see Kabak and Schiering (2006)). In order to be built into the sentential structure, function words must be associated to a host category, and there are, in theory, a variety of ways in which this may be accomplished. A function word (\(fnc\)) may associate either to the material which precedes it, or which follows. It may attach to a phrasal or word category, or to a lower level in the hierarchy. Its incorporation may involve the building of a recursive structure or a flat structure. The examples in (2) illustrate possible structures formed by enclisis of a function word at different hierarchical levels.

2a. \[ ((\text{host})_{\omega})_{\varphi} (fnc)_{\omega} \] recursive word formation (Kleinhenz (1996) for German)
2b. \[ ((\text{host})_{\omega})_{\varphi} (fnc)_{\varphi} \] free clitic attached at the phrasal level (based on Vogel (2005))
2c. \[ (\text{host}+fnc)_{\omega} \] incorporation into the host word (Hall (1999))
2d. \[ (\text{host}+fnc)_{F} \] incorporation into the foot (proposed by Booij (1996) for Dutch)

### 2.2 Phonetic evidence of prosodic structure

In addition to their relevance to phonological theory, recent work in phonetics has produced evidence for the reality of prosodic categories. This evidence comes in the form of systematic variation in the phonetic realization of a segment depending on the segment’s position in the prosody.

The realization of a segment located at an edge position of a category is acoustically distinct from that of a category-internal segment. Such distinctions fall generally under the headings of Initial Fortition and Final Lengthening. The latter is self-explanatory: category-final elements are longer in duration. Segments which are initial in their category tend to be more *fortis*-like. Depending on the type of segment involved, fortition may manifest as a lower percentage of voicing, longer voice onset time (VOT), higher intensity, or lengthening (Kuzla et. al. 2007). These acoustic effects of edge-position are cumulative, so that, for example, a segment in initial position of a phonological-phrase will show some degree of fortition in comparison to a segment in pword-initial position, and a greater degree of fortition may be found for a segment in IP-initial position (Keating et. al. 2003).

This can be illustrated by reference to the phonological phrase formed of the VP constituents in example (1a) above. The first two prosodic words in the phonological phrase begin with the voiced alveolar fricative /z/. The /z/ of *sieht*, though, is not only word-initial, but also phrase-initial. One would expect then that the realization of this /z/ will be distinct from that

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2 Alveolar fricatives in German are always voiced in word-initial position.
of /z/ in *sieben*, as the second /z/ is phrase-internal.

1a. \((\text{sieht})_\omega (\text{sieben})_\omega (\text{Schafe})_\omega \)  
  \[\phi\text{-internal /z/}\]  
  \[\phi\text{-initial /z/}\]

With regard specifically to German, there is evidence of initial fortition of stops and fricatives. Fricatives are lengthened in phrase-initial position, and stops are produced with a longer closure duration (Kuzla et al 2007; Kuzla & Ernestus 2007) Phrase-final syllables have been shown to lengthen (Kuzla et al 2007).

Experiments which examine the relationship between phonetics and prosody usually start with a defined prosodic structure, and seek to identify the acoustic characteristics which are affected by edge-positioning. In section 5 I will propose an experiment which approaches this relation the other way around. The experiment begins with a construction in German whose prosodic structure is ambiguous, and aims to diagnose the structure by examining the phonetic realization of segments which are expected to fall at phrasal edges.

In the next section, I describe the construction under examination. Clause-internal German weak pronouns occur in only two possible positions. Although the prosodic behavior of the pronoun is not firmly established in either case, for one of these two positions in particular, phonological analyses have made directly contradictory predictions. It is this construction, the one in which a weak pronoun follows a nominative subject, with which I will be concerned.

### 2.3. German weak pronouns

The following weak pronouns are used in the experiment. Weak and strong pronouns in German are, for most of the paradigm, composed of identical segmental strings, thus cannot easily be identified out of context. The pronouns listed here are always used as weak pronouns in this paper.

<table>
<thead>
<tr>
<th>mir</th>
<th>dir</th>
<th>sie</th>
<th>sie</th>
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<tbody>
<tr>
<td>[mir]</td>
<td>[diː]</td>
<td>[ziː]</td>
<td>[ziː]</td>
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<tbody>
<tr>
<td>‘me’</td>
<td>‘you’</td>
<td>‘her’</td>
<td>‘them’</td>
</tr>
</tbody>
</table>

*Table 1: German weak pronouns used in the experiment*
The two constructions in which weak pronouns may occur are illustrated in (3) and (4). In (3), the weak pronoun *sie* follows the modal verb *soll* which occupies the C position in the syntactic clausal structure. In (4), the pronoun follows the subject DP *Heiko*.

3. Morgen [C soll] *sie* Heiko kaufen
   'Tomorrow should *them* Heiko buy
   'Heiko is supposed to buy *them* tomorrow'

4. Morgen [C soll] Heiko *sie* kaufen
   'Tomorrow should Heiko *them* buy
   'Heiko is supposed to buy *them* tomorrow'

In what follows, I refer to the linear order illustrated in (3) as the post-C construction. The linear order shown in (4) is the post-subject construction.

   In most of the literature on the prosody of German weak pronouns, it the post-C construction which is used as an example of function word incorporation, and most analysts suggest that the pronoun encliticizes, attaching to the material which precedes it in C. The resulting structure is illustrated in (5). The level of the hierarchy at which the pronoun incorporates is disputed. As the experiment is concerned solely with direction of cliticization, identifying the level of attachment is not critical here. For ease of exposition in this section, I will use the category label π for the constituent formed by pronoun clisis.

5. Morgen (soll+sie)π Heiko kaufen.

   The post-subject construction is rarely addressed directly, although claims made about preferred prosodic structures in German make predictions about this construction as well. There are two possibilities for the structure resulting from pronoun incorporation in the post-subject construction. The pronoun may encliticize, joining the category containing the subject as in (6a) below, or it may procliticize, joining the category which here contains the verb as in (6b).

6a. Morgen soll (Heiko+sie)π kaufen

   6b. Morgen soll Heiko (sie+kaufen)π

   With regard to the prosody of the post-subject construction, the phonological analyses are inconclusive on several points, and particularly on the direction of incorporation. In some analyses, it is argued that enclisis is the preferred means of incorporating function words in German; in others, it is argued that proclisis is preferred. The lack of conclusive phonological evidence is the basis of the proposal that phonetic data may be informative in determining the directionality of post-subject weak pronoun clisis.
3. A Production Experiment

3.1 Phonetic predictions of proclisis and enclisis

For the purposes of the experiment under consideration, the critical aspect of the proposals just reviewed is that they make specific claims about the building of prosodic structure in German. In particular, Kleinhenz (1996) and Gärtner and Steinbach (2003) argue that enclisis is the preferred strategy for the incorporation of function words. This is equivalent to a claim that, when a weak pronoun occurs in post-subject position, it will encliticize to the subject, and will therefore occur in phrase-final position. Vogel (2004) argues the opposite; his claim that proclisis is preferred is equivalent to a claim that a weak pronoun will be in phrase-initial position.

Given the phonetic effects of phrase-edge position, a claim for pro- or enclisis of a weak pronoun is actually a prediction about the phonetic realization of the segments which comprise the pronoun, and this prediction can be experimentally tested.

In a sentence such as (7) which contains no weak pronoun, phrasal edges will align with lexical material. The phrase-final /o/ of the subject Heiko is expected to lengthen, and the phrase-initial /t/ of Tulpen will be realized with a longer closure duration.

\[ \text{7. Morgen soll Heiko) (Tulpen kaufen lassen} \]
\[ \text{“Heiko is supposed to have tulips bought tomorrow”} \]

If a weak pronoun is inserted in the post-subject position, it must be incorporated into one of the two phrases. Under enclisis, the following structure results.

\[ \text{8a. Morgen soll Heiko+sie) (Tulpen kaufen lassen)_{\phi}} \]

This places the pronoun nucleus /i/ in phrase-final position, and one would expect to find lengthening of the vowel in this case. The pronoun onset /z/ is phrase-internal, thus not subject to phonetic edge-effects.

Under proclisis as represented in (8b), it is the onset /z/ which is in an edge position: it is initial in the phonological phrase. As fricatives are known to lengthen in initial position in German, one expects that if this is the correct representation of the structure, /z/ will be lengthened. In contrast to (8a), the pronoun nucleus is now phrase-internal; there should be no edge effects on /i/.

\[ \text{8b. Morgen soll Heiko) (sie+Tulpen kaufen lassen.} \]

These predictions are the basis of the experiment described in the following.
3.2 Experimental Design

The directionality of weak pronoun clisis in Standard German was tested with a production experiment which consisted of four conditions of sentential stimuli. The basis of the design is to determine the phonetic characteristics of segments which are known to be positioned at phrase edges, and to compare these to the characteristics of segments whose prosodic position is unknown.

- **Condition 1: The Base Condition**

The Base condition contains no pronoun; this condition is used to establish the phonetic behavior of edge segments when no functional material is present. The subject DP of the sentence ends with a syllable containing a voiceless stop and a full vowel; this is always /ko/. The onset of the initial syllable of the VP is a voiceless stop. This condition is illustrated in (9). For reasons to be explained below, all sentential conditions contain a nonce word; in the example given here, this word is *Penten*.

It may be noted that the constituents are each of some length – the subject consists of two disyllabic trochaic words, and the complement of the main verb is a VP containing a verb and a DP. The length of sentential constituents in this and the remaining conditions is intended to ensure that speakers parse the sentence as two separate phonological phrases.³

9. Bald soll Peter-Nico) (Penten holen lassen
   \[\varphi\text{-final }/o/ \quad \varphi\text{-initial }/p/\]
   *Soon should Peter-Nico Penten buy let*
   *“Peter-Nico is supposed have Penten brought soon”*

- **Condition 2: The Weak Pronoun Condition**

As in the Base Condition, sentences in the Weak Pronoun Condition (WkP) have a subject ending in the syllable /ko/ and a nonce word beginning with a voiceless stop. The sentences in this condition, however, contain a weak pronoun at a phrase edge.

10. Bald soll Peter-Nico sie Penten kaufen lassen
   *Soon should Peter-Nico them Penten buy let*
   *“Peter-Nico is supposed to have them buy Penten soon”*

³ Féry (1993) writes that one of the default phrasing options in German is to parse the subject and the VP together in one phonological phrase. Establishing longer sentential constituents makes it less likely that subjects will produce this phrasing.
As direction of pronoun clisis is unknown, the position of phrase boundaries in this condition is likewise unknown. It is the location of these boundaries which is to be determined based on the phonetic characteristics of the segments comprising the pronoun, and of the segments adjacent to the pronoun.

• **Proclisis of the pronoun: phonetic predictions**

Should the pronoun procliticize, it will be initial in the phonological phrase, producing the structure in (11). This has repercussions for the realization of the pronoun segments, and for the segments which surround it. The subject-final /o/ should show lengthening, and the initial /z/ of *sie* should be lengthened as well. The pronoun-final /i/ is now in phrase-internal position, as is the onset /p/ of *Penten*; these should show no edge effects.

\[
\begin{align*}
\text{–final } /o/ & \quad \text{–initial } /z/ \\
11. \quad \text{Bald soll Peter-Nico s} & \text{ie Penten holen lassen} \\
& \quad \text{–internal } /i/,/p/
\end{align*}
\]

• **Enclisis of the pronoun: phonetic predictions**

If the pronoun encliticizes, the arrangement of segments relative to the phrase edges is different. In this case, edge-effects are predicted for /i/ and /p/: the pronoun-final /i/ is phrase-final, and the onset of *Penten* is phrase-initial. The segments /o/ and /z/ are now the ones in phrase-internal position.

\[
\begin{align*}
\text{–final } /i/ & \quad \text{–initial } /p/ \\
12. \quad \text{Bald soll Peter-Nico } & \text{s} \text{ie Penten holen lassen} \\
& \quad \text{–internal } /o/,/z/
\end{align*}
\]

• **Proclisis Model and Enclisis Model Conditions**

In order to interpret the data gathered from the WkP condition, it is necessary to know how edge effects manifest in the segments to be analyzed. It will, for example, be necessary to know what the characteristics of a phrase-initial and a phrase-internal /z/ within this segmental environment are. Without this information, it will be difficult to judge whether the duration of the pronoun initial /z/ is or is not consistent with initial fortition.

Two sentential conditions were therefore established to serve as phonetic models of pronoun pro- and enclisis. In each of these conditions, no pronoun is present. Instead, an
unstressed syllable homophonous with the weak pronoun occurs as a syllable of a lexical word. In one instance, this syllable forms the antepenult of a trisyllabic word, and in the other, it forms the ultima. This method produces structures which contain the same string of segments and the same stress pattern as those of the WkP condition; however, because no function word is present, the phrasing of the sentential constituents is predetermined.

One of the difficulties presented by this experimental design is the requirement that identical segmental strings which vary in lexical content and in prosodic structure occur across three conditions. As the necessary contrasts could not be established with German lexical items, this difficulty was resolved through the use of nonce words which could be more freely manipulated. Although it is only the two model conditions which require the use of a nonce word, for the sake of consistency nonce words were used in all conditions.

- **Condition 3: The Proclisis Model Condition**

For this condition, an unstressed syllable homophonous with the weak pronoun becomes the initial syllable of the grammatical object, producing a new nonce word. It is expected that, because the syllable is part of a lexical word representing the grammatical object, the syllable will be in initial position of the second phrase. This condition, the Proclisis Model Condition (Prcl) represents the prosodic structure which would be produced by proclisis.

13. Bald soll Peter-Níco) (Siepénten holen lassen

   Soon should Peter-Nico siepenten fetch let

   “Peter-Niko is supposed to have siepenten brought soon”

- **Condition 4: The Enclisis Model Condition**

The fourth sentential condition is the Enclisis Model Condition (Encl). Here, the unstressed syllable is incorporated as the ultima of a trisyllabic nonce word representing the name of the grammatical subject. In this case, the syllable falls in final position of the first phrase.

14. Bald soll Annas Píkosie) (Pénten fangen lernen

   Soon should Anna’s Pikosie Penten catch learn

   “Anna’s Pikosie is supposed to learn to catch penten soon.”

- **3.2.1 Subtypes within conditions**

In addition to the nonce word Penten, nonce words beginning with the voiceless stops /t/ (‘Tengen’) and /k/ (‘Kenten’) are used. There is also variation in the form of the weak pronoun: the pronouns mir (1.Sg.Dat.) and dir (2. Sg. Dat.) occur in addition to sie (see Appendix for a partial list of test sentences).

There are two reasons for the variation in pronouns and in stop place of articulation. One is to ensure that the results accurately reflect the behavior of weak pronouns and of voiceless
stops in general; incorporating a variety of exemplars ensures that the results are not affected by an idiosyncrasy in the prosodic or phonetic realization of either a particular pronoun or of one particular consonant. Secondly, it is expected that the phonetic edge effects may be quite subtle, and it may be the case that edge effects are more pronounced for one type of segment than for another. Therefore, having a range of segments available for examination increases the likelihood of producing usable data.

The use of three different nonce words produces three groups of the Base Condition. The use of three different pronouns in combination with the varied nonce words produces nine groups each for the WkP, Prcl, and Encl conditions.

4. Methods

4.1 Addressing the use of nonce words

As discussed above, the nature of the phenomenon to be examined requires the use of nonce words to create the required contrasting conditions. It is the goal of the experiment to capture natural phrasing patterns, thus the fact that the stimuli will present unknown, meaningless words to subjects is problematic. In order to ameliorate the consequences of the unusual stimuli, several precautions are introduced into the experimental methodology.

There are two concerns to be addressed. One is that speakers be able to easily interpret the structure of the sentences in order to produce a natural phrasing pattern. Subjects must be able to recognize that, for example, ‘Annas Pikosie’ represents the subject of the sentence, and that the word ‘Siepenten’ is the direct object in the verb phrase.

The second concern is to ensure correct production of the nonce words themselves. These vary in their stress patterns. The two-syllable form of the nonce word, which I will call the base form, carries stress on the penult (i.e. Pénten). The stress patterns of the three-syllable nonce words vary depending on whether the unstressed syllable is appended to the beginning or end of the base form. In the former case, stress still falls on the penult, however the penult is not word-initial (Siepénten); in the latter, the nonce word carries antepenultimate stress (Píkosie).

4.1.1 Context sentences

In order to enable an interpretation of the test sentences, context sentences have been included in the experiment. Each test sentence is preceded by two to three sentences which provide a meaning for the nonce word. For the test sentence shown in the diagram as (4) below, the subject would see a group of sentences such as the following on the computer screen, naturally without the English glosses.
The context sentences serve additional purposes. Speakers are asked to read aloud all sentences which appear on screen. This gives speakers an opportunity to practice speaking the nonce word before producing this word in the test sentence. The context sentences also serve to separate the utterances of the test sentences. Given that the test sentences are all quite similar in sound and structure, it is particularly important that speakers produce utterances unlike the test constructions between repetitions.

4.1.2 Subject training

Due to the importance of the varying stress patterns of the nonce words, subjects were trained in the production of these words. One option for training the subjects would have been to visually indicate the stressed syllable of the nonce word as the stimuli are presented – for example: SiePENten; Annas PIkosie. However, this method raised the concern that speakers might be prompted to produce these syllables with narrow focus, thus affecting the phrasing.

The alternate solution employed was to introduce subjects to the nonce words prior to their experimental participation. Each speaker underwent a brief training session in which they were shown some of the screens of sentences they would see during the experiment. The stress pattern of the words was explained and demonstrated, and speakers were asked to practice uttering some of the sentences. Speakers were told that they could repeat any sentence during the experiment if they felt that they had had difficulty with the pronunciation. When a subject began the experiment, the experimenter remained with him or her for the first round of repetitions and, as each screen appeared, pronounced the nonce word for the subject as needed. Once the subject...
was familiar with the stress patterns and produced them easily without assistance, he or she was left to complete the experiment on his/her own. In one instance, the experimenter remained with the subject for the entire duration of the experiment at the subject’s request.

4.2 Presentation of stimuli

The experiment was implemented using SuperLab software. The sentences were grouped into blocks according to the place of articulation of the initial stop segment of the VP-internal nonce word. That is, all sentences which have the base nonce word Penten and its variants were grouped together, and likewise for sentences based on the nonce words Tengen and Kenten.

Grouping the sentences in this way was intended to avoid misreading of the stop consonants. Given that the nonce words were unknown to the subject, are quite similar to one another, and all begin with stop consonants having different places of articulation, there was the concern that, in encountering a new stimulus, a speaker might tend to repeat the stop consonant he had just produced for the prior example, rather than the one appearing on the screen. Therefore, the place of articulation of the stop remained constant within each block, and the transition from the set of /p/-initial words to /t/-initial to /k/-initial words was clearly indicated by the context sentences so that speakers would be aware that a new nonce word was in play. For each repetition of a block of sentences, the subject saw the same block-initial screen, as this established the introduction of a new nonce word in a context situation. The remaining sentences within each block were randomized.

Recording of the test sentences was conducted in a sound-attenuated booth. Subjects wore a head-mounted microphone and the entire experiment session was recorded as a single .wav file onto a digital recorder. Subjects controlled the pace of the experiment, pressing the space bar on the keyboard to move from one screen to the next. Five native speakers of German participated as subjects in the experiment and were paid for their participation.

The sequence of three blocks was presented three times, giving three repetitions of each target sentence. Each block contained 12 screens of sentences; 3 of each test condition. This produced a total of 108 test sentences for each speaker, 27 of each condition. There were a total of 540 tokens for the experiment.

4.3 Segment labeling

The test sentences were extracted from the speaker recordings for annotation. Depending on condition, there were either two or four segments which were labeled for analysis: two segments were labeled for the Base condition which contained no pronoun, and four segments were labeled for the WkP, Prcl, and Encl conditions. These are identified in Table 2 below.

The segments occurring in all four conditions are those notated as ‘/o/’ and ‘voiceless stop’ in the table. /o/ is the first vowel measured in all conditions, and always followed the stop /k/. /o/ duration was determined to begin at the onset of voicing and end at the offset of the third or higher formants. The voiceless stop was /p/, /kl/, or /tl/, and these were labeled for three measurements. Voiceless stop closure duration was measured from the offset of the preceding
vowel formants to the onset of the release burst. Voice onset time (VOT) was measured from release to the onset of voicing. The mean intensity of the release burst was calculated for a 15 ms window beginning at the release point.

The WkP, Prcl and Encl conditions included measurements for the additional two segments comprising the syllable representing either the weak pronoun or a homophonous syllable. I will refer to this as the \textit{p-syllable}. Measurement of p-syllable onset duration for /z/ was labeled from the onset to the end of frication. Duration for /m/ was measured from the offset of vowel formants to the onset of the following vowel formants. Additional measurements were taken for the voiced stop /d/. These included the period from the offset of the preceding vowel formants to burst release (onset duration), and the VOT. Release burst intensity for /d/ was measured as indicated above for the voiceless stops. Because the pronoun \textit{dir} occurred in only one third of the tokens for these three conditions, the /d/ VOT and /d/ intensity measurements were taken for only 27 tokens per subject, or 135 tokens in all.
<table>
<thead>
<tr>
<th>Conditions</th>
<th>/o/</th>
<th>p-syllable onset</th>
<th>p-syllable nucleus</th>
<th>voiceless stop</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base:</strong></td>
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<tr>
<td>Peter-Nico Penten</td>
<td>o</td>
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<td>p t k</td>
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<td>Thomas-Janko Tengen</td>
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<td>Opa Heiko Knten</td>
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<td><strong>WkP:</strong></td>
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<td>Peter-Nico \ { \textit{sie} } Penten</td>
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<td>Opa Heiko \ { \textit{dir} } Knten</td>
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<td>Thomas-Janko Sietengen</td>
<td></td>
<td>z</td>
<td>i</td>
<td>p t k</td>
</tr>
<tr>
<td>Opa Heiko Sieknten</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mirpenten</td>
<td></td>
<td>m</td>
<td>ie</td>
<td>p t k</td>
</tr>
<tr>
<td>Mirtengen</td>
<td></td>
<td>m</td>
<td>ie</td>
<td>p t k</td>
</tr>
<tr>
<td>Mirknten</td>
<td></td>
<td>d</td>
<td>ie</td>
<td>p t k</td>
</tr>
<tr>
<td><strong>Encl:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annas \ { \textit{Picosie} } Penten</td>
<td>o</td>
<td>z</td>
<td>m</td>
<td>p t k</td>
</tr>
<tr>
<td>Ullis \ { \textit{Mikomir} } Tengen</td>
<td></td>
<td>m</td>
<td>i e</td>
<td>p t k</td>
</tr>
<tr>
<td>Susis \ { \textit{Dakodir} } Knten</td>
<td></td>
<td>d</td>
<td>i e</td>
<td>p t k</td>
</tr>
</tbody>
</table>

Table 2: Segments labeled by condition

5. Results

5.1 Interpretation of the data

ANOVARs were run on the data for each measurement. For all measurements, one of the specified factors was Condition; in some instances, this was the only factor. However, each condition is divided into groups which vary by place of articulation of the voiceless stop and, for all but the Base condition, by pronoun. This variation in segmental material contributed to greater variance in the measurements, and in order to control for this, additional factors were specified in the ANOVAs for certain measurements.
As the duration of /o/ is affected by the consonant which follows, the factor *Pronoun*, which distinguishes between the three pronoun exemplars, was included as a factor for this measurement. *Pronoun* was specified as a factor for the measurements taken on the p-syllable segments with the exception of the two measurements taken solely for /d/; the environment for /d/ did not vary. For the three measurements taken of the voiceless stop, the factor *Consonant*, distinguishing between /p/, /t/, or /k/, was specified as a factor. This is summarized in Table 3.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. /o/</td>
<td></td>
</tr>
<tr>
<td>2. p-syllable onset duration</td>
<td>Condition</td>
</tr>
<tr>
<td>3. p-syllable nucleus duration</td>
<td>Pronoun</td>
</tr>
<tr>
<td>4. /d/ VOT</td>
<td></td>
</tr>
<tr>
<td>5. /d/ release burst intensity</td>
<td>Condition</td>
</tr>
<tr>
<td>6. voiceless stop closure duration</td>
<td>Condition</td>
</tr>
<tr>
<td>7. voiceless stop VOT</td>
<td>Consonant</td>
</tr>
<tr>
<td>8. voiceless stop release burst intensity</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: ANOVA factors per dependent variable

As expected, differences in segmental material did in the majority of cases produce main effects. For example, the duration of the p-syllable onset /z/ in the WkP condition would naturally be distinct from the duration of the onset /d/ in the WkP condition. For analyses of data pooled across speakers, there were no measurements for which the interaction of Condition and a second factor proved significant. An interaction between Condition and a second factor was found for two measurements taken on the individual data for one speaker, and in one measurement for the individual data of a second speaker. These will be identified in Section 5.3.

The purpose of including a second factor in the ANOVAs was solely to reduce the variance introduced into the data by different segments; the results obtained for that second
factor are in and of themselves not relevant to the question under examination: effect of prosodic position on segment realization. Therefore, only the results for Condition as factor will be reported in this paper.

Bonferroni-corrected post-hoc tests were used for one-on-one comparisons between conditions. For each measurement, the first step was to determine whether there was a significant distinction between its realizations in the Proclisis condition and in the Enclisis condition. If the comparison between these two model conditions reached significance, this was taken to indicate that variation in the realization of the segment was correlated with its prosodic position. The comparisons between the WkP condition and each of the model conditions were then examined. It was expected that, if the weak pronoun were enclitized, then the post-hoc comparisons involving the WkP condition should pattern with those of the Encl condition; thus, the comparisons between the WkP and Prcl conditions should reach significance. If, on the other hand, the pronoun were procliticized, the Post-hoc comparisons should show the opposite result, and it should be the comparison between the WkP and Encl conditions which yielded a significant result.

In summary, in order to interpret the results of the ANOVAs and Bonferroni-corrected post-hoc comparisons, for each measurement there would, ideally, be a cluster of three results converging on a single conclusion: a main effect of Condition on the measurement, a significant distinction between the two model conditions, and a significant distinction between the WkP condition and either the Encl or Prcl condition.

5.1.1 Comments on presentation of the data

Statistical analysis was performed on data pooled across speakers, and on data segregated by speaker. In section 5.2 I will discuss the results derived from the pooled data. Following that, the results for individual speakers will be addressed in section 5.3.

The results of measurements taken for the Base Condition did not pattern as expected. Only two segments were examined for this condition; the first, /o/, was expected to pattern with that of the Proclisis Condition and the second, the voiceless stop, with that of the Enclisis condition. Overall, the values for these measurements were lower in the Base condition than in their expected counterparts. The reason for this is unclear. It may be related to the fact that the utterance did not contain a p-syllable. As noted earlier, rather lengthy sentential constituents were intentionally incorporated into the test sentences in order to encourage speakers to parse the utterance as two phrases. Perhaps, as the Base Condition utterance was shorter, speakers did not consistently produce a phrase break. If so, these segments would not have fallen at phrase edges, and thus their prosodic position would have been distinct from that of their correspondents in other conditions. Whatever the factors affecting segmental realization in the Base Condition may have been, these measurements proved uninformative for the purposes of the experiment; the measurements from this condition were not included in the analyses presented in the paper.
5.2 Results of data pooled across subjects

One- or two-way ANOVAs were performed on the data for each of the eight measurements discussed above, and Bonferroni-corrected post-hoc tests were used for one-on-one comparisons of conditions. A main effect for the factor condition was found for five measurements; the results are reported in Table 4. The analysis of the pooled data is consistent with proclisis of the weak pronoun.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>ANOVA results</th>
</tr>
</thead>
<tbody>
<tr>
<td>/o/ duration</td>
<td>F(2, 396) = 15.09, p &lt; .001</td>
</tr>
<tr>
<td>p-syllable onset duration</td>
<td>F(2, 396) = 6.73, p = .001</td>
</tr>
<tr>
<td>/d/ VOT</td>
<td>F(2, 131) = 3.74, p = .026</td>
</tr>
<tr>
<td>/d/ intensity</td>
<td>F(2, 131) = .99, p = .376</td>
</tr>
<tr>
<td>p-syllable nucleus duration</td>
<td>F(2, 396) = 61.29, p &lt; .001</td>
</tr>
<tr>
<td>vl. stop closure duration</td>
<td>F(2, 392) = 22.97 p &lt; .001</td>
</tr>
<tr>
<td>vl. stop VOT</td>
<td>F(2, 396) = .93, p = .397</td>
</tr>
<tr>
<td>vl. stop intensity</td>
<td>F(2, 396) = .09, p = .910</td>
</tr>
</tbody>
</table>

Table 4: ANOVA results for factor Condition; pooled subject data

- First measurement: /o/ duration

Condition had a main effect on /o/ duration, F(2, 396) = 15.09, p < .001. The comparison of /o/ durations in the Proclisis and Enclisis conditions was found to be significant (p < .001). The vowel /o/ is longer in the Proclisis than the Enclisis condition. This is the expected result, as /o/ is phrase-final in the Prcl condition, and phrase internal in the Encl condition. The distinction in /o/ duration between the WkP and Encl conditions was likewise significant (p < .01), indicating that /o/ duration in the WkP condition patterns with that of the Proclisis condition.
As can be seen in Figure 3, the vowel is longer in the WkP condition than in the Enc condition. This suggests phrase final lengthening of the vowel when it precedes the weak pronoun, and contrasts with the phrase-internal vowel in the enclisis position, which is shorter in duration. Individual speaker results are shown in Figure 4.
ANOVA and post-hoc results are given in Table 5. For each one-on-one comparison between conditions, the mean /o/ duration per condition is provided.

ANOVA:  $F(2, 396) = 15.09, \ p < .001$

<table>
<thead>
<tr>
<th>compared conditions</th>
<th>Prcl : Encl</th>
<th>WkP : Prcl</th>
<th>WkP : Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean /o/ duration in ms.</td>
<td>60.63</td>
<td>46.90</td>
<td>55.87</td>
</tr>
<tr>
<td>significance</td>
<td>.000</td>
<td>.185</td>
<td>.001</td>
</tr>
</tbody>
</table>

Table 5: Effect of Condition on /o/ duration; pooled speaker data
- ANOVA result
- Means per condition and Bonferroni-corrected post-hoc comparisons

- Second measurement: p-syllable onset duration

The factor Condition had a significant main effect on p-syllable onset duration; however, the comparison between the Prcl and the Encl conditions did not reach significance ($p > .100$).
The comparison between the WkPC and Prcl conditions did show a significant distinction (p < .01), as opposed to the comparison between the WkP and Encl conditions (p > .05). The full array of results is given in Table 6.

Lengthening of consonant duration is expected in the Prcl, as the p-syllable is phrase-initial and the onset is thus subject to initial fortition. The fact that the onset of the weak pronoun is significantly distinct from and of shorter duration than the syllable onset in the Prcl would therefore be consistent with enclisis of the pronoun.

\[ \varphi -\text{initial } /z/ \]

18. Proclisis Model: Bald soll Peter-Nico) (Siepenten holen lassen

\[ \varphi -\text{internal } /z/ \]

19. Enclisis Model: Bald soll Annas Pikosie) (Penten holen lassen

20. WkP Condition: Bald soll Peter-Nico sie) (Penten holen lassen

As can be seen in Figure 5, the duration of the pronoun onset consonant is shorter in the WkP condition than in either the Proclisis or Enclisis conditions. The graphs in Figure 6 showing individual speaker measurements illustrate that for some subjects, the p-syllable onset is as long or longer in the Encl than in the Prcl condition. This is an unexpected result, as the consonant is word-internal in the former, and phrase-initial in the latter. Note that the p-syllable is unstressed; possibly this has consequences for realization of the onset in phrase-initial position. In any event, the lack of significance between the two model conditions suggests that p-syllable onset duration is not a strong indicator of phrasal position.

![Figure 5: Mean p-syllable onset duration; pooled data](image)
Figure 6: Mean p-syllable onset duration: by speaker

ANOVA: $F(2, 396) = 6.73$, $p = .001$

<table>
<thead>
<tr>
<th>compared conditions</th>
<th>Prcl : Encl</th>
<th>WkP : Prcl</th>
<th>WkP : Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>means</td>
<td>70.41</td>
<td>63.73</td>
<td>63.73</td>
</tr>
<tr>
<td></td>
<td>67.99</td>
<td>70.41</td>
<td>67.99</td>
</tr>
<tr>
<td>significance</td>
<td>.567</td>
<td>.001</td>
<td>.064</td>
</tr>
</tbody>
</table>

Table 6: Effect of condition on p-syllable onset duration; pooled data

- ANOVA result
- Means per condition and Bonferroni-corrected post-hoc comparisons
• Third measurement: /d/ VOT

/d/ VOT was measured for only one third of the tokens - those having the p-syllable *dir*. Condition shows a significant main effect for this measurement (F(2, 131) = 3.74, p = .026). However, as was the case for p-syllable onset duration, a Bonferroni-corrected post-hoc comparison indicates no significant distinction between the two model conditions (p > .100), suggesting that /d/ VOT is not a good predictor of phrasal position.

\[\varphi \text{ -initial /d/} \]

21. Proclisis Model  Bald soll Peter-Nico) *Dirpenten holen lassen*

\[\varphi \text{-internal /d/} \]

22. Enclisis Model  Bald soll Annas Dako *dir* (Penten holen lassen)

One-on-one comparisons of the WkP condition with the Prcl and the Encl conditions show only marginal significance. VOT is shorter in the WkP condition than in either of the other two conditions, as seen in the graph in Figure 7. There is, though, a great deal of inter-speaker variation in the comparative durations for this measurement (Figure 8).

\[\text{ANOVA: } F(2, 131) = 3.74, \ p = .026\]

<table>
<thead>
<tr>
<th>compared conditions</th>
<th>Prcl : Encl</th>
<th>WkP : Prcl</th>
<th>WkP : Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>means</td>
<td>20.98</td>
<td>14.24</td>
<td>14.24</td>
</tr>
<tr>
<td></td>
<td>21.04</td>
<td>20.98</td>
<td>21.04</td>
</tr>
<tr>
<td>significance</td>
<td>1.00</td>
<td>.061</td>
<td>.055</td>
</tr>
</tbody>
</table>

Table 7: Effect of Condition on /d/ VOT: pooled data

• ANOVA results
• Means per condition and Bonferroni-corrected post-hoc results
Fourth Measurement: p-syllable nucleus duration

The duration of the pronoun nucleus was found to be a strong predictor of prosodic position. ANOVA results showed a highly significant main effect of Condition ($F(2, 396) = 61.29$, $p < .001$), and post-hoc comparisons indicate a correlation between phrase-final position and vowel lengthening (see Table 8 below).

Vowel duration is longer when the vowel is phrase final in the Encl Condition than when it is phrase internal in the Prcl Condition; comparison between these conditions is significant at
p < .001. As can be seen in Figure 9, the WkP condition patterns with the Prcl condition; the final syllable nucleus in the trisyllabic nonce word of Encl is longer than the weak pronoun nucleus of the WkP at a significance of p < .001. This indicates that the weak pronoun does not occur in phrase-final position, and has not encliticized. Note, however, that Figure 10 indicates inter-speaker variation in this measurement.

\[ \varphi \text{ –internal /i/} \]

23. Proclisis. Bald soll Peter-Nico) \( \text{Sie} \) penten holen lassen
24. WkP : Bald soll Peter-Nico) \( \text{sie} \) Penten holen lassen

\[ \varphi \text{ –final /i/} \]

25. Enclisis: Bald soll Annas Pikosie) (Penten holen lassen

<table>
<thead>
<tr>
<th>compared conditions</th>
<th>Prcl : Encl</th>
<th>WkP : Prcl</th>
<th>WkP : Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean p-syllable nucleus duration</td>
<td>67.12</td>
<td>92.92</td>
<td>70.19</td>
</tr>
<tr>
<td>significance</td>
<td>.000</td>
<td>.684</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 8. Effect of Condition on p-syllable nucleus duration; pooled data

- ANOVA results
- Means per condition and Bonferroni-corrected post-hoc comparisons
Fifth measurement: voiceless stop closure duration

The duration of the voiceless stop was found to be a strong predictor of phrasal position. The ANOVA result shows a main effect of Condition at $F(2, 392) = 22.97$, $p < .001$. The post-hoc comparisons again show that the WkP condition patterns with the Prcl, with a significant distinction at $p < .001$ between each of these conditions and the Encl condition.
ANOVA: $F(2, 392) = 22.97, p < .001$

<table>
<thead>
<tr>
<th>compared conditions</th>
<th>Prcl : Encl</th>
<th>WkP : Prcl</th>
<th>WkP : Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>means</td>
<td>60.53</td>
<td>61.96</td>
<td>61.96</td>
</tr>
<tr>
<td></td>
<td>69.13</td>
<td>60.53</td>
<td>69.13</td>
</tr>
<tr>
<td>post-hoc significance</td>
<td>.000</td>
<td>.904</td>
<td>.000</td>
</tr>
</tbody>
</table>

**Table 9. Effect of Condition on voiceless stop duration; pooled data**

- ANOVA result
- Means per condition and Bonferroni-corrected post-hoc comparisons

The duration of the consonant is longer in the Encl condition. This, again, is consistent with phrase-initial position of the stop. When the p-syllable is in final position of the first phrase, this places the onset of the grammatical object in initial position of the second phrase. This contrasts with the stop position in the Prcl condition; here, the unstressed p- syllable is leftmost in the phrase. If in the WkP condition the pronoun has procliticized, the onset of the object (e.g. ‘Penten’) is not phrase-initial, and does not undergo fortition.

\[ \varphi \text{ –internal} /p/ \]

26. Proclisis Model: Bald soll Peter-Nico) (Sie\textit{penten} holen lassen

27. WkP Condition: Bald soll Peter-Nico) (sie \textit{Penten} holen lassen

\[ \varphi \text{ –initial} /p/ \]

28. Enclisis Model: Bald soll Annas Pikosie) (\textit{Penten} holen lassen
Figure 11: Mean voiceless stop duration; pooled data

Figure 12: Mean voiceless stop duration; by speaker
Sixth measurement: voiceless stop VOT

Kuzla and Ernestus (2007) report for German that a voiceless stop in initial position of a higher prosodic category is realized with a shorter VOT than one at a lower category boundary; for voiced stops, there is no effect of boundary level on VOT. Kuzla and Ernestus suggest that at lower boundaries the voicing contrast between voiced and voiceless stops is obscured, so that increased VOT duration becomes a more salient cue to the identification of voiceless stops at lower levels. At a higher boundary, the voicing distinction becomes the more crucial cue, with the consequence that speakers do not maintain the VOT contrast.

Kuzla and Ernestus’ result was not replicated here. There was no main effect of condition on VOT of the voiceless stop.

### Table 10: Effect of Condition on voiceless stop VOT; pooled data

- ANOVA result
- Means per condition and Bonferroni-corrected post-hoc comparisons

<table>
<thead>
<tr>
<th>compared conditions</th>
<th>Prcl : Encl</th>
<th>WkP : Prcl</th>
<th>WkP : Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean vl stop duration</td>
<td>71.24</td>
<td>72.59</td>
<td>70.19</td>
</tr>
<tr>
<td>significance</td>
<td>1.00</td>
<td>1.00</td>
<td>.534</td>
</tr>
</tbody>
</table>
• Remaining measurements

There was no main effect of Condition on burst intensity of /d/ or of the voiceless stop. ANOVA results in both cases failed to reach significance (/d/ intensity: $F(2, 131) = .99, p > .1$; voiceless stop intensity: $F(2, 396) = .09, p > .1$)
5.2.1 Summary of results for pooled data

Analysis of data pooled across speakers yielded three indicators of proclisis. These were the duration of the subject-final vowel /o/, the p-syllable nucleus duration, and the voiceless stop closure duration. Several measurements did not produce the cluster of ANOVA and post-hoc results which form the basis of data interpretation; however, none of the results here are directly incompatible with a conclusion of proclisis.

5.3 Results of individual speaker data

The analysis of data of individual speakers is largely consistent with that of the pooled data. There are, however, indications of inter-speaker variation in directionality of clisis, and there are as well a number of results which do not pattern as expected.

• Speaker one: FT

The speaker whose data most strongly indicate proclisis of the pronoun is FT. This speaker’s data set is unique in its degree of internal consistency: although there are several measurements which yield no informative results, each measurement for which an ANOVA reaches significance shows the set of post-hoc results indicating proclisis. There are three such measurements: duration of the p-syllable onset; duration of the p-syllable nucleus, and duration of the voiceless stop closure. The results are given in Table 11.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>ANOVA</th>
<th>Comparison Prcl-Encl</th>
<th>Comparison WkP-Prcl</th>
<th>Comparison WkP-Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-syllable onset duration</td>
<td>$F(2, 72) = 17.43$  ( p = .000 )</td>
<td>.001</td>
<td>.218</td>
<td>.000</td>
</tr>
<tr>
<td>p-syllable nucleus duration</td>
<td>$F(2, 72) = 27.21$ ( p = .000 )</td>
<td>.000</td>
<td>1.000</td>
<td>.000</td>
</tr>
<tr>
<td>vl stop duration</td>
<td>$F(2, 72) = 17.24$ ( p = .000 )</td>
<td>.000</td>
<td>1.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 11: ANOVA and Bonferroni-corrected post-hoc results for FT
In each instance, there is a main effect of Condition, and the post-hoc comparisons indicate a distinction between the two model conditions, as well as a distinction between the WkP and Encl conditions. This is consistent evidence indicating proclisis. The prosodic structures associated with the results for FT are given in (29) – (31).

29. Proclisis Model  Bald soll Peter-Nico) (Siep enten holen lassen

30. WkP Condition  Bald soll Peter-Nico) (sie P enten holen lassen

31. Enclisis Model  Bald soll Annas Piko) (Penten holen lassen

Figure 15 below illustrates the full pattern of results for FT. As illustrated in the graph of p-syllable onset duration, the length of the consonant is in fact shorter in the WkP and Prcl conditions than in the Encl condition. The comparative durations of this segment were predicted to be the reverse. The p-syllable onset is phrase-internal in the Encl condition, and phrase-initial in the Prcl condition, thus the consonant should be subject to fortition lengthening in the latter, not the former, case. Despite this unexpected effect, the WkP and Prcl conditions do pattern together for this measurement.

Analysis of voiceless stop intensity for FT produced significance for the interaction of Condition and Pronoun (F(4,72) = 4.03, p < .01). However, no main effect of Condition was found, nor were any of the post-hoc results for Condition significant.
Figure 15: Results for FT
• **Speaker Two: JK**

The data for JK pattern quite differently, suggesting that this speaker encliticizes weak pronouns. The strongest indicators are /o/ duration and p-syllable onset duration. For both of these measurements, Condition was found to have a main effect, the distinction between the Proclisis and Enclisis conditions was significant, and the comparison between the WkP and Prcl conditions likewise reached significance.

\[ \varphi -\text{final } /o/ \quad \varphi -\text{initial } /z/ \]

32. Proclisis Model: Bald soll Peter-Nic\(\text{o}\) (Siepenten holen lassen

\[ \varphi -\text{internal } /z/ \quad \varphi -\text{internal } /o/ \]

33. Enclisis Model: Bald soll Annas Pik\(\text{o}\)sie) (Penten holen lassen

34. WkP Condition: Bald soll Peter-Nic\(\text{o}\)sie) (Penten holen lassen

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>ANOVA</th>
<th>Comparison: Prcl-Encl</th>
<th>Comparison: WkP-Prcl</th>
<th>Comparison: WkP-Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>/o/ duration</td>
<td>F(2, 72) = 12.29 p = .000</td>
<td>.000</td>
<td>.037</td>
<td>.058</td>
</tr>
<tr>
<td>p-syllable onset duration</td>
<td>F(2, 72) = 8.78 p = .000</td>
<td>.001</td>
<td>.002</td>
<td>1.000</td>
</tr>
</tbody>
</table>

**Table 12: ANOVA and Bonferroni-corrected post-hoc results for JK**

With one exception, the graphs in Figure 16 suggest an overall trend towards weak pronoun enclisis for JK. This is particularly noticeable in the graphs pertaining to the p-syllable onset and /d/ measurements, yet of these only the measurement for p-syllable onset duration produced significant results, as shown above. The factor Condition yielded significance in the ANOVAs for /d/ VOT and /d/ intensity, but not in the post-hoc comparisons; the results for these measurements, given in Table 13, may nevertheless indicate a trend towards enclisis.
Figure 16: Results for JK
Table 13: /d/ measurement results for JK

There is one measurement which is difficult to reconcile with a conclusion of enclisis for this speaker: p-syllable nucleus duration. The data for this measurement is shown in Table 14. Condition was found to have a main effect on this measurement. A comparison between the WkP and Encl conditions did reach significance. In contrast to the above-reported measurements for JK, this would appear to suggest weak pronoun proclisis, as this would suggest the segmental alignment shown in (35) – (36) below. However, comparison between the Prcl and Encl conditions was not found to be significant and thus this measurement does not appear to be a strong indicator of the segment’s prosodic position for this speaker.

\[ \varphi -\text{internal } /i/ \]

35. WkP Condition: Bald soll Peter-Nico) (sie Penten holen lassen

\[ \varphi -\text{final } /i/ \]

36. Enclisis Model: Bald soll Annas Pikosie) (Penten holen lassen

Table 14: p-syllable nucleus: ANOVA and Bonferroni-corrected post-hoc results for JK
• **Speakers Three and Four: CE and KE**

The results for these two speakers are similar to one another in that, for each, there is only a single strong indicator of directionality: results for the p-syllable nucleus duration indicate proclisis. ANOVAs indicate a main effect of condition on this measurement; the post-hoc comparisons show a distinction between the Proclisis and Enclisis conditions, as well as between the WkP and Enclisis conditions.

\[ \varphi \text{ – internal /i/} \]

37. Proclisis Model: Bald soll Peter-Nico) (Sie penten holen lassen
38. WkP Condition: Bald soll Peter-Nico) (sie Penten holen lassen

\[ \varphi \text{ – final /i/} \]

39. Enclisis Model: Bald soll Annas Pikości) (Penten holen lassen

<table>
<thead>
<tr>
<th>Speaker</th>
<th>ANOVA</th>
<th>Comparison: Prcl-Encl</th>
<th>Comparison: WkP-Prcl</th>
<th>Comparison: WkP-Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>F(2, 72) = 93.16 p = .000</td>
<td>.000</td>
<td>1.000</td>
<td>.000</td>
</tr>
<tr>
<td>KE</td>
<td>F(2, 72) = 14.29 p = .000</td>
<td>.004</td>
<td>1.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

**Table 15: p-syllable nucleus duration: ANOVA and post-hoc results for CE and KE**

None of the other results for these speakers are directly incompatible with a conclusion of proclisis; that is, there are no measurements which show a significant distinction between the two model conditions and a significant distinction between the Prcl and WkP conditions. There are, however, some results which are difficult to interpret.
• CE

The most interesting case of this sort for CE is the p-syllable onset duration. This is one of the measurements for which the ANOVA indicated both a main effect of Condition ($F(2, 72) = 9.65$, $p < .05$) and an interaction between Condition and Pronoun ($F(4, 72) = 7.97$, $p < .001$). As can be seen in the graph for this measurement in Figure 17, the Encl and Prcl conditions appear similar; however, the WkP condition is distinct from both. This is what the post-hoc comparisons reveal as well. Comparison between the two model conditions does not reach significance, but the WkP comparisons with each condition do.

\[
\begin{align*}
40. & \quad \text{Proclisis Model: Bald soll Peter-Nico) (Siepenten holen lassen} \\
41. & \quad \text{Enclisis Model: Bald soll Annas Pikosie) (Penten fangen lernen} \\
42. & \quad \text{WkP Condition: Bald soll Peter-Nico sie Penten holen lassen}
\end{align*}
\]

<table>
<thead>
<tr>
<th>ANOVAs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition: $F(2, 72) = 9.65$, $p = .000$</td>
</tr>
<tr>
<td>Condition*Pronoun: $F(4, 72) = 2.83$, $p = .031$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compared conditions</th>
<th>Prcl : Encl</th>
<th>WkP : Prcl</th>
<th>WkP : Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>post-hoc results</td>
<td>1.000</td>
<td>.004</td>
<td>.000</td>
</tr>
<tr>
<td>for Condition</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 16: p-syllable onset duration: ANOVA and Bonferroni-corrected post-hoc results for CE

It may be noticed that, in the measurements for /o/ duration, the WkP condition appears more similar to the Encl condition, rather than the Prcl condition. The ANOVA results for /o/ duration indicate both a main effect for Condition and a significant interaction of Condition and Pronoun (see Table 17 below). The post-hoc comparison between the Prcl and WkP conditions did reach significance; however, the comparison between the two model conditions did not. The graphs in Figure 18 present the durations for /o/ and for the p-syllable onset segregated by pronoun.
Figure 17: Results for CE
When the pronoun exemplar is *sie* in the Encl condition, the /o/ and pronoun onset durations are lengthened. The reason for this is unclear; however, this effect is likely the basis of the Condition and Pronoun interaction for these measurements. The mean duration of /o/ in the WkP condition is consistently shorter than in the Prcl condition, as is reflected in the significance of the post-hoc comparison between these conditions. Given the variability in this measurement, and the fact that the comparison between the two model conditions does not reach significance, the duration of /o/ does not appear to be a good indicator of pronoun position for CE. I therefore do not consider the results here clear enough to contradict the conclusion that this speaker procliticizes weak pronouns.

**ANOVA:**

| Condition: F(2, 72) = 3.15, p = .049 |
| Condition*Pronoun: F(4, 72) = 7.97, p = .000 |

<table>
<thead>
<tr>
<th>Compared conditions</th>
<th>Prcl : Encl</th>
<th>WkP : Prcl</th>
<th>WkP : Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>post-hoc results for Condition</td>
<td>.478</td>
<td>.044</td>
<td>.851</td>
</tr>
</tbody>
</table>

**Table 17: /o/ duration: ANOVA and Bonferroni-corrected post-hoc results for CE**

**Figure 18: /o/ and p-syllable onset durations by Pronoun for CE**
• KE

The data for this speaker likewise produced some unexpected results. The results for /d/ intensity, for example, are like those of the p-syllable onset for CE: the post-hoc comparisons show no significant difference between Proclisis and Enclisis, however, the WkP condition is distinct from each. These results are summarized in Table 18; graphs for KE follow in Figure 19.

\[
\begin{align*}
/d/ & \\
43. \text{Proclisis Model:} & \quad \text{Bald soll Peter-Nico) (Dirpenten holen lassen} \\
44. \text{Enclisis Model:} & \quad \text{Bald soll Annas Dakodir) Penten holen lassen} \\
/d/ & \\
45. \text{WkP Condition:} & \quad \text{Bald soll Peter-Nico dir Penten holen lassen}
\end{align*}
\]

<table>
<thead>
<tr>
<th>Measurement</th>
<th>ANOVA</th>
<th>Comparison: Prcl-Encl</th>
<th>Comparison: WkP-Prcl</th>
<th>Comparison: WkP-Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>/d/ intensity</td>
<td>F(2, 24) = 11.16, p = .000</td>
<td>.626</td>
<td>.009</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 18: ANOVA and Bonferroni-corrected post-hoc results for KE
Figure 19: Results for KE

- Mean /o/ duration
- Mean /p/ syll onset duration
- Mean /d/ VOT
- Mean /d/ intensity
- Mean /p/ syll nucleus duration
- Mean /t/ stop duration
- Mean /t/ stop VOT
- Mean /t/ stop intensity
**Speaker Five: NW**

For this speaker, two results are contradictory. These are the results for /o/ duration and for p-syllable nucleus duration. /o/ duration in the WkP condition appears consistent with weak pronoun proclisis, while the duration of the p-syllable nucleus is consistent with enclisis.

* /o/ pattern: Proclisis

φ-final /o/

47. Proclisis Model: Bald soll Peter-Nico) (Siepenten holen lassen
47. WkP Condition: Bald soll Peter-Nico) (sie Penten holen lassen

φ-internal /o/

48. Enclisis Model: Bald soll Annas Pikosie) (Penten holen lassen

* /i/ pattern: Enclisis

φ-internal /i/

49. Proclisis Model: Bald soll Peter-Nico) (Siepenten holen lassen

φ-final /i/

50. Enclisis Model: Bald soll Annas Pikosie) (Penten holen lassen

51. WkP Condition: Bald soll Peter-Nico sie) (Penten holen lassen

<table>
<thead>
<tr>
<th>Measurement</th>
<th>ANOVA</th>
<th>Comparison Prcl-Encl</th>
<th>Comparison WkP-Prcl</th>
<th>Comparison WkP-Encl</th>
</tr>
</thead>
<tbody>
<tr>
<td>/o/ duration</td>
<td>F(2, 98) = 6.38, p = .002</td>
<td>.055</td>
<td>1.000</td>
<td>.006</td>
</tr>
<tr>
<td>p-syllable nucleus duration</td>
<td>F(2, 72) = 17.58, p = .011</td>
<td>.000</td>
<td>.000</td>
<td>.226</td>
</tr>
</tbody>
</table>

Table 19: ANOVA and Bonferroni-corrected post-hoc results for NW
The ANOVA shows a main effect of condition on /o/ duration, and the post-hoc comparison between the WkP and the Encl conditions shows significant distinction; the comparison between the two model conditions yields marginal significance. As the graph below in Figure 20 illustrates, mean /o/ duration is somewhat longer in the WkP condition than in the Prcl condition; however, there is a high degree of variance in the measurement for these two conditions.

The results for p-syllable nucleus duration point in the opposite direction, indicating enclisis. For this measurement, the results of all three diagnostics reach significance. In sum, the results for these two vowels indicate that both undergo lengthening. This is surprising, as under either proclisis or enclisis of the pronoun, only one of these two vowels should be in phrase-edge position and subject to final lengthening.

Note that although the means illustrated in the graphs for p-syllable onset duration and for /d/ VOT appear to indicate that the WkP condition patterns with Proclisis, results for these measurements did not reach even marginal significance in either the ANOVA or in the post-hoc comparisons.
Figure 20: Results for NW
6. Discussion

Of the data sets of individual subjects, that of FT provides three measurements consistently indicating proclisis. The results for CE and KE provide one significant measurement indicating proclisis. Their data produced some results which are difficult to interpret, however, there are no results for these speakers which directly contradict the conclusion that they procliticize as well. Thus, the data for three of the five individual subjects are consistent with that of the pooled data in indicating that the weak pronoun is phrase-initial. For JK, there are no measurements which show the full pattern of results consistent with proclisis; rather, two measurements in this data set support the conclusion that the weak pronoun is phrase-final, thus that this speaker encliticizes. In the case of one speaker, NW, the results of two measurements are in conflict with one another.

Of the individual-speaker data sets, the NW set contains the only instance of two directly incompatible results; yet, as discussed above, there were for other speakers several results which did not pattern as expected. This could be attributed to a variety of possible causes. A number of measurements show a high degree of variance; perhaps a clearer picture would emerge given a substantially larger data pool. It may also be the case that some speakers can produce both pro- and enclisis of the pronoun, and for this reason the measurements indicate mixed results.

There is one further possibility which I would like to briefly discuss here - one which neither the experimental design nor the metric for interpretation of the data were designed to address.

The experiment is based on comparison between the condition whose prosody is to be diagnosed, the Weak Pronoun Condition, and two conditions whose prosodic structure is known, the Proclisis and Enclisis model conditions. The location of phrasal boundaries in the model conditions were established through the placement of lexical material at phrase edges, rather than functional material. It was assumed that, for the purpose of the experiment, the prosodic structure formed by weak pronoun cliticization would be essentially identical to that of one of the two models. If the weak pronoun structure is identical to either the enclisis or proclisis model, then it is expected that the phonetic measurements taken in the weak pronoun condition will pattern consistently with this model condition. That is, if the pronoun has formed a structure like that of the enclisis model, then whichever measurements show significant distinctions between the enclisis and proclisis models should also consistently show significant distinctions between the weak pronoun and proclisis models.

This was exactly the patterning which was found in the data for FT, clearly indicating proclisis, but this degree of consistency was not found for the other speakers. In addition to the conflicting result for NW, one measurement for JK, the duration of the p-syllable nucleus, was unexpected given phrase-final position of the weak pronoun. And for some measurements for CE and KE, results seem to suggest that the weak pronoun condition is distinct from both the proclisis and enclisis conditions.

The experiment is reliant on comparison of the structures schematized in (52) through (54). In both the Proclisis and Enclisis Model conditions, phrase edges align with lexical
material. But in the WkP condition, depending on direction of clisis, either a final or initial phrase boundary will be aligned with functional material.

52. Proclisis/Enclisis Model:  
   (…lex) (lex…)

53. Pronoun proclisis:  
   (…lex) (fnc=lex…)

54. Pronoun enclisis:  
   (…lex=fnc) (lex…)

However, as was discussed in the introduction, a category formed by function word incorporation is sometimes argued to be distinct from a category formed by lexical material. Function word incorporation may instantiate additional prosodic boundaries, so that the comparison between the model conditions and the weak pronoun condition may in fact be between structures as in (55) – (57):

55. Pronoun/Enclisis Model:  
   (…lex) (lex…)

56. Pronoun proclisis:  
   (…lex) (fnc (lex…..)

57. Pronoun enclisis:  
   ((…lex) fnc) (lex…..)

If one takes into account the possibility of additional prosodic boundaries in the weak pronoun condition, this might be a means of considering some of the results reported here, particularly those which indicated a distinction between the WkP condition and both the Prcl and Encl conditions. If additional boundaries are present, then these are also boundaries where edge effects may occur, and perhaps to a greater or lesser degree than at boundaries aligned with lexical material. On the other hand, edge effects may be restricted to certain types of boundaries, in which case effects may be seen only in the weak pronoun condition but not in the model condition, or vice versa.

I would note that the data produced in this experiment do not fall into a clear and consistent pattern indicative of recursive boundaries, but the quantity of data here are not sufficient to support an investigation of such subtle effects. Perhaps a larger data set would provide a basis for further examination of this question.
7. Conclusion

The experiment discussed in this paper was designed to test whether data on phonetic edge effects could be used to diagnose the prosodic structure formed by cliticization of German weak pronouns in post-subject position. The data pooled across all experimental subjects produced three strong results indicating proclisis. The subject-final /o/ was longer in the Prcl and WkP conditions than in the Encl condition; the p-syllable nucleus was shorter in the Prcl and WkP conditions than in the Encl condition, and the voiceless stop closure duration was longer in the Encl condition than in the WkP and Prcl conditions. Although several measurements produced results which either failed to reach significance or did not show the cluster of results which permitted an interpretation based on the methodology adopted here, there were no results which were directly inconsistent with the conclusion that the overall trend is towards proclisis of weak pronouns. This outcome is consistent with the claim in Vogel (2004) that proclisis is the preferred means of function word incorporation in German.

The results derived from individual-speaker data were largely consistent with those of the pooled data; for three of the five speakers, measurements indicated proclisis. However, the results for one speaker were more consistent with enclisis. This section of the analysis therefore provides initial evidence of inter-speaker variation in the incorporation of German weak pronouns. If this is correct, then the contradictory claims of proclisis and enclisis found in the literature may be a reflection of this variability.

The experimental methodology was successful in identifying clear results for much of the data. In light of those results which were less amenable to interpretation, the final section of the paper took into consideration factors which may be relevant for further phonetic research on function word prosodification. Among these were the possibilities that, given the high degree of variance in some measurements, the data set was too small to produce significant results; that individual speakers may not produce exclusively enclisis or proclisis, leading to measurements which represent a mixture of both; and that the internal structure of prosodic categories formed by incorporation of functional material may trigger phonetic effects strong enough to have repercussions on experimental results.
Appendix: Test Sentences

Block 1: base nonce word - *Penten*

*Base Condition:*

1. Öfters muss Peter-Nico Penten holen lassen
   *Often must Peter-Nico have penten fetched.*
2. Sofort muss Peter-Nico Penten holen lassen
   *Immediately must Peter-Nico have penten fetched*
3. Wieder kann Peter-Nico Penten holen lassen
   *Again can Peter-Nico have penten fetched*

*Weak Pronoun Condition:*

4. Bald soll Peter-Nico sie Penten holen lassen
   *Soon should Peter-Nico have them fetch penten*
5. Daher soll Peter-Nico mir Penten geben lassen
   *Therefore should Peter-Nico have penten given to me.*
6. Also kann Peter-Nico dir Penten holen lassen
   *Therefore can Peter-Nico have penten fetched for you.*

*Proclisis Model Condition:*

7. Heute will Peter-Nico Siepenten holen lassen
   *Today Peter-Nico wants to have siepenten fetched.*
8. Nun will Peter-Nico Mirpenten holen lassen
   *Now Peter-Nico wants to have mirpenten fetched*
9. Vielleicht kann Peter-Nico Dirpenten holen lassen
   *Perhaps Peter-Nico can have dirpenten fetched.*

*Enclisis Model Condition:*

10. Heute kann Elsas Pikosie Penten fangen lernen
    *Today Elsa’s Pikosie can learn to catch penten.*
11. Jetzt kann Ullis Mikomir Penten fangen lernen
    *Now Ulli’s Mikomir can learn to catch penten.*
12. Morgen wird Elsas Dakodir Penten fangen lernen
    *Tomorrow Elsa’s Dakodir will learn to catch penten.*

*Base Condition for Block 2: nonce word - *Tengen* *

13. Bald soll Thomas-Janko Tengen holen lassen
    *Soon Thomas Janko should have tengen fetched.*

*Base Condition for Block 3: nonce word - *Kenten* *

14. Bald soll Opa Heiko Kenten holen lassen.
    *Soon Grandpa Heiko should have kenten fetched.*
References


