Phonological Trochaic Grouping in Language Planning and Language Change

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1 Grouping of Morphosyntactic and Phonological Constituents

Grouping (constituency) is our only concern here. How do the parts and wholes of morphosyntactic constructions relate to the parts and wholes of phonological constructions? Morphosyntactic constituents are largely, though not always, meaningful (morphemes, morphosyntactic words, morphosyntactic phrases, sentences etc.) and phonological constituents are largely meaningless (features, segments, syllables, feet, phonological words, phonological phrases, etc.). An analogous question concerning the relation between semantic and morphosyntactic grouping can be raised. The grouping in constructing semantic representations tends to determine/to be mirrored by morphosyntactic grouping (compositionality), but does not have to be (cf. Lahiri and Plank 2007, in press; Plank and Lahiri 2009). Example (1) points to possible obstacles for transparent mapping. The morphological bracketing in (1a) is imposed by English grammar, which permits the negative prefix un- to combine only with adjectives to form adjectives (and rarely verbs). However, on purely semantic grounds a grouping of a negative with a nominal would be equally plausible as in (1b). The relevant grouping for lexical phonological domains as stress and *Trisyllabic Shortening* are again not isomorphic to the others (1c), where *-ity* must be suffixed before the prefixation of *un-*. Finally, syllabic and morphological bracketing rarely coincides as in (1d).

(1) Constituent grouping

(a)	[[un-[[de-[cipherN]V]-abilA]A] -ity N]	morphological
(b)	[[un-] [[[de-[cipherN]V]-abilA]-ityN] N]	semantic
(c)	[[[un-] [[de-[cipherN]V]-abilA]A]-ityN]	lexical phonological domains
(d)	(un).((de.CI.phe.ra).(BI.li.ty))	postlexical phonological grouping

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Note that it is not so much the divisions into units — morphemes vs. syllables — which diverge, but their groupings which diverge indiscriminately.

Our focus in this paper is on the grouping of units on the level of utterances. Is there a natural, preferred grouping in certain languages, of lexical words into larger constituents based on rhythmic principles? If yes, what evidence do we have for such grouping? Scholars such as Henry Sweet in the mid 1800s did recommend such grouping when explaining constituency in natural speech in the course of second language learning. He provided a trochaic tone-group of English texts for the benefit of German language learners as shown in (2) (from Lahiri and Plank 2007, in press).

(2) Henry Sweet's (1885) trochaic grouping

(a) in conventional English orthography
People **used to** $_{(\text{FOCUS})}$ think the earth was a flat cake, with the sea all round it; but we know now that it's really round.

(b) syntactic bracketing
[[people] [[[used] [to think]] [[[[the] [earth]] [[was] [[a kind] [[of] [[flat] [cake]]]]]], [[with] [[[the] [sea]] [[all] [[round] [it]]]]]]]]

(c) Trochaic grouping
(people) (**used to** think the) (earth) (was a flat cake), (with the) (sea all) (round it) (but we) (know now) (that it's) (really) (round).

(d) IPA variant of Sweet's Broad Romic
-pijpl juwsttəþiŋkði əəð wəzəkaindəv flæt keik̀, -wiðə sijɔl raundit bətwij nou nau ðætits riəli ˙raunđ

The grouping in (2d) shows that the syntactic structure is maintained only when it follows the trochaic grouping. Preposition and determiners are grouped together (e.g. *with the*) ignoring the syntactic phrasing. Likewise, *used to think the* is a perfectly unaffected grouping in a normal speech production, but cannot be interpreted as a meaningful constituent. Sweet provides comparable phonological grouping of Dutch sequences as well.

(3) Dutch syntactic vs. trochaic grouping following Sweet (1885)

(i)	(Geef mij en licht) give me a light	(Geef mij en) (licht)
(ii)	Heb je goed geslapen? have you good sleep-PART	(Heb je) (goed ge) (slapen)? [xutxe]
(iii)	Ik kan mijn boek niet finden I can my book not find-INF	(Ik kan mijn) (boek niet) (finden)

Thus, Sweet's instruction to foreigners suggests that at least in Germanic, the phrasal rhythm as he perceived it a century ago was trochaic, where a strong stress prefers to attract upcoming unstressed elements. Evidence for leftwards

attachment which lead to cliticization and eventually grammaticalised suffixes is available from most languages (e.g. Plank 2005 for Latin). We will briefly discuss the effect of such cliticization from Swedish, Norwegian, and Bengali, where trochaic grouping has led to the creation of single phonological words.

Other than leftwards attachment of unstressed items and their formations into prosodic words, there is another type of trochaic grouping which is pertinent — the case of compounds. If we consider ordinary two-word lexical compounds, like *blackbird*, then a compelling assumption is that the compound is a syntactic word consisting of two prosodic words but with one main stress. Thus, *blackbird* is a noun, with main stress on the first foot. How does one then prosodically label a compound? Do we allow recursive prosodic word formation and call it a single prosodic word (Lahiri, Jongman and Sereno 1990)? In the prosodic hierarchy literature we do not have a category that fits naturally. Under Selkirk's (1986) assumption, a compound could be a *minor phrase*. Booij (1995) proposed a recursive structure where compounds could be assumed to be a prosodic word where one prosodic word is Chomsky-adjoined to a preceding prosodic word. Under Nespor and Vogel's (1986) hierarchy, we have the choice of a *Clitic Group* but this would be a misnomer. More recently, Vogel and Wheeldon (in prep) and Vogel (2009, submitted) have proposed a *Composite Group*, while Vigário (2009) introduced the *Prosodic Word Group*, both of which essentially replaces the *Clitic Group* as an alternative to recursive phonological word formation. Regardless of the recursive/non-recursive debate, the trochaic grouping remains the same.

The hypothesis we entertain is that normal trochaic grouping and compounding lead to prosodic constituents which play a vital role in normal language production planning and lead to change in morphophonological systems. By language production, we mean not only the acoustic or articulatory outputs but the processing involved in planning to produce speech (cf. Levelt 1989). What are the units used by speakers to plan their articulation? Are they lexical words or are they prosodically grouped structures not necessarily isomorphic to syntactic structure? We begin with a discussion of examples of trochaic grouping which led to cliticization and suffixation in Scandinavian (Section 2), Germanic and Bengali verb morphology (Section 3) and English cliticization (Section 4). In Section 5, we show that different types of prosodic structures based on trochaic grouping can form different domains for different rules. The examples will be from Dutch. We then turn to psycholinguistic evidence (Section 6) arguing that language planning does not involve simple lexical words but rather prosodic structures related to trochaic grouping.

2 Leftwards Grouping with DEFINITE ARTICLE: Evidence from Swedish and Norwegian

Certain Swedish and Norwegian dialects maintain contrastive tonal accents *villa*$_1$ 'villa' vs. *flicka*$_2$ 'girl'. A striking contrast that has emerged in these languages involves the definite article which attaches leftwards to nouns. Phonologically

they are quite distinct from, for instance, plural suffixes. This cliticization, to a large extent, consolidated the accent contrast in Scandinavian: *lagen*$_1$ vs. *lagar*$_2$ 'the law/laws'. The synchronic syntactic structures often show double determination, which is not unusual in other languages (Plank 2003). Other than Danish, double determination is the default rather than the exception (Börjars 1994).

(4) Scandinavian determiners

(a) Swedish: must co-occur with one exception (*denna* 'this' cannot co-occur in most dialects)
den gamla mus-**en**/*mus
den mus-**en**/*mus
den där mus-**en**/*mus
denna ?*mus-**en**/mus

(b) Norwegian: must co-occur (even *denne* must co-occur)
same as Swedish except:
denne bil-**en**

(c) Danish: def occurs in complementary distribution with determiners:
mand-**en**
den mand/*mand-**en**
denne mand/*mand-**en**

The argument from syntacticians is that the determiner is an affix rather than a clitic since it is placed in affix-typical position. Here the DEF attaches to the first word of the phrase only when there is no premodification; to the final word only when there is no postmodification (Lahiri, Wetterlin and Jönsson-Steiner 2005a). However, this controversy is not relevant. What is crucial is the grouping which led to the definite marker being attached to the noun. The article derives from the demonstratives in 'articular' (=joining) function with an attributive adjective following after a noun which was the normal adjective position of old. This is the same in most Germanic languages. Thus the constructions that would have led to the grouping would be of the following type:

(5) Steps in double definiteness due to leftwards attachment in Scandinavian

(i) warrior, this/the valiant [one]
(ii) warrior=the valiant
(iii) valiant warrior=the
(iv) the valiant warrior=the

The effect of the trochaic grouping is clearly seen through the proposed stages in (5). From the construction in (5i), the article was prosodically rephrased and reanalysed with the preceding stressed noun as in (5ii). And this is where the article remained when nouns were on their own, once definiteness marking had become obligatory (5iii). When the regular adjective position came to be pre-nominal, adjectives took the definite marker with them.

In these synchronic systems, one can still see the consequences of the cliticization in the tonal outputs. When one attaches the indefinite plural suffix to a monosyllabic noun, it gets assigned Accent 2 as a normal trochaic word would. If, instead, the definite ending is attached, also forming a trochee, the noun remains Accent 1. Indeed the definite ending has no effect on the tonal properties of the noun and it thus behaves phonologically like a clitic (Riad 1998; Lahiri, Wetterlin and Jönsson-Steiner 2005b; Kristoffersen 2000, and references therein).

(6) Definite clitics and plural suffixes in Scandinavian

	Swedish	*Norwegian*
sg	$stol_1$ $månad_2$ $tĕrmos_1$	$stol_1$ $måned_2$ $tĕrmos_1$
sg.def.	$stol{=}en_1$ $månad{=}en_2$ $tĕrmos{=}en_1$	$stol{=}en_1$ $måned{=}en_2$ $tĕrmos{=}en_1$
pl	$stol\text{-}ar_2$ $månad\text{-}er_2$ $tĕrmos\text{-}ar_1$	$stol\text{-}er_2$ $måned\text{-}er_2$ $tĕrmos\text{-}er_1$
pl.def.	$stol\text{-}ar{=}a_2$ $månad\text{-}er{=}na_2$ $tĕrmos\text{-}ar{=}na_1$	$stol\text{-}er{=}ne_2$ $månad\text{-}e(r){=}ne_2$ $tĕrmos\text{-}e(r){=}ne_1$
Gloss	chair/chair=DEF/chair-PL month/month=DEF/month-PL thermos/thermos=DEF/thermos-PL	chair/chair=DEF/chair-PL month/month=DEF/month-PL thermos/thermos=DEF/thermos-PL

The standard assumption is that the definite clitic is attached to the prosodic word after accent assignment, while the plural suffix is attached before. In the nouns above, the word *tĕrmos* is marked with an asterisk to indicate that it is lexically specified for Accent 1 (Lahiri et al. 2005a). We turn to this below.

(7) Attachment of plural suffix and definite clitic

$[/stem/\text{-}(PL)_{accent}]\omega$ =DEF

Swedish plural & definite	/stol/-ar	/månad/-er	/tĕrmos/-ar
accent assignment	$stolar_2$ $[stolar_2]_\omega$=DEF *stolarna*$_2$	$månader_2$ $[månader_2]_\omega$=DEF *månaderna*$_2$	$tĕrmosar_1$ $[tĕrmosar_1]_\omega$=DEF *termosarna*$_1$

Norwegian			
singular definite	/stol/	/månad/	/tĕrmos/
accent assignment	$stol_1$ $[stol_1]_\omega$=DEF_1 *stolen*$_1$	$månad_2$ $[månad_2]_\omega$=DEF_2 *månaden*$_2$	$tĕrmos_1$ $[tĕrmos]_{1\omega}$=DEF_1 *termosen*$_1$

According to Lahiri et al. (2005b), words like *termos* are represented with their accent in the lexicon, indicated here with the accent mark (*). Specified lexical accent is always interpreted as Accent 1 and overrides the default accent assignment rule. Consequently, irrespective of whether the plural suffix or the clitic is added, words like *termos* always have Accent 1. The default rule states that trochaic words, if unspecified for lexical accent, bear Accent 2. All specified words have Accent 1, including all words that do not consist of a trochee, e.g. all monosyllabic words. A word like *stol*, which is not specified for underlying accent, is assigned Accent 1 since it is monosyllabic. After plural suffixation, that leads to a trochaic structure it is assigned Accent 2 e.g *stolar*. However, it is already Accent 1 in the singular form when the definite clitic is attached. In other words, the clitic has no effect on accentuation.

(8) Accent assignment

(i) Lexically specified (indicated by $^{\times}$) are always assigned Accent 1
(ii) If no specification and the word has a trochee (*kirke*) then it is assigned Accent 2, else Accent 1 (which includes monosyllabic words)

Since we are also interested in the prosodic structure of compounds, we can note that the clitic attached to a compound again has no affect on the accentuation. Here we only refer to Norwegian, specifically Standard East Norwegian, since Swedish compounds all bear Accent 2. Compound accent assignment in Norwegian is sensitive to the lexical accent of the first prosodic word of the compound as we see in the examples in (8) (Wetterlin 2008).

(9) Compound accent in Standard East Norwegian
[ω̆ ω] > Accent 1 (first word is lexically specified)
else, [ω ω] > Accent 2 (as in any default trochaic accent)

Lexical repr. ω_1	/kirke/		/åksje/	
Lexical repr. ω_2	/tårn/	/ŏrgel/	/bank/	/marked/
Compound	'kirke,$tårn_2$	'kirke,$orgel_2$	'aksje,$bank_1$	'aksje,$marked_1$
Gloss of compound	*church tower*	*church organ*	*stock bank*	*stock market*
DEFINITE	'kirke,tårn=et_2	'kirke,orgel=en_2	'aksje,bank=en_1	'aksje,marked=et_1

The word *aksje* is lexically specified for Accent 1 and this determines the accent of the compound. When the accent of the word is unspecified as in *kirke* (it would take default Accent 2 in isolation because it is a trochee), the compound as whole bears Accent 2. What is crucial here is that accent assignment of the compound must come after compounding, as we can see from the following examples where the first prosodic word is monosyllabic. Although monosyllabic words in isolation are always Accent 1 (see 8), they influence compounds in different ways. We follow Lahiri et al. (2005a) and Wetterlin (2008) in assuming that the difference lies in the lexical accent specification; some monosyllables are specified for Accent 1, and some are not.

(10) Monosyllabic first word with Accent 1 and 2

Lexical repr. ω_1	/land/		/skǒ/	
Lexical repr. ω_2	/vei/	/tunge/	/krem/	/fa'brikk/
Compound	'landvei$_2$	'land$_{\text{,}}$tunge$_2$	'sko$_{\text{,}}$krem$_1$	'skofa$_{\text{,}}$brikk$_1$
Gloss of compound	*country path*	*peninsula*	*shoe cream*	*shoe factory*
DEFINITE	landvei=en$_2$	'land$_{\text{,}}$tunge=en$_2$	'sko$_{\text{,}}$krem=en$_1$	'skofa$_{\text{,}}$brikk=en$_1$

The monosyllabic *land* is not specified with its accent in the underlying representation. It gets Accent 1 as default when uttered in isolation since it is monosyllabic. However, since it is unspecified for accent, it has no effect on the compound accent which is the default (trochaic) Accent 2. Thus, *land* must get its accent after compounding, and the cliticized *land=en* is formed after accent assignment. The noun *skǒ*, on the other hand, is specified for Accent 1, and hence its accent has an effect on the compound accent which is assigned Accent 1. Note that accent assignment is not influenced by the accent of the second member. The definite article cliticizes leftwards to attach to the compound. Again these are not suffixal since they remain outside the tonal domain. Consequently, the cliticization of the definite article is exactly the same for compounds and single prosodic words. Our assumptions of compounding and accent assignment follow Wetterlin (2008). Examples in (11) exemplify the interaction of accent assignment and compounding.

(11) Accent assignment and compounding

	/land/	/skǒ/	/land/	/skǒ/
compounding	(land)(vei)	(skǒ)(krem)		
lexical & compound accent assignment	(landvei)$_2$	(skokrem)$_1$		sko$_1$
default accent assignment			land$_1$	
cliticization	((landvei)$_2$=en)$_2$	((skokrem)$_1$=en)$_1$	(land)$_1$=en)$_1$	(sko)$_1$=en)$_1$

What we cannot convincingly determine from these compounds is whether they are definitively formed on two prosodic words or whether they are still stems which are combined to make a compound. This is unlikely since one usually assumes that compounds are made up of two words, i.e. $((\omega)(\omega))\omega_{\text{compound}}$. The clitics are attached to the entire compound which is a prosodic word on its own and therefore we will have a recursive formation, viz. $(((\omega)(\omega))_{\omega\text{-(compound)}} = \text{CLITIC})_{\omega}$. If we assume no recursivity, and consider compounds to be *Composite Group*, what would be the constituent after cliticization: e.g. $(((\omega)(\omega))_{\text{CG(compound)}} = \text{CLITIC})_{X}$? Clearer evidence for an independent compound domain comes from Dutch (Section 5). Before that, we touch briefly on Bengali and Germanic auxiliaries, which cliticized to verbs, again providing evidence for trochaic grouping.

3 Germanic and Bengali Auxiliary Cliticization in Verbs

The verb 'do' provided tense marking in weak verbs in all Germanic languages. In Bengali the auxiliary 'be' has provided a progressive suffix. Both have been consequences of the main verb roots attracting the less strong auxiliary in its prosodic domain.

3.1 Germanic weak verbs were made from nouns, adjectives or other verbs with the addition of suffixes, most commonly the /j/ causative suffix which caused gemination and umlaut in certain conditions. Ablaut, or changing the root vowel under specific morphological conditions was the dominant way of marking the past; Old English *helpan, healp, hulpon, holpen* 'help INF, 1/3SG PAST INDIC, PLURAL PAST INDIC, PAST PARTICIPLE.The modern Germanic languages all maintain a present-past distinction in these verbs; cf. English *come, came;* German *komme, kam*; Dutch *kom, kam* etc. Ablaut was, however, not possible to indicate the past tense of derived verbs, since the root vowel in most instances would have been umlauted and therefore a front vowel. The vowel alternation pattern of ablaut verbs was not available. Consequently, the past was constructed as a compound verb by adding the past of 'to do' (Lahiri 2000).

(12) Morphological decomposition of derived weak verbs in older Germanic

Present tense [ROOT+ /j/ CAUSATIVE SUFFIX] + PERSON-NUMBER inflection
Past tense - compound formation, where X=infinitive or verbal noun
[ROOT + /j/ CAUSATIVE SUFFIX + X]ω + [do_{AUX}-PAST-PERSON-NUMBER inflection]

> [[ROOT]ω = do_{AUX}-PAST-PERSON-NUMBER inflection]ω
> [[ROOT] -*d* - PAST-PERSON-NUMBER inflection]ω

For instance, a word like *fall* would be made causative with the suffix /j/ which would trigger umlaut and generate *fell*. Present tense suffixes could be added to it like *he fells the tree*. But for the past tense, one would need to make a construction as in *fell did* which later became *felled*.The strong past patterns as in *ring-rang* could not be used as a template.

The modern Germanic languages all have the coronal stop /t/ or /d/ as the past marker. Whether they are voiced or voiceless depends on the normal historical development and assimilation; English {d,t,ed}, German {t, et}, Dutch {d, t, et} etc. For verbs ending with a coronal stop, either a schwa is inserted between the root and the coronal stop or the stop is deleted.

(13) Past tense in modern Germanic weak verbs

[ROOT+ coronal stop] + person-number inflection

	INF	PAST-3p	INF	PAST-3p
English	pat	patt-ed [ed]	beg	begged[d]
German	red-en	red-ete [ete]	schraub-en	schraub-te[t]
Dutch	rijd-en	reed	krabb-en	krab-de[d]

	INF	PAST-3p
English	kiss	kiss-ed [t]
German	hüpf-en	hüpf-te [t]
Dutch	knijp-en	knijp-te[t]

Thus, the past tense of *do*/*tun*/*doen* cliticized to the root. The coronal stop of *do* became a morpheme indicating past. What is consistent is that the coronal stop has been retained, while the inflectional suffixes conform to the morphological system of the language. The suffixed forms are prosodic words in their entirety. The verb 'do', has continued to exist as an independent verb. Again, we see a trochaic grouping causing leftwards attachment of the auxiliary.

3.2 The auxiliary /ach-/ 'to be' in Bengali is suppletive; only the present and the simple past tense forms exist. Through the last 1000 years it has been used to supplement the verbal aspectual system. One example is that of the present progressive which is a suffix derived from the original /ach-/. The suffix consists of the palatoalveolar consonant, but has become underlyingly a geminate due to regular sound changes (Lahiri 2000, Lahiri and Fitzpatrick-Cole 1999).

(14) Bengali progressive forms

	ROOT-1PERS.PRESENT	ROOT-PROGRESSIVE-1PERS
lie down	shu-i	shu-cch-i
play	khel-i	khel-ch-i

The progressive developed from a full verb form and gradually was attached leftwards to the root and lost its vowel. Later, in the context of vowel final roots, the palatoalveolar consonant geminated and is now the underlying form of the suffix.

(15) Development of the progressive

[ROOT - PROG]$_{\omega}$ [*ach*$_{\text{AUX}}$- *e* PRESENT-3PERSON] ω
[ROOT - PROG]$_{\omega}$= [*ch*$_{\text{AUX}}$- *e* PRESENT-3PERSON] ω
[ROOT - *cch* $_{\text{AUX}}$- *e* PRESENT-3PERSON] ω

	lie down	play
Old Bengali	shu-ite ach-e	khel-ite ach-e
Middle Bengali	shu-i ach-e	khel-i ache-e
Early modern	shu-i=ch-e	khel-i=ch-e
Modern	shu-cch-e	khel-ch-e

An interesting factor is the underlying geminate in the new progressive morpheme /-cch/. This was an innovation, although medial geminates were frequent in the language, and no inflectional morpheme had as yet an underlying geminate. Again, for our purposes, we find the leftwards attachment of an auxiliary to make a trochaic grouping.

4 Cliticizations of Unstressed Words in English

The classic example non-isomorphism between syntactic phrasing and phonological phrasing has always been embedded structures. The syntactic structure has four levels of embedding, while the phonological grouping is flat as we can see in (16).

(16) Non-isomorphism between syntactic and phonological phrasing

(i) [[[[The cat] [[that ate the mouse] [[that ate the cheese] was sick.]
(ii) (The cat that) (ate the mouse that) (ate the cheese) (was sick)

Selkirk (1995, 1996) provides a full list of possibilities of phonological groupings with function words. She assumes that above a (morphological) word, there is the assumption of a necessarily close match between syntactic and phonological mapping, in that phonological grouping is in essence determined by (morpho)syntactic grouping. The possible prosodizations of English [Fnc Lex] with [XP] and phonological phrases (PPh) are as follows, with brackets/parentheses coinciding owing to a general constraint on Edge Alignment such that XP/PPh brackets coincide.

(17) Selkirk's function words prosodization

S-Structure	[Fnc Lex] XP	
P-Structure	(i) $((\text{fnc})_{\text{PWd}}\ (\text{lex})_{\text{Pwd}})_{\text{PPh}}$	Prosodic Word [function word is not weak)
	(ii) $(\text{fnc}\ (\text{lex})_{\text{Pwd}})_{\text{PPh}}$	prosodic clitic = free clitic
	(iii) $(\text{fnc lex})_{\text{Pwd}})_{\text{PPh}}$	internal clitic
	(iv) $((\text{fnc}\ (\text{lex})_{\text{Pwd}})_{\text{PWd}})_{\text{PPh}}$	affixal clitic

According to Selkirk, weak forms of function words in English appear when non-focused, when not phrase final, and when phrase final, but not as an object of a verb (e.g *Where have you got* ***to****?*). Examples of weak function words (underlined) and their subsequent phrasing following Selkirk are given in (18).

(18) [Diane] [can paint] [her portrait] [of Timothy] [at home]
[But ǂshe found] [that ǂthe weather] [was ǂtoo hot] [for painting]

In English, function words with a weak form in this kind of examples are proclitic (underlined), of the subtype 'free (pro-)clitics': *I must fly to Toronto* $((\text{to})_{\text{clitic}}(\text{Toronto})_{\omega})_{\Phi}$.Selkirk's evidence comes from postlexical rules like aspiration of initial voiceless stops (in stressed as well as unstressed syllables) which is P-Wd-initial; hence *to* T^{h}*oronto,* *t^{h}*o Toronto,* *t^{h}*o* T^{h}*oronto*. Nevertheless, one can also obtain these facts by trochaic grouping as in (19) (Plank and Lahiri 2009, in press).

(19) Trochaic grouping
$[\text{fly to}]_{\omega}$ $[\text{Toronto}]_{\omega}$

As we have seen from Sweet's examples in (2), English also has enclitics, which are weak forms of function words in constructions with lexical words preceding them (e.g., [feed 'em], [see ya]). These are of the subtype 'affixal (en-)clitics' which include object pronouns. Additionally, in the Selkirk 1995 approach, there are also *enclitics* in English whose hosts are preceding Lex words:

(20) [Nina] ['s left]; [Mary] ['s coming]; [I] ['ll leave] too; [I] ['d like] [to stay]

Following Lahiri and Plank (2007) and Plank and Lahiri (2009), the hypothesis entertained here is that the default phrasing is left attachment, i.e. encliticization.

(21) Encliticization following trochaic grouping

[Nina has] [left]
[John] [walked to] [school]
[I'd] [like to] [stay]

The complementizer *to*, indeed, is a notorious 'misfits' *liketa*, *hafta*, *wanna*, *gonna* etc. which have been discussed a lot in the syntax literature (cf. Zwicky and Pullum 1983) and leftwards attachment is the only explanation. Again, English also has evidence for encliticizations.

5 Encliticization in Dutch

Dutch is no different from other Germanic languages in that function words do not count as phonological words unless focused. Earlier work on Dutch has established that the definite article can easily cliticize leftwards to attach to the preceding verb giving us the familiar grouping in (22).

(22) What is the definite article phonologically grouped with — noun or verb?

syntactic grouping:	VERB [DEF N]
phonological grouping:	(VERB DEF) N

Accepting this phonological grouping, Gussenhoven (1983) proposed a P-word formation (Left; X^0) giving us the grouping in (23).

(23) P-word formation in Dutch

Ik zoek de krant	$_{\omega}$(ik $_{\omega}$(zoek de $_{\omega}$(krant)))
	'I am looking for the newspaper'
syntactic phrasing	(ik) ((zoek) (de krant))

In Dutch, we can obtain evidence from voicing assimilation for the different domains. Here we can directly compare across word assimilations between compounds, cliticized words and a sequence of X^0 categories. Compare the following examples from Lahiri, Jongman and Sereno (1990) (based on Berendsen (1986) and Zonneveld (1983)) indicating the differences between compounds, cliticized prosodic words and across prosodic words within and across a phonological phrase. Here we see clear evidence for a difference between compounds and two separate prosodic words.

(24) Voicing assimilation in different domains

a)	compounds $((\omega\ )\ (\omega\ ))_{\omega\ \text{COMPOUND}}$	regressive assimilation obligatory
b)	P-wds across phrases $((\omega\ ))_{\phi}\ (\omega\ ))_{\phi}$	regressive assimilation optional
c)	cliticized word $((\omega\ ) = \text{Fnc}_{\text{CLITIC}}\ )_{\omega}$	regressive or progressive assimilation optional

The optionality and obligatory character of the voicing assimilations are made explicit in the following examples.

(25) Optionality of voicing assimilations across lexical boundaries

underlying	a. $((\text{meet})_{\omega}\ (\text{band})_{\omega})_{\omega}$ *measuring tape*	b. ik vind $((\text{Joop})_{\omega}\ (\text{dun})_{\omega}\ )_{\Phi}$ $((\text{Joop})_{\omega}\ )_{\Phi}\ ((\text{dun})_{\omega}\ )_{\Phi}$ *I find Joop thin*	c. ik zoek der (haar) $((\text{zoek})_{\omega}=\text{der})_{\omega}$ $(\text{zoekder})_{\omega}$ *I look for her*
	$((\text{zak})_{\omega}\ (\text{doek})_{\omega})_{\omega}$ *handkerchief*		
regressive assimilation	mee[d][b]and za[g][d]oek	joo[b][d]un *joo[b][d]un	zoe[g][d]er *zoe[g][d]er

progressive assimilation	*mee[t][p]and *za[k][t]oek	*joo[p][t]un *joo[p][t]un	*zoe[k][t]er zoe[k][t]er
No change	*mee[t][b]and *za[k][d]oek	*joo[p] [d]un joo[p] [d]un	*zoe[k][d]er *zoe[k][d]er

The clitic *der* cannot be stressed. If it is, then the full pronoun *haar* has to be used. Voicing assimilation is a must in a compound, but not so for the cliticized words. Following cliticization, there are two options: either the clitic joins with the preceding word like a single lexical item and then the constraint for such items comes into play, viz., no voiced clusters word internally (there is probably one exception, *abdomen* (cf. Zonneveld 1983); or *der* cliticizes to the preceding word and undergoes voicing assimilation like a compound. The crucial point is that *der* must share the voicing of the preceding word, and the subsequent cluster must be either voiced or voiceless. For a compound, the sequence has to be voiced if the initial stop of the second word is voiced (Zonneveld 1983). Notice that for (25b), when there are two prosodic words which may or may not be in phonological phrase, voicing assimilation is possible, but not obligatory as it is for the compound. Thus, the cliticized forms, compounds and a sequence of prosodic words are subject to different constraints for voicing assimilation.

Returning to the Gussenhoven's P-word formation in (23), and following Berendsen (1986), we can find additional evidence from voicing assimilation facts. Consider the following possibilities where voicing assimilation allows for two options: [zoekte] or [zoegde].

(26) Voicing assimilations for the cliticized definite article

	Ik zoek de krant Ik (zoe[k] [t]e)$_{\omega}$ (krant)$_{\omega}$	progressive assimilation of def art	1Pwd
	Ik ((zoe[g])$_{\omega}$[d]e))$_{\omega}$ (krant)$_{\omega}$	regressive assimilation of verb	clitic attached to preceding Pwd;
	*Ik (zoe[k])$_{\omega}$ ([d]e krant)$_{\omega}$	no assimilation is not possible	clitic attached to following Pwd
cf.	*ik vind Dik dun* Ik vind (Dik)$_{\omega}$ (dun)$_{\omega}$	'I find Dik thin' where [k] [d] as well as [g][d] are possible.	

These postlexical processes are always optional and variable. What we want to note here are the differences between the levels of prosodic grouping. Cliticized words share properties with compounds, but are different in some

ways. Similarly, compounds are different from a sequence of two lexical prosodic words which do not form a compound. These differences are more easily accounted for in a system which allows recursive phonological word formation.

Now we turn to online sentence production. Do we have any psycholinguistic evidence from sentence generation — not just measuring the acoustics after production — but the actual planning involved in the production? The process of producing a sentence includes many steps. Depending on circumstances, the speaker may have a certain amount of time to prepare to speak or must begin articulation with little preparation, for example as a reply to an urgent question. What units does the speaker use to plan his/her utterances? Are they syntactic or are they prosodic? If they are prosodic, do they follow our hypothesis of trochaic grouping argued for above? Do speakers treat compounds as two words or one? We discuss briefly some experimental evidence which begins to address these issues.

6 Can We Find Any Psycholinguistic Evidence for Such Structures?

What is the evidence that prosodic structures such as the phonological words described above play a role during language production processes? Prior to the onset of an utterance, a phonological representation must be planned that guides articulation. We have argued that the lexical item is not the optimal unit for the planning of phonological structure or for its subsequent articulation. In this section we summarize the psycholinguistic research that has focused on the relationship between syntactic and prosodic structures during language production. The existing research has used two experimental methodologies to investigate which units are involved in the planning and articulation of speech.

- In the *prepared speech paradigm*, speakers are required to construct an utterance for output and to prepare to say it on a given cue. This is not an unusual situation in language production, as in conversational settings speakers must often wait for an opening in order to produce utterances that they have already planned. In this case, the time it takes for a speaker to initiate articulation should be determined by the structure of the utterance as a whole. In other words, speech onset latency should be a function of the *number of units* in the utterance. The question addressed by this paradigm is what is the nature of the unit that determines speech onset latency?
- In the *on-line speech production paradigm*, speakers must construct and articulate their utterances as quickly as possible. There is a great deal of evidence that, during fluent speech, language is planned incrementally, with minimal units being constructed at a given level of representation prior to the onset of processing at the subsequent level. In other words speakers do not normally wait until they have constructed and entire utterance before they

begin to speak. Instead they articulate the first unit of an utterance whilst simultaneously planning subsequent units (Kempen and Hoenkamp 1987; Levelt 1989). In this situation the time it takes to initiate speech will be determined by the **size of the first unit** to be produced.

Thus, planning to produce an utterance entails a decision on the part of the speaker whether to spend time preparing the output or whether to begin speaking as soon as possible. Under both conditions, the problem is the preferred minimal unit of output - is it a syntactic phrasal unit or is it a prosodic phrasal unit constructed online as the articulators plan to produce the output? The minimal planning unit affects the two production strategies in different ways.

(27) Prepared versus online planning of speech production

(i) Prepared production is affected by the **number** of units planned
(ii) Online production is influenced by the **size** of the initial planned unit

We discuss each in turn.

6.1 Prepared Speech Production Studies

The prepared speech paradigm was first used by Sternberg and colleagues (1978, 1980) to investigate the planning of rapid speech sequences. They asked speakers to prepare to produce lists of random words or digits and to begin producing a sequence at a cued delay. They found that speech onset latencies for the lists increased in a linear fashion as the length of the list increased. In other words, speakers took longer to initiate longer lists. A comparison of different list types helped to determine the nature of the unit that determines list length in this task.

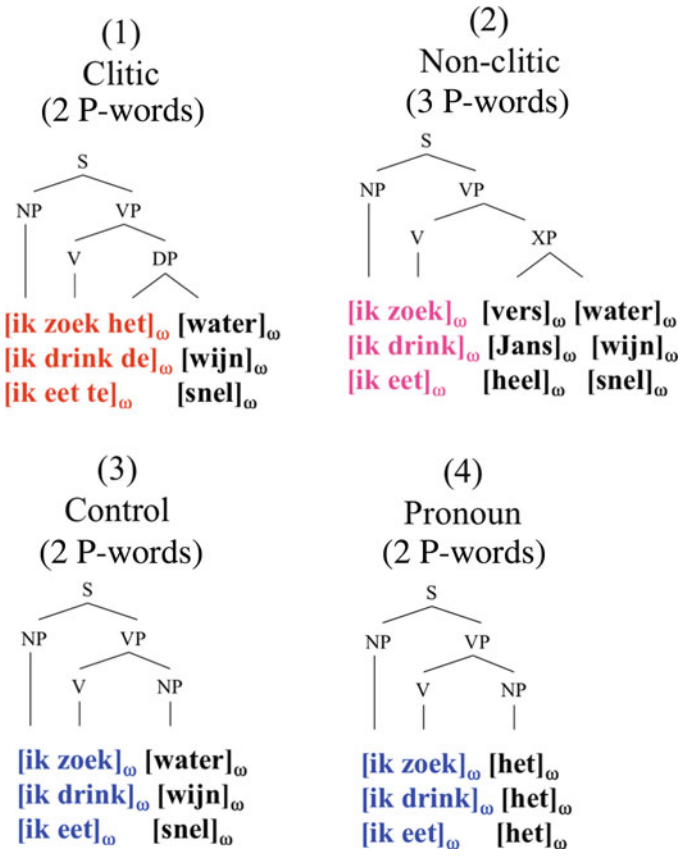
(28)

Monosyllabic words:	bay rum mark
Disyllabic words:	baby rumble market
Nouns plus function words:	bay and rum and mark

The critical unit cannot be the number of syllables or lexical items in the list, as the slope of the latency function was the same for monosyllabic and disyllabic word lists, as well as for lists of words including unstressed function words such as 'and'. The data therefore suggest that all of the list types shown above contain the same number of 'units' despite differing in the number of syllables and words. Sternberg et al. concluded that prior to articulation the lists were structured into 'stress groups' (e.g., /bay/ /baby/ /bay and/) each of which contained one primary stress and that these units determined list length and therefore speech onset latency in this task.

Wheeldon and Lahiri (1997, 2002) suspected that the units of importance in the Sternberg et al. task might be phonological words. We tested this idea by comparing the delayed production of clitic and non-clitic structures in Dutch.

(29) Test conditions



As can be seen, the clitic (1) and non-clitic (2) sentences are matched for global syntactic complexity and number of lexical items but differ in the number of phonological words they comprise. Therefore, if lexical items are the critical units of production, the latencies to initiate both sentence types should be the same. Alternatively, if phonological words are the critical units then non-clitic sentences should take longer to initiate than clitic sentences.

Two additional sentence types were tested in order to rule out alternative explanations. The control sentences (3) were included to check for effects of the complexity of the initial phonological word. These sentences have the same number of phonological words as the clitic sentences but the initial phonological word is less complex and identical to those of the non-clitic sentences. Any

effect of phonological word complexity should be seen in a difference in onset latency between the clitic and control sentences.

Finally, if longer onset latencies are obtained for the non-clitic than the clitic sentences, the effect could be attributed to the fact that the non-clitic sentences contain an additional content word rather than to differences in prosodic structure. The pronoun sentences (4) were included to test this possibility. In these sentences the phrase final determiner attracts stress and therefore becomes a phonological word on its own giving the pronoun and clitic sentences an equal number of phonological words but different numbers of content words. If the number of phonological words rather than number of content words is the critical factor, then onset latencies for these sentence types should not differ.

The order of events on the experimental trials is illustrated below. Speakers were shown the required noun phrase (e.g., het water, *the water*) on a computer screen and then heard a question relating to it (e.g., wat zoek je?, *what do you seek?*). They had a few seconds to prepare their sentences, which they produced following a variable response. Three different cue latencies were used in random order to ensure that speakers could not anticipate when they should start to speak. Although sentence onset latencies were usually shorter following longer cue latencies the pattern of results across cue latencies did not differ. Sentence onset latencies, were measured from the cue to the onset of articulation.

(30) The prepared speech experimental procedure

The results were as we predicted if the critical units in phonological planning are phonological words rather than lexical items.

- Speakers took significantly longer to begin to produce the non-clitic sentences than the clitic sentences.
- The complexity of the initial phonological word did not effect prepared sentence production, as onset latencies for the clitic and control sentences did not differ.
- The number of content words in a sentence had no effect on prepared sentence production, as onset latencies for the clitic and pronoun sentences did not differ.
- Finally, onset latencies were not a function of whole sentence duration, as spoken sentence durations showed a very different pattern of results with all sentence types significantly differing from each other in the direction one would expect.

We concluded that onset latency was a function of the number of phonological words in the utterance.

6.2 On-Line Speech Production Studies

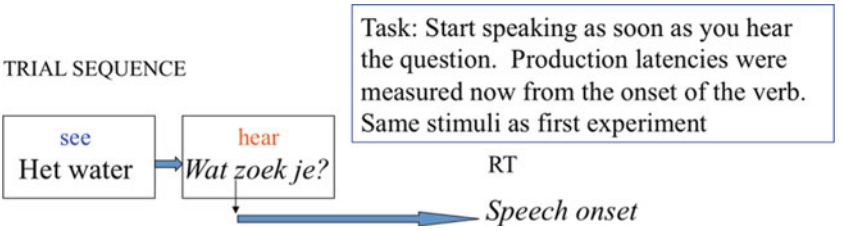
The prepared speech production experiments described in the previous section provide strong evidence that, prior to articulation, stored morpho-lexical representations are restructured into prosodic units. They also provide support for the grouping of unstressed function words into prosodic units. However, these experiments cannot tell us how prosodic structure affects sentence production when the time to prepare is limited. As mentioned above, when planning must occur online, speech is produced incrementally and it is likely that only the minimal production unit is planned prior to the onset of articulation. On-line speech production studies can therefore provide information about the preferred minimal unit of production. If this unit is the phonological word, then the articulators will have to wait for this unit to be planned. In other words, the length of the utterance initial phonological word will determine sentence onset latency (see Levelt 1989; Levelt and Wheeldon 1994).

In addition, while the delayed speech production experiments provide evidence concerning the number of prosodic units constructed, they do not tell us about the direction of attachment during cliticization. We have assumed that the clitic attaches leftwards to the verb, however the right attachment of clitics has also been proposed (Selkirk 1995). Clearly, the direction of attachment will determine the size of the initial phonological word and therefore sentence onset latencies to our clitic sentences. For the sentences given below, left attachment predicts that the clitic sentences should have longer onset latencies that the non-clitic and control sentences. In contrast, right attachment predicts no difference in onset latencies for the three sentence types.

(31)	Clitic, left attachment	[ik zoek het]$_w$ [water]$_w$	2 P-words
	Clitic, right attachment	[ik zoek]$_w$[het water]$_w$	2 P-words
	Non-clitic	[ik zoek]$_w$ [vers]$_w$ [water]$_w$	3 P-words
	Control	[ik zoek]$_w$ [water]$_w$	2 P-words

In order to address these issues, Wheeldon and Lahiri (1997) used the same question-answer technique as we used in our prepared speech experiments but changed the paradigm to elicit on-line sentence production. The timing of events is illustrated below. The critical difference was that speakers were given no time to prepare their responses but had to begin to speak as soon as they could. Sentence onset latencies were measured from the onset of the verb in the question, as the verb is required before sentence construction can begin.

(32) The on-line speech experimental procedure



As predicted, this experiment produced a very different pattern of results to that of the delayed speech production experiments. Onset latencies to the clitic sentences were now significantly slower than onset latencies to the clitic and control sentences, which did not differ. This pattern of results can be explained if we assume that the function words left-attached making the initial phonological word of the clitic sentences longer than those of the non-clitic and control sentences. These data provide support for the proposal that the phonological word is the preferred unit of output during speech production, as speakers clearly prefer to construct such a unit even at the cost of initiation speed. Furthermore, the resultant grouping must be due to encliticization rather than procliticization. That is, the grouping must be *(zoek het) (water)* rather than *(zoek) (het water)*, clearly demonstrating the non-isomorphism between syntactic and phonological structure.

6.3 Compounds vs. Two Prosodic Words

The final question we addressed was whether compounds are treated as one phonological word or two for the purposes of phonological encoding (Wheeldon and Lahiri, 2002). Using a prepared speech task we tested the production of the words and phrases shown below. Each word was produced preceded by the phrase 'het was', *it was*.

(33)	Adj + Noun	[oud] [lid]	Old member
	Compound	[[oog][lid]]	eyelid
	Monomorphemic		
	Initial stress	[orgel]	Organ
	Final stress	[orkest]	Orchestra

This experiment yielded a very clear pattern of results. The production latency for the initial and final stress monomorphemic words did not differ, demonstrating that the location of the stressed syllable was not critical. Critically, the production latencies for the compounds clearly patterned with the morphologically simple words rather than with the adjective–noun phrases whose production

latencies were significantly longer that for all other conditions (See also Vogel and Wheeldon, in prep, for a similar pattern of results in Italian). Clearly compounds as compared to phrases function as a single lexical unit with their own lexical meaning.

7 Conclusion

The hypothesis we have been entertaining is that the default grouping of phonological clitics which are usually unstressed function words is trochaic. That is, these clitics attach leftwards to the preceding stressed word. The obvious exception appears to be Romance where trochaic grouping does not hold and where compounds have main prominence on the second element (Peperkamp 1997; Vigário 2003). A line of research worth pursuing is to investigate if there are independent reasons for preferring one grouping over another. This would also have obvious consequences for language acquisition. A further relevant point that has come up in the discussion is recursivity in phonology. In the tradition of Nespor and Vogel (1986), it would be preferable if we could keep phonology distinct from syntax in assuming that there is no recursivity in phonological domains. Consequently a group of two or more phonological words would not constitute another phonological word but rather form a separate phonological level. Vogel (2009) and Vigário (2009) have independently been referring to such a proposal. Let us first consider compounds, which under Nespor and Vogel's analysis, are a problem. They would either have to be fall under a *Phonological Phrase* or would constitute a *Clitic Group,* neither of which are satisfactory. Since a two-word compound would normally consist of two prosodic words, it would be unusual to refer to it as a *Clitic Group* because there are no clitics. Furthermore, a compound has its own lexical properties and could hardly be a phrase. Vogel (2009, in preparation with Wheeldon) has been referring to compounds as a *Composite Group* (CG) which also encompasses phonological cliticisations. It is difficult to see how this would work for recursive three or four word compounds, or could these be designated as phrases?

(34) Two/three word compounds

(a)	high school	$((\text{high})_{\omega}\ (\text{school})_{\omega})_{\omega}$
(b)	hand ball	$(\text{hand})_{\omega}(\text{ball})_{\omega})_{\omega}$
(c)	high school handball	$(((\text{high})_{\omega}\ (\text{school})_{\omega})((\text{hand})_{\omega}\ (\text{ball})_{\omega}))_{\omega}$

As we are aware, compounds are extremely problematic and essentially a can of worms. But even simple compounds as those in (34) suggest that these groupings may be more easily explained in a model allowing recursivity in phonological word formation. As the Dutch experimental data show (§6), latencies for compounds were equal to those of monomorphemic words;

i.e. $((oud)_{\omega}\ (lid)_{\omega})_{\omega}$took the same amount of time to plan as $(orgel)_{\omega}$. What we did not test was whether $(((high)_{\omega}\ (school)_{\omega})\ ((hand)_{\omega}\ (ball)_{\omega}))_{\omega}$ would also take the same time to plan as a monomorphemic four syllable word $(manufacture)_{\omega}$. If recursivity was not permitted, (34c) would either have to be a flat structure or a phrase in Vogel's analysis because *highschool* and *handbag* would be CGs and two CGs would make up a phrase.[1] Thus, it is not entirely clear whether the quest of excluding recursivity is a sufficient motive to make the phonological analyses rather complicated.

What is crucial is that experimentally as well as in data from language-change, we have unmistakable evidence that surface morphosyntactic and phonological structure are non-isomorphic. We have provided substantial data of left-attachment in several languages and from various sources — from prescribed pronunciation rules to normal rules of sentence production. Furthermore, language change data also provide additional evidence of encliticization, from North and West Germanic, as well as from Bengali. Finally, psycholinguistic tasks measuring the latency of prepared and online utterances provide additional evidence for leftwards cliticization during sentence generation. Crucially, the data from all of these sources converge on the same trochaic groupings, at least in a subset of languages of the world.

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[1]One further issue in Vogel's approach is that although recursivity is forbidden, one can skip levels. For example, a prefix need not be a foot, clitic or a word, but may attach directly to the prefixed word.

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