

Recursion in phonology

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Abstract

This paper investigates phonological recursion by means of early accent placement (stress shift), which marks the initial boundary of a phonological phrase. The question is whether or not this early pitch accent placement can be applied recursively to phonological phrases that are embedded in larger phonological phrases. This was investigated in a map task experiment, with various Dutch phonological phrases as landmarks drawn on the map. The target phrases consisted of a noun modified by either one adjective, of the type *aardrijkskundig genóotschap* ‘geographical society’, or by two adjectives, of the type *Amsterdams aardrijkskundig genóotschap*, i.e. syntactically recursive noun phrases. An early pitch accent was realized on both the first and the second adjective in 30% of the spoken syntactically recursive phrases: e.g. *Amsterdams aardrijkskundig genóotschap*. These prosodically recursive structures indicate that recursion may apply in phonology, as it does in syntax.

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1. Introduction

Recursion has been claimed to be the only uniquely human component of the faculty of language (Hauser et al., 2002). Animal communication systems allegedly lack this rich expressive and open-ended power of human language that enables us to acquire a complex natural language on the basis of limited data.¹

A subject of considerable debate in linguistics is that a mismatch seems to exist between syntactic structure and phonological structure. Syntactic phrases display recursivity, whereas it is questionable whether recursivity plays a role in phonology (cf. Selkirk, 1984). In this paper evidence will be given for the idea that phonology does exhibit regular context-free recursive structures as well. We conducted an experiment in order to study an instance of phrasal structure. The question is whether edge-marking processes, such as early pitch accent placement, can be applied

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¹ This statement is rather controversial. In fact Hauser et al. tone down their statement by suggesting that it is possible that other animals may develop the same abilities, if recursion in humans evolved from the same cognitive capacity that is also used to solve other computational problems, such as navigation (p. 1578).

recursively to phonological phrases. We show that recursion in phonological phrases should be admitted in the prosodic hierarchy.

In section 2 we discuss recursion in linguistics and in section 3 we wonder whether recursion occurs in phonological phrases. In section 4 we discuss the design, methodology and results of an experiment in which we show that prosodic recursion does indeed exist. The discussion of the results follows in section 5.

2. Strict layering and recursion

In syntax recursion refers to rules which are capable of repeated application in generating a sentence. The number of prepositional phrases that may occur after a noun in a noun phrase is in principle unlimited: *the American in the desert on a horse with no name*, in which *with no name* is a PP embedded in the PP *on a horse*, and you can always add a sentence to a sentence within a sentence as exemplified by the present sentence.

In phonology, things seem to be different. Although iterative rule application has been proposed for foot assignment, prosodic building rules seem to be limited in that sense. For example, one cannot freely add onsets or nuclei to a syllable, nor syllables to a prosodic word. The limitations to the prosodic hierarchy are reflected in the Strict Layer Hypothesis (Selkirk, 1984), of which one of the fundamental assumptions is that prosodic structure is not recursive. A mismatch thus exists between syntactically recursive constituent structure and the linearly segmented structure in prosody.

Several phonologists, however, show that in many cases the Strict Layer Hypothesis is violable (e.g. Itô and Mester, 1992). The assumption of non-recursivity has been challenged by a number of authors, in particular with regard to prosodic words with affixal clitics (Booij, 1996; Vigário, 1999; Zec and Inkelas, 1991 among others). Vigário, for example, represents prefixed words in European Portuguese as a prosodic word within a prosodic word. In this language word-internal vowels can be reduced, word-initial vowels cannot. Although the <o> in *desocupar* ‘disoccupy’ seems to be a word-internal vowel, it actually fails to undergo vowel reduction, because it is still the initial vowel of a prosodic word. This can only be explained if recursion is allowed in the prosodic hierarchy.

Examples of recursion in larger prosodic domains like the Intonational Phrase (IP) can be found in Ladd (1986, 1996). The Intonational Phrase is the domain of a perceptually coherent intonational contour (Shattuck-Hufnagel and Turk, 1996). These Intonational Phrases are dominated by the Utterance (Utt), the largest span of application of phonological rules (Hayes, 1989; Nespor and Vogel, 1986; Selkirk, 1978, 1980).

Ladd (1986, 1996) represents different kinds of conjunction as in Fig. 1. Phonetic differences such as pause-duration cues and resetting of the declination slope motivate the division into three Intonational Phrases; of these, the *but*-boundaries are phonetically stronger than the *and*-boundaries, i.e. there is a longer pause and a higher F0 reset in case of *but*-boundaries (Ladd, 1996:242). The difference in phonetic strength is represented as a difference in embedding in Fig. 1: The conjunction marked by *and* is less deep than the conjunction marked by *but*, which is visualized by different levels of embedding. Without recursion, we cannot explain the phonetic differences between the two kinds of conjunction. The following sentence, which has the structure of Fig. 1a, exemplifies these different conjunctions: *Aretha Franklin is a soulful singer, and Carole King is an excellent composer, but Florence Foster Jenkins amuses us the most.*

Similar arguments to the ones above can be found in Inkelas (1989), Ladd (1992) and McCarthy and Prince (1993a,b). These arguments led Selkirk (1995b) to replace the Strict Layer Hypothesis with a series of four separate

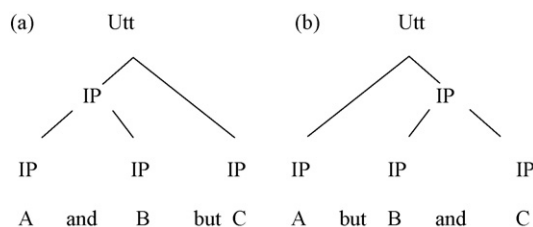


Fig. 1. Recursive Intonational Phrase (Ladd, 1986, 1996).

constraints, one of which is non-recursivity, which is a violable constraint in terms of standard Optimality Theory (Prince and Smolensky, 1993/2004).

Since recursion is very common in syntax, the primary source of evidence for instances of recursion in phonology is probably provided by phonological rules that operate over (morpho-)syntactically defined recursive domains. The phonological phrase is one instance of a domain of which the phrase breaks typically coincide with the edges of morphosyntactic phrases (Nespor and Vogel, 1986; Selkirk, 1984). Nespor and Vogel (1986), for example, provide examples of the phonological domains on English, Italian and Dutch among other languages. The proposed phonological domains are supposed to be universal.

Although there is no consensus on what exactly constitutes the phonological phrase, we follow Selkirk (1995b), who assumes that the phonological phrase aligns with a syntactic boundary, namely the left or the right edge of the head of a maximal projection which is not lexically governed, i.e. it groups a phrasal head together with its adjacent modifiers and functional elements.

3. Research question

The main question in the present paper is whether recursion can be found at higher domains in the prosodic hierarchy, above the word level. To investigate this, we examine Dutch phonological phrases, consisting of a noun modified by either one preceding adjective, of the type *aardrijkskundig genóotschap* ‘geographical society’, or by two preceding adjectives, of the type *Amsterdams aardrijkskundig genóotschap*, i.e. a recursive noun phrase (the accents on the adjectives indicate the main-stress position in the citation form of each word). Syntactically, this kind of phrase can in principle be infinitely extended with adjectives: [*onafhankelijk* [*Amsterdams* [*aardrijkskundig genótschap*]_{NP}]_{NP}]_{NP} ‘independent Amsterdam geographical society’ (lexically stressed as *onafhankelijk Amsterdams aardrijkskundig genótschap*).

The phonological phrase *aardrijkskundig genótschap* can also be realized with a stressed initial syllable: *àardrijkskundig genótschap*. This phenomenon has been described in various ways in the literature. For English, it is referred to as stress shift (Liberman and Prince, 1977), the English Rhythm Rule (Liberman and Prince, 1977), or the Phrasal Rule (Hayes, 1984; Shattuck-Hufnagel et al., 1994; Shattuck-Hufnagel, 2000). Shattuck-Hufnagel et al. (1994) and Shattuck-Hufnagel (2000) claim that these phrases display early pitch accent placement as a means to indicate a phrasal boundary to the listener. The phenomenon seems to be universal, at least for stress-timed languages. Van Zonneveld (1983) and Visch (1989) claim that the Phrasal Rule is often applied in Dutch phrases, resulting in what they call ‘Rhythmic Hammock’ patterns in which both domain edges are stressed.

Horne (1990), Gussenhoven (1991, 2005), Grabe and Warren (1995) and Vogel et al. (1995) provide an alternative explanation of this boundary marking phenomenon which is not based on stress shift: They propose that the phenomenon is not shift of lexical main stress, but an effect of the non-occurrence of a pitch accent on the later lexical main-stress syllable of the adjective. Irrespective of whether the phenomenon can be analyzed as shift, placement or deletion of stress or accent, the result is always a phonological domain with marked edges. In this paper, we will use the term ‘early pitch accent’, because this term indicates that the domain starts with a prosodically marked left edge.

The question here is which prosodic structure has to be assumed for the syntactically recursive noun phrase, i.e. if the noun is modified by two or more preceding adjectives. If the non-recursivity assumption holds and these phrases are non-recursive, then they must have a flat, linear structure, and hence no early accent will occur on the intermediate adjectives: [*onafhankelijk Amsterdams aardrijkskundig genótschap*], as depicted in Fig. 2.

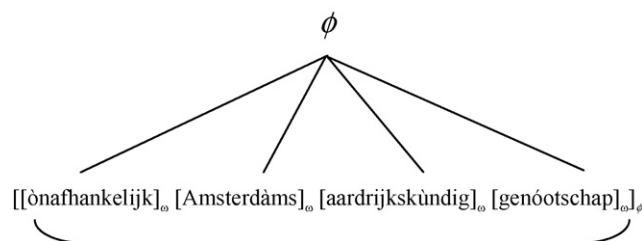


Fig. 2. Non-recursive phonological phrase.

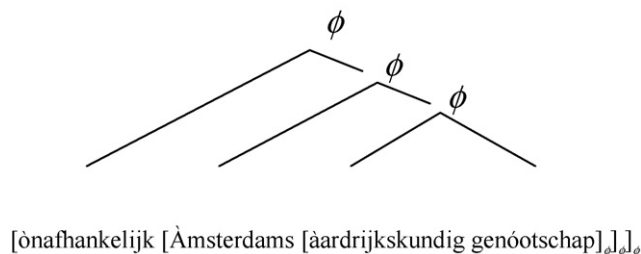


Fig. 3. Recursive phonological phrase.

If, on the other hand, an early accent can be realized on these intermediate adjectives, we have to assume a nested, recursive phrase structure, indicating two or more left domain boundaries, i.e. a nested prosodic structure: [ònafhankelijk [Àmsterdams [àardrijkskundig genóotschap]]], as shown in Fig. 3.²

To investigate whether these kinds of phonological phrases can indeed be produced with a recursive prosodic structure, with early accent placement applying two or more times, we conducted an experiment, which is described in the next section.

4. The experiment

4.1. Task design

In order to get as close to spontaneous speech as possible, we used the Map Task (Brown et al., 1984) to build our speech corpus in a controlled way. We adapted the original design somewhat to our own requirements. The participant and the experimenter sat opposite one another, the participant sat in a soundproof studio behind a glass window, and each had a map which the other could not see. The participant had a map on which six landmarks were given, labeled with their names. Of these landmarks, one was the starting point and one was the endpoint. The phrases of interest were two of the four intermediate landmarks. The other two were fillers in which stress shift was impossible, e.g. *Winkelcentrum Zuid* ‘South Mall’. The position of the phrases of interest varied among maps. The experimenter’s map only had the starting point drawn on it, which makes the experiment more or less ‘double blind’. We made 50 different maps, with two phrases of interest on each map, which makes a 100 phrases in total. Each map contained one syntactically recursive phrase landmark [Adj [Adj Noun]] and one non-recursive, phrase landmark [Adj Noun]. We ensured that a participant only saw one of the two members of a pair of recursive or non-recursive phrases, e.g. either *Amsterdams aardrijkskundig genootschap* or *aardrijkskundig genootschap*.

4.2. Participants

Twenty-four volunteers (10 men and 14 women, aged 19–28) participated in this study. Most of them were law students, with Dutch as their mother tongue. Ten participants were brought up in the northern provinces of the Netherlands, nine of them came from the center, three from the west and two from the south. One participant had grown up in the Netherlands Antilles, and Dutch was not her mother tongue, though she learned it in her childhood. We found no differences in the characteristics of interest, so her data were kept in the experiment. We did not find any regional influences on the results either. The participants were informed that this was a map reading experiment, and hence they were unaware of the linguistic nature of the study. After the map reading task, however, participants were debriefed and informed about this linguistic research focus.

² Selkirk (1995a) herself gives some examples of a similar kind in English: [[nòrthern][Càlifornia wínes]] as opposed to the right-branching phrase [[nòrthern Calìfòrnia] wínes], but without going into its recursivity. We hypothesize that these syntactically recursive noun phrases can be realized as recursive phrases in prosody as well (Schreuder, 2006). Gussenhoven (2005) provides a phonological analysis of this kind of phonological phrasing.

4.3. Method

The participants were told that their goal was to lead the experimenter from point A to point B on the map, leading past all landmarks on the map, and they were supposed to mention all the landmarks they came across. The experimenter did not interfere. After the map reading task and subsequent debriefing (during which the linguistic purpose of the experiment was revealed), they were asked to read the adjectives aloud in citation form, in the carrier sentence *Ik spreek nu het woord. . . uit* ‘I now pronounce the word. . .’.

All data were recorded with a Sennheiser MKH 40 Microphone (mono), on a Sony DTC-57ES DAT-recorder, using Fuji Digital Audio Tapes. The sound files were then re-digitized using Cool Edit Pro at 22,050 Hz sampling rate and 16 bits resolution, normalized to 100%, and saved as uncompressed PCM files. The phrases of interest were extracted from the sound materials; the same procedure was used for the citation form words.

For the (auditory) analysis five trained listeners judged the data auditorily and indicated on which syllables in the adjectives they perceived word accent. They were free to indicate more than one accent per adjective if they could not make up their mind on the place of the main stress, which meant that words could be double accented in their reports. We will regard these as early accented, because double accented implies that an accent on the first syllable is observed. We regarded a majority judgment of the five trained listeners as decisive for the place of the accent. The data were analyzed by means of logistic regression (Hosmer and Lemeshow, 2000) combined with bootstrap validation (Shao and Tu, 1995), as will be explained in section 4.5.

4.4. Stimuli

The stimuli consisted of 100 phonological phrases, half of which were [Adjective Noun] combinations and the other half corresponding [Adjective [Adjective Noun]] combinations. Table 1 shows a selection of our stimuli. The full set of stimuli is given in Appendix A.

Table 1 shows two kinds of stimuli. In the first type (33 phrases), the first adjective of the syntactically recursive phrase can have a variable accent pattern, as exemplified in Table 1a–e, e.g. *Amsterdams*, which can be accented on the first or the last syllable. The second type (17 phrases) has a first adjective with a fixed early accent position, as exemplified in Table 1f–h, e.g. *tijdelijk*, which can only have an accent on the first syllable. In Appendix A these stimuli are marked as ‘vac’ in order to indicate that stress shift is vacuous in these adjectives. In all 50 phrases, however, the second adjective has a variable accent pattern and therefore all phrases can be analyzed with respect to recursive prosody.

In order to minimize the influence of purely regular rhythm effects, for example eurhythmicity effects of the Quadrisyllabic Rule (Hayes, 1984), we tried to avoid rhythmic similarity in the stimuli. Therefore, we varied the distance between the accentable positions in the words from 1 syllable (as in the lexical pattern in *monumentaal k n stwerk* ‘monumental piece of art’) to 7 syllables (as in the shifted pattern in * penbare bibliotheek* ‘public library’).

We tried to minimize stress clash effects, such as the clash in *monumentaal k n stwerk* of which just 5 phrases appeared in our stimulus set (see Appendix A). Furthermore, we minimized contrast effects of phrases ending in a similar suffix (*aardrijkskundig* versus *tandheerkundig*) or contrasting phrases on one map (*Amsterdams* versus *Rotterdams*).

The participants were divided over 5 different map sets, so each participant read 10 maps, which means 10 recursive and 10 non-recursive phrases for each participant. This resulted in about 550 spoken phrases in total. An

Table 1
Stimulus examples with lexical stress.

a	<i>amsterd�ms aardrijksk�ndig gen�otschap</i>	‘Amsterdam geographical society’
b	<i>internationale diplomatieke organisaties</i>	‘international diplomatic organizations’
c	<i>algemene regionale dagbladers</i>	‘general regional daily press’
d	<i>progressieve socialistische partij</i>	‘progressive socialist party’
e	<i>academisch psychiatrisch ziekenhuis</i>	‘university psychiatric hospital’
f	<i>tijdelijk universitair g�sthuis</i>	‘temporary university guest house’
g	<i>nederlandse centrale bank</i>	‘Dutch central bank’
h	<i>noordelijk antropologisch museum</i>	‘northern anthropological museum’

Table 2

Numbers of observed realizations of different accent structures for the syntactically recursive NPs.

	Bracket and accent alignment	Observed	%
1	e.g., [amsterdàms aardrijkskùndig genóotschap]	106	46
2	e.g., [àmsterdams aardrijkskùndig genóotschap]	56	24
3	e.g., [àmsterdams [àardrijkskundig genóotschap]]	70	30

impressionistic observation reveals that the participants mostly pronounced the names of the landmarks in focus, and most of the times it was before a ‘comma’ pause, pronounced with a so-called continuation rise in the intonation (L–H%), or before a ‘full stop’ pause, with the so-called declarative intonation (L–L%) (Pierrehumbert, 1980; Gussenhoven et al., 1999). We recorded a total number of 573 spoken target phrases, of which 307 were of the syntactically non-recursive type and 266 were of the syntactically recursive type. However, some participants occasionally repeated the phrases. The repetition was then most of the time out of focus and sometimes produced with a different rhythmic pattern. Others unfortunately missed some of the phrases. In section 4.5 we only report on first realizations that were not repeated. Omitting all repeated spoken realizations, we ended up with 241 syntactically recursive utterances for analysis.

4.5. Results

Table 2 shows the percentages of pitch accents perceived on the early syllable and on the main-stress position of the adjectives of 232 of our 241 syntactically recursive utterances, as based on the numbers given in Appendix A.³

Realizations indicated as 1 and 2 in Table 2 both have a non-recursive prosody (70%), while example 3 shows the recursive pattern (30%). There is a strong preference for the participants only to accent the main-stress syllable. However, adjectives that are not the initial words of the longer phonological phrases, still receive an early accent in 30% of the phrases. This result seems to confirm our hypothesis that these syntactically recursive phrases are also recursive prosodically.

Our auditory analysis revealed that some of the participants often produced early accents, whereas others rarely did. Furthermore, some phrases of the stimuli were never produced with early accents, whereas other phrases always were. Closer inspection did not reveal any systematic characteristic among these phrases that could account for this observation. It does not appear to be a rhythmic phenomenon: The number of syllables between accentable syllables in a phrase does not influence the propensity of early pitch accents on that phrase. Gussenhoven (1983), on the other hand, finds that if one of the interstress intervals contains a low number of syllables, the propensity for early accent placement increases.

Perceived stress patterns were analyzed by means of a two-stage bootstrap validation technique. This amounts to a logistic regression of the percentage of early accented responses (Hosmer and Lemeshow, 2000). The random variation over items was taken into account by first drawing a random sample of items, and then a random sample of responses corresponding to the selected items (following Shao and Tu, 1995:247; see Nooteboom and Quené, 2008). The resulting data set was then analyzed by means of logistic regression, with the intercept (i.e. mean) as the only predictor. This bootstrap-and-regression procedure was repeated 250 times. The variation in these 250 estimated coefficients reflects the between-item variability in propensity of early accent. The average percentage of early accents in the bootstrap validation was indeed 30%, with an associated 95% confidence interval spanning from 19% to 42%. In conclusion, listeners did perceive prosodic recursion in a substantial proportion of all realizations.

5. Discussion

The prosodic structure of the phonological phrase is less linear than assumed in proposals like the Strict Layer Hypothesis, which claim that each phonological phrase has to be part of a higher domain, an Intonational Phrase. Strict

³ One accent pattern, *amsterdàms [àardrijkskundig genóotschap]*, was observed in nine realizations. From a linguistic point of view this is an unexpected structure, because the first adjective is unparsed in the phrase structure, and the rhythm pattern exhibits a stress clash. These nine items constitute just a small percentage of all realizations and it constitutes 6% of the first type of phrases in Table 1(a–e). We left them out, because we cannot compare this number of nine observations to the complete set of data (241), since the complete set also includes the second type of phrases (Table 1(f–h)), in which the first adjective has a fixed accent pattern with an accented early syllable: *tijdelijk universitàir gásthuis*.

layering is claimed to be satisfied if and only if a domain contains one or more direct subdomains without unparsed parts. However, our experiment revealed that a phonological phrase can indeed be part of another phonological phrase. Just like the edge of the maximal phrase, the edge of an embedded phrase can be marked with an early pitch accent. If the phonological phrase would be non-recursive, then the attested early accent placements in the embedded phrases could no longer be regarded as the result of a domain edge-marking process, because if there is no separate, embedded domain, then there can be no embedded domain edges either.

In about one-third of the relevant cases (cf. Table 2), both adjectives in a syntactically recursive noun phrase are perceived as having an early accent, and therefore it is reasonable to assume that the phonological phrases may be prosodically recursive as well. Consequently, phonology has no exceptional position in linguistics with respect to recursion.

6. Conclusion

In this paper we provided evidence for the existence of recursion in phonology on the basis of auditory analyses. The occurrence of ‘double’ early pitch accent placement on both adjectives in the target phrase shows that boundary marking of the phonological phrase is not restricted to maximal projections of that domain. Moreover, the results of our experiment show that early pitch accent placement is indeed perceived in embedded phonological phrases as well, although maximal phonological phrases are early accented significantly more often. The optionality of boundary marking of the embedded phrase shows once more that there is no one-to-one mapping from syntax to prosody.

Acknowledgements

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Appendix A. all stimuli

Lexical accent:	e.g. [amsterdàms aardrijkskùndig genóotschap]
Early accent, non-recursive	e.g. [àmsterdams aardrijkskùndig genóotschap]
Recursive:	e.g. [àmsterdams [àardrijkskundig genóotschap]]

Stimuli are marked as ‘vac’ if stress shift is vacuous in their first adjective.

Stimuli (with lexical accent)				Lexical accent	Early accent non-recursive	Recursive
1	<i>amsterdàms</i> ‘amsterdam	<i>aardrijkskùndig</i> geographical	<i>genóotschap</i> society’	0	4	3
2	<i>fiscàle</i> ‘fiscal	<i>financiële</i> financial	<i>hùlpgroep</i> aid team’	6	0	1
3	<i>algemène</i> ‘general	<i>regionàle</i> regional	<i>dágbladpers</i> daily press’	0	1	6
4	<i>progressieve</i> ‘progressive	<i>socialistische</i> socialist	<i>partíj</i> party’	1	6	0
5	<i>amsterdàms</i> ‘amsterdam	<i>monumentàl</i> monumental	<i>kúnstwerk</i> work of art’	0	4	3
6	<i>eigenzinnige</i> ‘self-willed	<i>commerciële</i> commercial	<i>ómroep</i> broadcasting organization’	4	2	1
7	<i>nòordelijk</i> ‘northern	<i>antropològisch</i> anthropological	<i>muséum</i> museum’	7	0 (vac)	0
8	<i>vrijgemaakte</i> ‘orthodox	<i>reformatòrische</i> reformed	<i>kérk</i> church’	5	0 (vac)	1
9	<i>làndelijke</i> ‘national	<i>algemène</i> public accounts	<i>rékenkamer</i> accounts committee	0	0 (vac)	7

10	<i>beveiligde</i> 'protected	<i>amerikaanse</i> American	<i>ambassade</i> 'embassy'	6	0 (vac)	1
11	<i>algemene</i> 'general	<i>tandheelkundige</i> dental	<i>praktijk</i> 'practice'	0	1	6
12	<i>christelijke</i> 'christean	<i>europese</i> European	<i>partij</i> 'party'	6	0 (vac)	0
13	<i>groningse</i> ' groningen	<i>openbare</i> public	<i>bibliotheek</i> 'library'	4	0 (vac)	3
14	<i>middelbare</i> 'secondary	<i>bibliothecaire</i> librarian	<i>opleiding</i> 'school'	0	6	1
15	<i>regionale</i> 'regional	<i>openbare</i> public	<i>basisschool</i> 'primary school'	1	0	6
16	<i>amsterdamse</i> 'amsterdam	<i>communistische</i> communist	<i>boekhandel</i> 'book shop'	3	4	0
17	<i>nederlands</i> 'dutch	<i>republikeins</i> republican	<i>genootschap</i> 'society'	6	0 (vac)	1
18	<i>west-europese</i> 'west european	<i>militaire</i> military	<i>academie</i> 'academy'	0	6	1
19	<i>algemene</i> 'general	<i>theologische</i> theological	<i>vereniging</i> 'society'	0	6	1
20	<i>sportieve</i> 'sport-loving	<i>recreatieve</i> recreational	<i>buurtvereniging</i> 'neighborhood association'	5	0	2
21	<i>universitair</i> 'university	<i>geologisch</i> geological	<i>instituut</i> 'institute'	1	0	0
22	<i>katholieke</i> 'catholic	<i>oratorische</i> oratorical	<i>zangvereniging</i> 'choral society'	1	2	0
23	<i>tijdelijk</i> 'temporary	<i>universitair</i> university	<i>gasthuis</i> 'guest house'	2	0 (vac)	0
24	<i>regionaal</i> 'regional	<i>democratisch</i> democratic	<i>dagblad</i> 'daily press'	2	1	0
25	<i>openbaar</i> 'public	<i>cultureel</i> cultural	<i>centrum</i> 'centre'	0	1	1
26	<i>ondersteunend</i> 'supporting	<i>politiek</i> political	<i>centrum</i> 'centre'	2	2	0
27	<i>oost-europese</i> 'east european	<i>culinaire</i> culinary	<i>groothandel</i> 'wholesale trade'	0	0	0
28	<i>oude</i> 'old	<i>rotterdamse</i> rotterdam	<i>haven</i> 'harbour'	0	0 (vac)	4
29	<i>speciale</i> 'special	<i>pedagogische</i> training college for primary schoolteachers'	<i>academie</i> 'primary schoolteachers'	2	0	0
30	<i>brabantse</i> 'brabant	<i>katholieke</i> catholic	<i>kerk</i> 'church'	0	0 (vac)	4
31	<i>sociale</i> 'social	<i>economische</i> economical	<i>dienst</i> 'service'	3	0	0
32	<i>academisch</i> 'university	<i>psychiatrisch</i> psychiatric	<i>ziekenhuis</i> 'hospital'	1	0	3
33	<i>verenigde</i> 'united	<i>wetenschappelijke</i> scientific	<i>persseenheid</i> 'press unit'	1	0 (vac)	3
34	<i>nederlands</i> 'dutch	<i>financiële</i> financial	<i>persbureau</i> 'press agency'	3	0 (vac)	1

35	<i>algemène</i> 'general	<i>sociològische</i> social science	<i>opleidingen</i> training colleges'	2	3	0
36	<i>nòordelijk</i> 'northern	<i>filharmònisch</i> philharmonic	<i>orkést</i> orchestra'	3	0 (vac)	1
37	<i>speciële</i> 'special	<i>mobiele</i> mobile	<i>éénheid</i> unit'	4	0	0
38	<i>nèderlandse</i> 'dutch	<i>centrale</i> central	<i>báńk</i> bank'	4	0 (vac)	0
39	<i>publieke</i> 'public	<i>nationàle</i> national	<i>réchtbank</i> tribunal'	1	0	3
40	<i>gerèchtelijk</i> 'judicial	<i>openbàar</i> public	<i>ministérie</i> prosecution service'	2	0 (vac)	1
41	<i>alternatief</i> 'alternative	<i>europèes</i> european	<i>parlemént</i> parliament'	2	0	0
42	<i>nijmeegse</i> 'nijmegen	<i>islamitische</i> Islamic	<i>básisschool</i> primary school'	3	0 (vac)	1
43	<i>cognitieve</i> 'cognitive	<i>psychològische</i> psychology	<i>facultéit</i> faculty'	1	1	0
44	<i>randstèdelijk</i> interurban	<i>geriàtrisch</i> geriatrics	<i>céntrum</i> centre'	3	1	0
45	<i>progressief</i> 'progressive	<i>individualistisch</i> individual	<i>verbóńd</i> alliance	2	0	0
46	<i>oud-hollands</i> 'old dutch	<i>traditioneel</i> traditional	<i>theáter</i> theatre'	0	3	1
47	<i>voormàlige</i> 'former(ly)	<i>koloniàle</i> colonial	<i>bibliothéek</i> library'	2	0	0
48	<i>onafhàńkelijke</i> 'independent	<i>particuliere</i> private	<i>verzékeringsmaatschappij</i> insurance company'	1	2	1
49	<i>internationàle</i> 'international	<i>diplomàtieke</i> diplomatic	<i>organisáties</i> organizations'	1	0	1
50	<i>sàmenwerkende</i> 'cooperative	<i>humanitàire</i> humanitarian	<i>húlporganisaties</i> charities'	3	0 (vac)	1
Total				106	56	70

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