Abstract
This paper investigates the prosodic structure of weak (stressless) function words in Persian within the framework of Prosodic Phonology. Weak function words in Persian are prosodic clitics that form phrases with the material following them (proclitics) or preceding them (enclitics). So far, only the prosody of enclitics has been studied in the literature. The present study proposes that, in Persian, enclitics are affixal clitics, while proclitics are free clitics. These proposals contribute to the findings in Prosodic Phonology that prosodic categories can in fact be recursive and non-exhaustive.

Keywords: Persian, stress, prosodic structure, function words, recursivity, exhaustivity

1. Introduction
Following the standard prosodic distinction between lexical and function words set forth in Selkirk (1995) and subsequent work, we assume that morpho-syntactic words in Persian can be divided into two groups. The first group consists of words which can have stress, and since most of these belong to the category of lexical or content words, following the literature, we refer to them as lexical (lex) words. The second group comprises weak function words (fnc) which are always stressless, except when focused or used metalinguistically. In Persian, demonstrative and personal pronouns such as un ‘that, he/she’ or to ‘you’, although being semantically function words, are stressed and thus belong to the first group.

Weak function words are prosodic clitics; i.e., they combine with other material into a single prosodic unit rather than being autonomous units themselves (Anderson 2005: 42). In this sense, Persian has both enclitics and proclitics. This study proposes that, in Persian, enclitics are affixal clitics, while proclitics are free clitics. Following the definitions in Selkirk (1995), in affixal clitics the lexical host comprises its own prosodic word, and the clitic is adjoined to the host in a recursive structure. Free clitics on the other hand are incorporated directly into the phonological phrase, as a sister of the prosodic word containing the lexical word, in a non-exhaustive structure.

Some of the most frequently used enclitics in Persian are the indefinite article and relative particle -i, the direct object particles -o and -râ, the conjunction -o, the Ezafe particle -e, the verbal copula -e, the particle meaning ‘also, even’ -am / -ham, pronoun suffixes such as -et ‘your’, and personal agreement suffixes when attached to past tense verbs. Some examples of proclitics are class1 (true) prepositions; class2a prepositions, which are proclitics only when used without Ezafe linker (Pantcheva 2006: 1); the conjunctions va and yâ; and the particle ke in some of its usages.

The phonological theory applied in this study is known as Prosodic Phonology, Phrasal Phonology or Prosodic Hierarchy Theory, and is based on the work of such
researchers as Selkirk (1978, 1981, 1995, 2011), Nespor and Vogel (1986), Ito and Mester (2009) among others. The main idea of Prosodic Phonology, as shown in (1), is that utterances are phrased in prosodic constituents which are themselves organized into a hierarchy.

(1) Intonational Phrase (IPhrase) \( \uparrow \)
Phonological Phrase (PPhrase) \( \varphi \)
Prosodic Word (PWord) \( \wedge \)
Foot \( \pi \)
Syllable \( \sigma \)

2. Background
The prosodic structure of proclitics in Persian has not been specifically explored in previous literature, though there are a number of works that study enclitics. In this section we briefly present Amini (1997), Kahnemuyipour (2003), and two other approaches, and point out their theoretical and empirical problems.

2.1. Amini (1997)
Amini proposes for Persian enclitics a non-recursive exhaustively parsed structure in which enclitics form a single Phonological Word (PWord) with their hosts. She then explains the lack of stress of these enclitics using Extrametricality Theory. The examples in (2) demonstrate Amini’s approach. The last syllable in (2i) and the last two ones in (2ii) are considered extrametrical.

(2) i. ketâb -i \( \rightarrow \) ke.tâ <bi>
book IND ‘a book’

ii. ketâb -ešun \( \rightarrow \) ke.tâ <be.šun>
book POSS3pl ‘their book’

Firstly, Amini’s OT analysis lacks an active constraint which triggers extrametricality in cliticized words exclusively. More importantly, according to Hayes (1995: 57) only constituents (segment, syllable, foot, phonological word, etc.) may be marked as extrametrical, but in Persian, we frequently encounter cases in which more than one enclitic is attached to a host resulting in a clitic cluster. In most cases, such clusters, which are considered to be “extrametrical” in Amini’s analysis, do not form a constituent in either a prosodic or morphological sense. Example (3) illustrates such cases:

(3) i. ketâb -ešun -am \( \rightarrow \) *ke.tâ <be.šu.nam>
book POSS3pl too ‘their book too’

ii. ketâb -etun -o \( \rightarrow \) *ke.tâ <be.tu.no>
book POSS2pl ACC ‘your book-ACC’
If we assume with Amini (1997) that stresslessness of enclitics in Persian is due to extrametricality, then the entire strings within < > in example (3) must be considered as extrametrical constituents. However, these strings are not a single prosodic or morphological constituent, and thus cannot be subject to extrametricality. Note that in cases like (3) an approach assuming a cyclic process in which each morpheme is marked as extrametrical in a different cycle is also unacceptable, because the extrametricality rule/constraint has access only to the final constituent of a prosodic category.

In sum, explaining the lack of stress on Persian enclitics by extrametricality is problematic, since it fails to account for a wide range of cases. Therefore, it is impossible to take enclitics and their hosts as a single non-branching PWord as suggested in Amini (1997).


In this comprehensive study, prosodic parsing is exhaustive in all levels and no recursive structure is allowed. All morpho-syntactic words including weak function words such as enclitics form their own PWords, and due to the phrasal stress rule, the leftmost PWord in the phonological phrase (PPhrase) takes stress. The reason enclitics never receive stress is that these functional morphemes happen to follow lexical words, and the phrasal stress rule puts the stress on the leftmost lexical word: 

\((\text{ketáb})_{\omega}(\text{t})_{\omega})\) ‘a book’.

As discussed in the literature (Selkirk 1995; Anderson 2005; Ito and Mester 2009) weak (stressless) function words cannot constitute PWords by themselves, and essentially tend to phrase with their adjacent lexical words. So theoretically it is inappropriate to take Persian enclitics as autonomous PWords in the absence of any phonological or phonetic evidence.

Taking Persian function words as independent PWords also suffers from a major empirical problem. Kahnemuyipour (2003) does not deal with proclitics, but if all morpho-syntactic words, including enclitics, can constitute PWords, then proclitics such as class1 prepositions should also have the right to form PWords on their own. However, in the case of most proclitics, this analysis will wrongly predict the PPhrase stress on the phrase-initial proclitic as shown in (4).

\[(4) \text{i. } [\text{az Tehrán}]_{\text{PP}} \rightarrow *(((\text{áz})_{\omega}(\text{Tehrân})_{\omega})_{\phi})\]

from Tehran

\[
\text{ii. } [\text{be un xune}]_{\text{PP}} \rightarrow *(((\text{bé})_{\omega}(\text{un})_{\omega}(\text{xune})_{\omega})_{\phi})
\]

to that house

In brief, treating weak function words in Persian as independent PWords encounters theoretical and empirical problems and should therefore be avoided.

2.3. Other Proposals

Clitic Group (CG) and Accentual Phrase (AP) categories have also been proposed for Persian. Both CG and AP are composed of a lexical word and its enclitics. One
major problem with these approaches is that they do not take proclitics into consideration, and thus fail to account for the asymmetry between proclitics and enclitics. More importantly, the necessity of such additional and non-universal categories as AP and CG has been questioned and rejected frequently in the literature (Selkirk 1995, 2011; Anderson 2005; Ito and Mester 2009; Féry 2010). As pointed out in Ito and Mester (2009: 168), Occam’s razor militates against any additional category such as Clitic Group, as long as the existing ones are sufficient to represent the prosodic phrasings.

3. Discussions and proposals
This section examines the prosodization of Persian function words, using phonetic and phonological evidence.

3.1. Proclitics
As Selkirk (1995) points out, for any given host-plus-clitic combination, irrespective of their order, there are essentially four formal possibilities. These four possibilities are illustrated for proclitics in (5).

(5)

(a) \(\varphi\) 
\(\omega\) 
\(\text{fnc}\) 
\(\text{lex}\) 
Amalgamated fnc internal clitic

(b) \(\varphi\) 
\(\omega\) 
\(\text{fnc}\) 
\(\text{lex}\) 
Full-\(\omega\) fnc PWord clitic

(c) \(\varphi\) 
\(\varphi\) 
\(\omega\) 
\(\text{fnc}\) 
\(\text{lex}\) \(\varphi\)-attached fnc free clitic

(d) \(\varphi\) 
\(\omega\) 
\(\text{fnc}\) 
\(\text{lex}\) \(\omega\)-joined fnc affixal clitic

A crucial point in (5) is that the proclitic fnc is \(\omega\)-initial (in the initial position of a PWord) in (a), (b), and (d), but not in (c). The fnc in (c) is the only one which is not parsed into \(\omega\), and is immediately dominated by the \(\varphi\) (PPhrase) node, although in all four structures the proclitic fnc is \(\varphi\)-initial.

Selkirk (1995) reports that the initial position in a PWord is often associated with effects involving the phonetic realization of segments. In English, for example, a word-initial voiceless stop is aspirated, even when the syllable to which it belongs is stressless.

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1 For a detailed discussion of AP see Sadat Tehrani (2007), and for CG, refer to Abolhasanizadeh, Gussenhoven and Bijankhan (2012).
Cooper (1991, 1994), as cited in Selkirk (1995), shows that there is a distinct word-initial aspiration effect which cannot be reduced to a simple syllable-initial effect. Prosodic structure theory takes such “word-initial” effects to be PWord-initial effects.

Aspiration in Persian is studied in Samare (1985: 27) according to which all voiceless stops are aspirated, but the degree of aspiration depends on the position of the stop. In the onset position of stressed syllables and word initially, stops are more aspirated. For example /p/ in parváz ‘flight’ and sepáh ‘army’ are more aspirated than in sepáye ‘tripod’. If we accept the claim in Samare (1985), then it becomes clear that Persian is similar to English in having a word-initial aspiration effect.

Therefore, if we can demonstrate that proclitic-initial stops are significantly less aspirated than word-initial stops, then we can claim that proclitics are not located in the initial position of a PWord, and this will support the structure in (5c).

An experiment was conducted to compare the degree of aspiration between proclitic-initial stops and word-initial stops.

3.1.1. PWord-initial aspiration, an experiment

In an experiment, the Persian class 1 preposition tā and class 2a preposition tu were used in two sentences before polysyllabic nouns starting with the syllables /ta-/ and /tu-/, in non-ι-initial positions.

Six Persian native speakers read each of the two sentences (6) and (7) twice, and the utterances were recorded at a sampling frequency of 44,100 Hz and analysed using the phonetics software Praat.

(6) dišab tu tunél tasádóf kard-am
    last night in tunnel accident do.PAST-1SG
    ‘I had an accident in the tunnel last night.’

(7) behruz tā tābestún kár kard-Ø
    Behruz until summer work do.PAST-3SG
    ‘Behruz worked till summer.’

The Voice Onset Time (VOT) in proclitics and word-initial syllables was measured and the mean values and standard deviations were calculated. A paired Student’s t-test was conducted to determine the significance of differences between VOT values in the two positions. The significance threshold of the t-test was 0.01, the degree of freedom being the number of participants minus one. Table 1 presents a summary of the statistical analyses.

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<td>(word-initial)</td>
<td>(proclitic)</td>
<td>(word-initial)</td>
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<td>26.55</td>
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<td>4.13</td>
<td>6.47</td>
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<td>t-test results</td>
<td>t(5) = 131.13, p &lt; 0.01</td>
<td>t(5) = 106.2, p &lt; 0.01</td>
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Table 1. Summary of VOT analyses
As is apparent from the t-test results, the VOT value (degree of aspiration) in proclitics is significantly less than that in word-initial position, showing that there is less aspiration on proclitics than on word-initial syllables. In Figure 1, two examples of the recorded data in this experiment are presented, in which the substantial difference between the aspiration of initial voiceless stop on proclitics and the first syllable of lexical words is observable.

![Figure 1. VOT differences observable in recorded data](image)

Based on these findings, we can conclude that proclitics in Persian are not in PWord-initial position; thus they are not $\omega$-adjoined, and rather are $\phi$-attached free clitics as shown in (5c). Section 4 provides more evidence for this claim.

### 3.2. Enclitics

The structures in (8) demonstrate the four possibilities of host-plus-clitic combinations for enclitics.

The structure in (8a) is the one proposed in Amini (1997), and as we discussed in section 2.1 it is not acceptable because if we take Persian enclitics as amalgamated function words, their lack of stress cannot be explained by extrametricality. The structure in (8b), in which weak function words are independent phonological words, is the one proposed in Kahnemuyipour (2003), and as we saw in section 2.2, this too is not acceptable due to both theoretical and empirical problems. Consequently, there are only two remaining possibilities for the structure of enclitics in Persian, namely (8c) and (8d). The main difference between (8c) and (8d) is that in the latter, the clitic and its host are parsed into the same PWord, but in the former, the clitic is not parsed into the PWord. The evidence for our argumentation comes from syllabification.
3.2.1. Syllabification

Syllabification is carried out on different levels. At the lexical level, syllabification rules/constraints require all segments in the domain to syllabify with each other, but at post-lexical levels, factors such as high rate of speed can cause syllabification to optionally take place at domain boundaries. Laeuer (1995: 118–119) states that syllabification applies cyclically to roots and is reapplied after each word formation process to incorporate newly added elements. In some languages however it is sensitive to morphological structure, while in others it is not. In other words, in some languages the domain of lexical syllabification is the morpheme, and in others the word.

The canonical syllable type in Persian is (C)V(C)(C) and the prosodic requirements of the syllable, such as obligatory onset, allowing no consonant clusters in onset position, and allowing at most two segments in coda position, determine the syllable structure in the word domain, ignoring the morpheme boundaries (Mahootian 1997: 303–305). In (9i and ii) morpheme boundaries are shown by ‘-’ on the left, while a ‘.’ marks syllable boundaries on the right.2

(9)

i. dân-eš-mand-ân → dâ.neš.man.dân / *dân.(ʔ)eš.mand.(ʔ)ân ‘scientists’

ii. ham-âhang-i → ha.mâ.han.gi / *ham.(ʔ)â.hang.(ʔ)i ‘harmony’

As can be seen, the syllabification is not sensitive to morphological structure and takes the whole word as its domain. Since in Prosodic Phonology PWords are the equivalents of words in syntactic constituent structure (Selkirk 2011), we can conclude that in Persian lexical syllabification takes place in PWord domains. However at the post-lexical level, resyllabification is also possible at higher levels, ignoring PWord boundaries. This is shown in (10):

2 Word-initial glottal stops are shown in parentheses, since their existence in phonological representation is controversial and is beyond the scope of this study.
The syllabic structures to the left of the slash (/) show the lexical level syllabification, while the structures to the right show the post-lexical resyllabification, which ignores PWord boundaries. The existence of such resyllabifications proves that the obligatory syllabification is only a characteristic of the PWord domain and does not necessarily apply to higher domains such as PPhrase.

A close investigation of syllabification in cliticized words reveals that content words and their enclitics are necessarily syllabified with each other and it is not possible to syllabify them independently, as shown in (11).

This shows that host+enclitic combinations are more similar to the structures in (9) than those in (10), meaning that there are no PWord boundaries between a host and its enclitic. If we return to the two possible structures for enclitics mentioned in 3.2, we now have enough evidence to claim that the only acceptable structure for host+enclitic combinations is the one shown in (8d), which is a $\omega$-adjoined affixal clitic.

There are two PWord nodes (shown by $\omega$) in (8d). The lower PWord, which does not dominate any other PWord, is called a Minimal PWord, and the higher PWord, which is not dominated by any other PWord, is called a Maximal PWord. In Persian, the domain of obligatory syllabification is Maximal PWord, and stress is culminating and obligatory in this domain. Minimal PWord is right-aligned with a $\text{lex}$, and stress is rightmost in this domain.

4. Further evidence

In this section, three additional pieces of evidence are provided, that support the claim that proclitics and enclitics behave asymmetrically in Persian, and that there is a PWord boundary between a proclitic and its host, while enclitics and their hosts are parsed into a single PWord.

4.1. Proclitics and Syllabification

In 3.2.1. we argued that the obligatory syllabification of host+enclitic combinations in Persian suggests that there is no PWord boundary between a host and its enclitic. Proclitics, on the other hand, behave like the structures in (10), suggesting that they are not parsed into PWords together with their hosts and that there is a PWord boundary between them and their lexical hosts. This is exemplified in (12):

(10)

i. 

( (har) $_{\text{p}}$ (âdam)$_{\omega}$ )$_{\Phi}$ \rightarrow har. (l)â.dam / ha.ra.dam ‘each human’  
ii. 

( (panj)$_{\text{p}}$ (angošt)$_{\omega}$ )$_{\Phi}$ \rightarrow panj. (l)an.gošt / pan.jan.gošt ‘five fingers’

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4.2. Uninterruptability

It is uncontroversial that it is prosodically unacceptable to insert a pause in the middle of a PWord:*[pe...dár]_p. This principle is known as **uninterruptability** and is used as one of the major criteria of wordhood (Bauer 2003: 63–64). An examination of clitics in Persian shows that the insertion of a pause between a *lex* and its enclitic is not possible, however, one can make a pause between a *lex* and its proclitic. As shown in (13) pause insertion is not possible between a noun and the Ezafe particle (13a), between a verb and a personal agreement suffix (13b), or between a noun and the conjunction -o (13c). However a pause can be made between a proclitic and its host, for instance between the complementizer *ke* and the material following it (13d), a preposition and a noun (13e), and the conjunction *va* and the following noun (13f).

(12)

i. \([az]_{pnc} \ [injá]_{lex} \rightarrow (l)a.zin.já / (l)az.(l)in.já \) ‘from here’

ii. \([dar]_{pnc} \ [āsemān]_{lex} \rightarrow da.rā.se.mān / dar.(l)ā.se.mān \) ‘in the sky’

iii. \([joz]_{pnc} \ [Īrān]_{lex} \rightarrow jo.zi.rān / joz.(l)i.rān \) ‘except Iran’

(13) a. \*mārd...-e dānā \ ‘wise man’

b. \*rāft...-im \ ‘we went’

c. \*zān...-o márd \ ‘woman and man’

d. behrūz *ke...dirūz \ ‘Behruz that yesterday…’

e. az...šomā \ ‘from you’

f. zan va...mārd \ ‘woman and man’

4.3. Glide epenthesis

In Persian words no adjacent vowels are allowed (Windfuhr and Perry 2009: 429). Adjacent vowels are also avoided when the first of two vowels is the final vowel of a *lex* and the second one is the initial vowel of an enclitic. In this case, an epenthetic segment (mostly a glide) is inserted between the two vowels. In contrast, there is no such epenthetic segment insertion between a proclitic-final vowel and a *lex*-initial vowel. In (14i and ii) word-final vowels are followed by a clitic vowel, and to avoid vowel adjacency, a glide is epenthized between the two vowels.

(14) i. \([xodá]_{lex} \ [i]_{pnc} \rightarrow xodá-yi \) ‘a God’

ii. \([pesté]_{lex} \ [e]_{pnc} \rightarrow pesté-ye \) ‘pistachio-EZ’

In (15i and ii) we have exactly the same vowels as in (14), but unlike (14), glide epenthesis between the two vowels is unacceptable.
In cases such as \( bâ + -am \rightarrow bâhâm \) ‘with me’, it may seem that an epenthetic segment is inserted after the preposition \( bâ \), suggesting that \( bâ \) may not exclusively be a proclitic. However, as Naderi and van Oostendorp (2011: 164–165) observe, the insertion of /h/ in \( bâhâm \) or \( behem \) ‘to me’ is not productive, and happens in only a few frozen phrases, and should not be considered an epenthesis process in Persian. In these cases the second part of the combination (the nominal suffix \(-am\)) is a prosodically weak function word itself and cannot be a legitimate host for a proclitic. These fossilized combinations of two clitics form a single PWord in these examples, while \( bâ \) and \( be \), when used as true prepositions before lexical words, are always proclitics.

5. Multiple function words

In Persian, more than one weak function word can occur before or after a lexical word. In cases with multiple proclitics, e.g., \( az \ tu \ xune \) ‘from inside the house’, we observe that none of the proclitics are stressed, suggesting that they do not form PWords on their own. Even in literary forms such as \( vazân \) and \( kazîn \), which are contracted forms of \( va \ az \ ân \) ‘and from that’ and \( ke \ az \ in \) ‘that from this’ respectively, the whole contracted form is cliticized to the following \( lex \) without itself being stressed. Also, in multiple proclitics there is more than one possible syllabification, similar to what we saw in (10) and (12). For example \( joz \ az \ irân \) ‘except from Iran’, when produced without any focus, is a sequence of two proclitics and a host and can be syllabified in four ways:

\[
\begin{align*}
jö.za.zi.rán & \quad jö.(?)a.zi.rán & \quad jö.zaz.(?)i.rán & \quad jö.(?)az.(?)i.rán
\end{align*}
\]

The possibility of syllabifying each proclitic independently from the host and other proclitics, suggests that neither of the proclitics is parsed into the PWord, a domain in which, only one specific syllabification is allowed. Thus the structure for multiple proclitics would be multiple free clitics \((fnc_1,fnc_2,lex_0)_\varphi\).

So far we have argued that enclitics in Persian are affixal clitics that adjoin to PWords in a recursive manner. In the case of multiple enclitics, e.g., \( pedáreto \) ‘father-POSS2sg-ACC’, there are two possible structures:

\[
\begin{align*}
(16) \quad i. & \quad ((lex_0,fnc_1,fnc_2)_0)_\varphi \\
& \quad ii. & \quad ((lex_0,fnc_1)_0,fnc_2)_0)_\varphi
\end{align*}
\]

3 Please also note that contracted forms like \( kazîn \) or \( kîn \) also support the proclitic nature of \( ke \) in such cases.

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In the relatively plain structure in (16i) there are only two levels of PWord, namely a minimal and a maximal one, while in the more nested structure in (16ii) there is an intermediate level PWord between the minimal and the maximal one. In fact there seems to be neither a phonological process nor phonetic evidence in Persian supporting either of the structures in (16).

From a theoretical point of view, it is assumed in Prosodic Phonology that recursive morpho-syntactic structures and recursive prosodic structures should correspond to each other. As is asserted in Selkirk (2011) among others, prosodic structure reflects morphological structure as closely as possible. Kabak and Revithaidou (2009: 112–113) argue that in inherently recursive morpho-syntactic structures, the category of the whole construction is the same as its head. This category includes constructions that contain function words that are adjoined to syntactic lexical heads such as clitics. Based on these theoretical considerations, in the case of multiple enclitics above, the structure in (16ii) would be more appropriate because it mirrors the recursive morphological structure of the construction more accurately.

6. Conclusion

We have examined the existing proposals for the prosodic structure of function words in Persian and shown that taking function words as amalgamated clitics and independent PWords is theoretically and empirically problematic. The proposal made in this paper is that enclitics are grouped with their hosts in a recursive structure, while proclitics are not parsed into PWords, but rather are immediately dominated by a PPhrase in a non-exhaustive structure. In recursive PWords, syllabification is obligatory in the Maximal PWord domain, and stress is also obligatory and culminating in this domain. Minimal PWords are always right-aligned with a lex and stress is rightmost in their domain.

Abbreviations

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<th>Abbreviation</th>
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<td>accusative</td>
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