Persian Abstract Meaning Representation

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Abstract Meaning Representation (AMR) is an annotation framework representing the semantic structure of a sentence as a whole. From the beginning, AMR was not intended to act as an interlingua; however, it has made progress towards the idea of designing a universal meaning representation framework. Accordingly, developing AMR annotation guidelines for different languages, based on language divergences, is of significant importance. In this paper, we elaborate on Persian Abstract Meaning Representation (PAMR) annotation specifications, based on which we annotated the Persian translation of The Little Prince as the first gold standard for Persian AMR. Moreover, we describe how some Persian-specific syntactic constructions would result in different AMR annotations.

1. Introduction

Abstract Meaning Representation (AMR) makes use of an acyclic, single rooted, directed graph to encapsulate the meaning of a sentence. Making use of graphs allows for node reentrancy which makes it possible to return to a specific word in a sentence structure and study its semantic relation with other words. Prior to AMR, semantic annotations tried to capture a single aspect or dimension of meaning of sentences, which resulted in a disunified set of semantically annotated data sets, each with their own specific evaluation measures. Named entities, predicate-argument relations, co-reference, temporal entities, discourse connectives etc., are among such islanded attempts (Banarescu et al. 2013; Li et al. 2016).

While there is an abundance of syntactic treebanks which statistical language processing systems easily make use of, AMR aims to fill the void of such novelties in the realm of computational semantics: "A simple readable sembank for English sentences paired with their whole-sentence, logical meanings" (Banarescu et al. 2013). During the last two decades, there have been several projects focusing on designing sembanks covering whole-sentence semantic including the Groningen Meaning Bank (GMB) (Basile et al. 2012), Minimal Recursion Semantics (MRS) (Copestake et al. 2005),
Universal Networking Language (UNL) (Martins 2012), and the Prague Dependency Treebank (Böhmová et al. 2003). Among all these projects, not many of them, including AMR, has ever offered a framework that overcomes linguistic barriers to act as an interlingua. Since the release of the AMR specification, little effort has been made to develop language-specific AMR annotation guidelines based on specific syntactic constructions (Li et al. 2016; Xue et al. 2014). Conducting such research may result in refining the original AMR structure towards designing a universal meaning representation framework.

AMR is heavily dependent on Proposition Bank framesets (Palmer, Gildea, and Kingsbury 2005). This poses a problem for computationally under-developed and low-resource languages such as Persian. At the time of this writing, no such data was available for the language. As a result, we were forced to rely on pairing Perspred’s (Samvelian and Faghiri 2013) entries with their English PropBank verb-frame counterparts (Bonial et al. 2014).

On the other hand, abstraction away from surface syntactic structure is one of the key features of AMR: function words are ignored or converted to semantic relations, word order has almost no influence on the AMR annotation of the sentence. This allows for the framework to be adapted by many other languages, even a pro-drop language like Persian with a more or less free word order and light verb constructions with different degrees of separability in syntax 1 and various lexical and syntactic alternations. Therefore, AMR has the capacity for mapping a wide range of sentences, which carry the same core meaning, to a single representation. However, without a clear and comprehensive guideline for annotators to follow, there would be a great risk of inconsistency.

In this paper, we present the Persian AMR (PAMR) annotation specifications adapted from the English AMR (Banarescu et al. 2013). These specifications were used to annotate the Persian translation of *the Little Prince* with 1,562 sentences for which an English AMR annotated data is available. The full version of specification in persian is publicaly available. 2 Using *The Little Prince* as a parallel corpus enables us to compare Persian AMR annotations with their English counterparts which, in turn, results in recognizing Persian-specific constructions we need to take care of while annotating sentences. For this purpose, two linguistics students were trained to perform the annotation and build the first gold standard for Persian AMR which is also publicly available. 3

Here, we have avoided reviewing related works in a separate section to mainly focus on PAMR and its Persian-specific issues. However, the body of the paper includes brief mentions of AMR being implemented for other languages. The rest of the paper is as follows. Section 2 provides a general view of AMR and its annotation procedure followed by resources we used in PAMR annotation. Section 3 elaborates on how we dealt with constructions specific to Persian compared to English AMR. In the 4th section the annotation process and the corpus is given. Finally, the conclusion of this paper is provided in section 5.

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1 The modern form of Persian has changed towards the agglutinative type of language
2 https://github.com/Persian-AMR/manual
3 https://github.com/Persian-AMR/dataset
2. AMR Annotation: A Bird’s-eye View

AMR semantically represents sentences as rooted, directed, acyclic graphs with labeled edges and leaves to be used in statistical natural language processing. The graphs are translated into PENMAN notation for interpretability (1). One of the advantages of representing meaning via graphs is the possibility of reentering nodes called \textit{reentrancy}. In example 1, \((g / \text{girl})\) represents the leaf concept by noting that \(g\) is an instance of “girl”. The same “girl” may reenter the graph as an argument of another predicate by the use of its instance: “g”.

In AMR, concepts and relations play the core roles in representing the meaning of sentences in a consistent way. Concepts may include simple words such as “girl”, propBank framesets (“go-02”), or some designed keywords to show logical conjunctions (“but”, “and”, etc.), or canonicalized entity types and special frames (“date-entity”, “correlate-91”, etc.) (Banarescu et al. 2013). The argument structure of predicates extracted from Propbank verb frames (Bonial et al. 2014) is the mainstay of AMR annotation. Following Propbank conventions, core roles for arguments (:arg0-:arg5) are used to represent the argument structure of predicates with different senses. Furthermore, there are links between entities in AMR which are marked as relations including semantic relations, relations for quantities, date entities, or lists.

\textbf{Example 1:}

\begin{verbatim}
(w / want-01
 :ARG0 (g / girl)
 :ARG1 (g2 / go-02
 :ARG0 g
 :ARG4 (c / city
 :wiki "Tehran"
 :name (n / name
 :op1 "Tehran")))})
\end{verbatim}

The girl wants to go to Tehran.

In general, PAMR annotation framework does its best to conform with English AMR conventions and keeps an eye on Persian’s specific constructions where it needs defining new ways of annotating sentences. In the next section, some of such constructions will be explained in detail.

3. The Curious Case of PAMR

In order to annotate Persian sentences with PAMR, the English AMR specifications need to be augmented and extended to fit the specific needs of Persian. However, as with CAMR\(^4\) (Li et al. 2016), the tagset for the non-lexical concepts and relations was directly taken from English AMR specifications\(^5\).

As mentioned in the previous section, concepts constitute a big part of AMR. These concepts are either lemmatized forms of word tokens e.g. go-02 or girl in (2) or words

\(^4\) Chinese AMR
\(^5\) In addition to familiar categories (person, number, etc.), the following abbreviations are used in glosses: PRO, pronoun; DDO, the definite direct object marker râ.
without any specified links to a lexical item in the sentence. In the later case, the source of the concept can be inferred from the context (e.g., city). Here, city is a named entity tag for “Tehran”. Following previous researches in AMR annotation specifications, we call the first type of concept lexical and the later abstract concept (Li et al. 2016; Banarescu et al. 2013).

Lexical concepts in PAMR are lemmatized forms of word tokens. PAMR annotation specifications, and some other lexicons (Mirzaei and Moloodi 2016; Shamsfard 2008), define the lemma of Persian verbs as their infinitive form for certain reasons. First, in Persian, the lemma for past and present tense verbs is distinct. Second, if we were to use both past and present lemmas of the verb together (as in some Persian data (Mirzaei and Moloodi 2016)) as a single concept, each would still carry the undesired sense of time. Finally, the infinitive form sounds more natural to the speakers of the language as the core meaning of different forms of verbs (Samvelian and Faghiri 2013). Therefore, we decided to build our own version of valency lexicon based on the only available open-source lexicon (Rasooli et al. 2011) rather than using the proposition bank for Persian (Mirzaei and Moloodi 2016).

As shown in (2) which is the Persian translation of “The girl wants to go to Tehran”, semantic roles and nominal relations are the same as the original AMR. The similarity between two representations, (1) and (2), is easily observable. Just like the English version, the abstract concept, city, has not been directly taken from a lexical item in the sentence.

Example 2:

```plaintext
(x / xastan
 :ARG0 (x2 / doxtar)
 :ARG1 (x3 / raftan
 :ARG0 x2
 :ARG4 (t / city
 :wiki "tehrân"
 :name (n / name
 :opl "tehrân")))

doxtar mixâhad be tehrân beravad
girl want-3SG to Tehran go-3SG
‘The girl wants to go to Tehran.’
```

AMR proves to be very adaptable (Xue et al. 2014), however, as mentioned before, to have consistent PAMRs, we had to go above and beyond to handle Persian-specific constructions which are either absent or have different forms in English. In this paper, we describe some light verb constructions and impersonal constructions which are specific to Persian. Furthermore, we discuss some constructions like event-provoking nouns, causative alternation, modals, and clitics that either do not exist in English or their syntactic forms are totally different.

3.1 Light Verb Constructions

Handling Light Verb Constructions (LVC) in PAMR brought about one of the most fundamental deviations from AMR. Although AMR "abstracts away from light verb
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constructions" (Banarescu et al. 2013), by removing the light verb and keeping the main verb in the AMR graph, the nature of Persian would not allow this to happen.

LVs in Persian are made up of a nonverbal element (NV) and a light verb (LV). The NV could be a noun like gush (ear) in gush kardan (to listen), an adjective like pahn (wide) in pahn kardan (to spread), an adverb like bâlâ (up) in bâlâ keshidan (pull up) or a prepositional phrase like be dast (to the hand) in be dast âvardan (to gain). The LVs are semantically "lighter" versions of lexical heavy verbs. The fact that light verbs are replicas of heavy verbs have caused much dispute in distinguishing LVs from other complex predicates such as heavy verbs with an NV argument. This issue, which is still under debate, might not directly concern PAMR, however, due to lack of resources which would facilitate annotators with easy recognition of LVs, it needs to be addressed. First, we discuss what is considered as an LV and how to distinguish it from other types of verbs. In addition, we provide reasons for keeping the light verb forms in PAMR annotations.

Some linguists consider adjectival copula constructions as LVs. According to their presumption, such constructions are added to the above list as LVs (Folli, Harley, and Karimi 2005), however, we believe such constructions should be considered as heavy verbs with an adjective argument. For example, while the former take sard kardan (to make cold) as an LV, the latter consider kardan (to make) as a heavy causal linking verb, and sard (cold) as its third argument. As examples (3), (4) and (5) show, in PAMR, we side with the latter as it is supported by solid theoretical evidence.

Example 3:

\[
(x / \text{kardan} : \text{ARG0} (x2 / \text{bad}) : \text{ARG1} (x3 / \text{ghâza}) : \text{ARG2} (x4 / \text{sârd}))
\]

bad ghazâ râ sard kard
wind food-DDO cold made-3SG
‘The wind cooled the food.’

One way to distinguish LVs from such groups is the compositionality of meaning. In LVs, meaning of the whole cannot be derived from the combined meaning of each element. In fact, replacing the NV in an LV would result in a shift in the NV-LV relation and a change in the meaning of the LV, for instance, zarbe xordan (to take a blow) and af xordan (to be pardoned). On the other hand, we can see in an example like Gazâ xordan (to eat food) where xordan (to eat) is a heavy verb and we can change the noun while the main verb keeps the same meaning and the relationship between verb and its argument would not change. For example, mâst xordan (to eat yogurt) and mive xordan (to eat fruits) have the same core meaning with the only difference in the thing that is being eaten. Moreover, in such cases, it is possible to understand the meaning of the whole construction by looking at the meanings of each word. Therefore, we may conclude that the verbal element has pivotal contribution to the meaning of the whole construction. However, it can be argued that LVs in Persian form a continuum according to the role that the LV and the NV play with regard to the semantic interpretation of the whole construction. At one end of this continuum are LVs that rely on their NV elements to represent meaning, e.g. fot kardan (to pass away). As another
example, we can have a look at jang kardan (to fight) and jangidan (to fight) which have the same meaning and the LV is almost void of meaning. Constructions in which the semantic burden is shouldered by both elements are in the middle of the continuum, e.g. sar dadan (to release). At the other end are constructions in which the LV contains semantic properties of the whole construct, e.g. kotak zadan (to beat). Moreover, we can see that in LVCs the meaning is mostly carried by the NV.6

The second way to identify an LVC is to see whether the nominal argument can take part in simple copula constructions or not. Consider the same example we mentioned before: the main verb kardan (To make) in sard kardan (To make cold) can be replaced with budan (to be) and shodan (to become). If all three constructions are grammatical, we are not dealing with an LVC. This is more or less in line with the way Perspred (Samvelian and Faghiri 2013) treats LVCs. PAMR considers sard budan (being cold) which shows the state of being cold, exactly as AMR does with the main verb "be". Moreover, in sard shodan (becoming cold), shodan (to become) is the main verb and sard (cold) is its second argument. It is also worth mentioning that in some cases, the meaning of the nominal part is not literal and the whole construction is considered as an LVC. For example pahn kardan (to hang) in lebâs hâ râ pahn kardam (I hung the cloths) is an LVC.

Example 4:  
\[(x / \text{sard}) \quad \text{:domain} \quad (x3 / \text{ GGazâ}) \]
ghazâ sard ast
food cold is
‘The food is cold.’

Example 5:  
\[(x / \text{shodan}) \quad \text{:ARG1} \quad (x3 / \text{ghazâ}) \]
\[\text{:ARG2} \quad (x4 / \text{sard})\]
ghazâ sard shod
food cold became-3SG
‘The food became cold.’

Having explained the nature of Persian light verb constructions, it is time to discuss reasons why PAMR annotation does not follow AMR specifications in dropping the light verbs.

Persian LVCs behave like single lexical verbs in some respects. These structurally complex constructions govern arguments at clausal level exactly like a single non-complex verb. They also function like a single verb as far as different types of nominalization (e.g. Gerundive Nominalization, Agentive Nominalization, Past Participle Adjective Formation) are concerned. In addition, these LVCs may undergo pure morphological rules to form derived adjectives and manner adverbials which definitely have a zero-level status (Karimi-Doostan 1997).

These facts indicate that Persian LVCs should be considered as a whole.

We have also taken into consideration the natural tendency of the native speakers to use LVCs. Currently, Persian verb inventory is comprised of a small number of simple verbs and large number of LVCs. As Folli, Harley and Karimi discuss, from the thirteenth century, Persian speakers have started to form and use LVCs in place of simple verbs (Folli, Harley, and Karimi 2005). Although this situation has almost rendered the morphological rules for the formation of new simple verbs mute, there

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6 For more information on the role of Persian nonverbal element and the light verb in determining the syntactic and semantic properties see Karimidoostan and Folli et al.
are still many cases in which both simple and complex verbs, which share the same meaning and event structure, are used interchangeably. Later, we will address these variations in more detail.

The other reason for this assertion is that it has been claimed that syntactic properties such as argument and event structures of Persian LVCs cannot be solely extracted from the lexical properties of the LV or NV. A light verb does not always have the same event structure of its heavy counterpart, and at the same time, it fails to fully determine the event structure and telicity of the LVC. On the other hand, the NV lacks agentivity and eventiveness. The roles of LV in LVCs are summarized in the list below (Folli, Harley, and Karimi 2005).

1. Agentivity - Causativity
2. Eventiveness
3. Duration

Karimidoostan argues in favor of the argument structure (a-structure) of LVCs to be compositional, stating that the inseparable NVs join with LVs to gain thematic force (Karimi-Doostan 2011). Moreover, in the case of a separable and predicative NV, although it bears a-structure, at least one of the roles in the list below is fulfilled by LV making the LVC a single predicate. Next, the separability of Persian LVCs is discussed in more detail.

With all that said, it would not be justifiable for PAMR to simply drop the LV. Moreover, with this decision, we are able to keep the consistency among events which are derived from simple verbs and those derived from LVCs. As mentioned before, we use the infinitive form of the verb as the lemma. Furthermore, Persian infinitives for LVCs are defined as NVs plus the infinitive LV. Hence, by including light verbs in PAMR graphs, the Events for both simple and LVCs follow the same pattern.

Another issue with Persian LVCs is that depending on the nature of their NV, they could be separable. Example (6) shows this phenomena. Karimidoostan states that a-structure bearing NVs with carrying +N feature may be separated from the LV and become the head in a DP. They may be modified by adjectives, and become objects. Furthermore, in their new state they can "be relativized, focused by Wh-interrogatives and scrambled. He argues that even when separated, NV and LV are still functioning as single predicates. (Karimi-Doostan 2011) This can be somewhat similar to “split verb constructions” in Chinese where syntactically, the construction has the form of a verb-object but semantically, it is a single unit (Li et al. 2016). Since in AMR we are abstracting away from syntax and dealing with events as with CAMR, we treat separable and inseparable LVCs in the same manner and annotate separated LVCs as single events.

We can observe in (6) that latme zadan (to damage) is considered a single unit of LVC even though the LV is separated from the NV.

Variable light verbs is yet another issue concerning LVCs. As mentioned before, some LVCs have a simple verb counterpart (Folli, Harley, and Karimi 2005) and some are formed with different LVs while having the same meaning and argument structure. PAMR tries to normalize such verbs and the way it deals with the situation is as follows. Wherever PAMR encounters a simple verb which has an equivalent LVC, it annotates it with the LVC and if it encounters an LVC which is ly used with another LV more frequent, the commonest form enters PAMR.
Example 6:

(x / latme zadan
 :ARG0 (x2 / tagarg)
 :ARG1 (x3 / bâgh
   :poss (x4 / man))
 :mod (x5 / bad)
 :time (x6 / diruz))

tagarg latme-ye bâdi diruz be bâgh-e man zad
hail damage bad yesterday to garden my hit-3SG
‘The hail damaged my garden badly yesterday.’
tagarg diruz be bâgh-e man bad latme zad
hail yesterday to garden my bad damage hit-3SG
‘Yesterday, the hail damaged my garden badly.’

To illustrate, simple verbs like raghsidan (to dance) and geristan (to cry) each have an LVC equivalent which respectively are raghs kardan (to dance) and gerye kardan (to cry). In such cases, the LVC enters the PAMR graph. Moreover, LVCs such as fot kardan (to pass away) and birun kardan (to kick out) are also formed with another LV: fot shodan (to pass away) and birun andâkhtan (to kick out) respectively. Here the LVC with the unmarked LV variant, kardan (to make) enters the PAMR graph (7).

Example 7:

(x / birun kardan
 :ARG0 (x2 / mâri)
 :ARG1 (x3 / dalghak))

mâri dalghak ra birun andâkht
Mary clown-DDO out threw-3SG
‘Mary kicked out the clown.’

Another point worth mentioning concerning variable light verbs is the formal and informal variations. For example, LVCs like da’vat kardan (to invite) and fot kardan (to pass away) have the formal variants da’vat nemudan (to invite) and fot nemudan (to pass away). PAMR simply makes use of the :polite + relation and normalizes the light verb in the previously mentioned manner.

One last issue that needs to be briefly discussed is that sometimes, two constructions which may be a combination of the same NV and V/LV have different meanings and hence are two different structures. For example, keshidan (to rub) in dast keshidan (to rub one’s hand (on something)) occurs with heavy interpretation resulting in a verb phrase (8). However, in dast keshidan (to desist/to give up) it loses its heavy interpretation entirely, turns into a light verb and forms a single unit of LVC (9).
Example 8:

\[
(x / \text{keshidan} \\
: \text{ARG0} (x2 / \text{dalghak}) \\
: \text{ARG1} (x3 / \text{miz}) \\
: \text{ARG2} (x4 / \text{dast}))
\]

dalghak be miz dast keshid
clown to table hand rubbed-3SG
‘The clown rubbed the table.’

Example 9:

\[
(x / \text{dast keshidan} \\
: \text{ARG0} (x2 / \text{dalghak}) \\
: \text{ARG1} (x3 / \text{kâr}))
\]
dalghak az kâr dast keshid
clown from work hand withdrew-3SG
‘The clown gave up on working.’

3.2 Predicative Nominals

AMR’s strong tendency to make events out of nouns and adjective on one hand, and the Persian’s capability of producing complex predicates can create a vortex which sucks PAMR annotators into extracting events out of almost every noun they encounter. Hence, PAMR specifications provide a clear cut guide to ensure the sanity of annotators and integrity of PAMR.

Nominal preverbs in Persian LVCs are categorized into two main types: predicative and non-predicative nouns. This classification is based on the argument structure, predication and thematic force (Karimi-Doostan 2011). In PAMR annotation, we accept that predicative nouns are actions that carry a structure, while non-predicatives cannot contain a structure. To illustrate with an example, let’s take a look at the noun \textit{gush} (ear), which can be used as a preverb in \textit{gush kardan} (to listen). Since \textit{gush} (ear) is not a predicative noun, we do not annotate it as an event. On the contrary, \textit{da’vat} (to invite) as seen in (10) becomes an event. Moreover, the characteristics of such nominal preverbs can be shown using distributional and morphosyntactic tests. Predicative nouns can be pluralized, accompany determiners, prepositions, Ezafe particle, and demonstratives besides acting as an object or subject (Karimi-Doostan 2011). To show this, we can compare \textit{da’vat} (to invite) in (10) which is a predicative noun with the non-predicative one \textit{gush} (ear) in gushe Ali be râdyo (ear Ali’s to Radio) where it cannot co-occur with Ezafe Particle to build a well-formed sentence.

Example 10:

\[
(x / \text{da’vat kardan} \\
: \text{ARG0} (x2 / \text{dalghak}) \\
: \text{ARG1} (x3 / \text{mâri}))
\]
da’vat-e dalghak az mâri
invitation clown from Mary
‘The clown’s invitation of Mary’

\footnote{Ezafe particle is the enclitic –e/-ye which connects a noun/adjective/adverb/preposition to its complement}
3.3 Modality

Many linguists and logicians consider modality as a linguistic phenomenon that can be expressed at the level of sentence and constituents smaller than sentence or at the level of discourse (Portner 2009). Regarding Persian, previous studies have introduced elements such as modal verbs and auxiliaries, modal adverbs and past tense, modal nouns and modal adjectives to Persian modal system (Taleghani 2008a) (Tavangar and Amouzadeh 2009). Here, we focus on the representation of modal verbs and adverbs.

To ensure quick and consistent PAMR annotations, we have not proposed a deep representation of modality. Unlike English, in Persian, modality is mostly represented through lexical verbs which unlike auxiliaries, can take arguments. Therefore, we treat them as simple lexical verbs which are used in a semantically modal manner.

In Persian, modality could be imposed on the main verb with the use of tavânestan (be able to, possible), bâyad (should) and shâyad (perhaps). While tavânestan (be able to, possible) has all the features of a lexical verb, the case for bâyad (should) and shâyad (perhaps) is a bit more complicated.

Some researches believe they are both comparable to English modals. (Taleghani 2008b). Taleghani discusses that since both can accept a negation prefix, they must be considered as modal auxiliaries. Some other believe they are both adverbs (Karimi 2008). However, a more concrete view is to say that "in Persian it is only bâyad (should) which is comparable to English modals in defectiveness: it has only one form and is not conjugated." (Yousef and Torabi 2015) and shâyad (perhaps) as perhaps in English (Salager-Meyer 1997) is an adverb.

First of all, while it is generally true that both bâyad (should) and shâyad (perhaps) can be negated via a negation prefix, it is only bâyad (should) that undergoes this phenomena in contemporaneity everyday usage. The negated shâyad (perhaps) is observed, rarely, in poetry with a great shift in meaning. Hence, bâyad (should) can not be considered an adverb. Second, their sequential order is an evidence against them both for being adverbs. While shâyad bâyad be kelâs miraftam (Perhaps I should have gone to the class) is grammatical, bâyad shâyad be kelâs miraftam (I should perhaps have gone to the class) is not.

With such evidence, PAMR considers treating shâyad (perhaps) as an adverb and bâyad (should) as a modal auxiliary. However, since bâyad (should) has an infinitive form: bâyestan (should) and can be conjugated: mibâyest or bâyest, for the sake of consistency we annotate bâyad (should) (along with tavânestan (be able to, possible)) as lexical verbs. 8

8 Technically, all conjugated forms of bâyad (should) are synonyms to bâyad (should) itself. Yet, as mentioned before, to keep PAMR consistent, we decided to keep modality annotation as simple as possible until our deeper proposal for annotating this linguistic phenomenon is ready.
Example 11:

\[
\begin{aligned}
(x / \text{bâyestan} &
: \text{ARG1} (x2 / \text{raftan} \\
: \text{ARG0} (x3 / \text{dalghak}))
\end{aligned}
\]

dalghak bâyad beravad
clown must go-3SG
'The clown must go.'

\[
\begin{aligned}
\text{lâzem ast ke dalghak beravad} &
necessary is that clown go-3SG
'It is obligatory that the clown goes.'
\end{aligned}
\]

Example 12:

\[
\begin{aligned}
(x / \text{tavânestan} &
: \text{ARG1} (x2 / \text{raftan} \\
: \text{ARG0} (x3 / \text{dalghak}))
\end{aligned}
\]

dalghak mitavânad beravad
clown can-3SG go-3SG
'The clown can go.'

dalghak ejaze dârad ke beravad
clown permission has-1SG that go-3SG
'The clown is permitted to go.'

While AMR maps modal auxiliaries to verb frames which best fit their semantic sense, for the aforementioned reasons, we believe such mapping is not needed for Persian modals since they are either lexical verbs or adverbs. Hence, inserting the lemma of the verb would suffice. This is exactly what happens with a verb like think which could have the literal meaning of to think or carry a modal sense and mean to be possible. In such cases, AMR chooses not to map the modal sense into a different event and the same event is inserted into the AMR graph regardless of its modal sense.

Examples (11) to (13) illustrate the annotation of modal elements in PAMR.

Example 13:

\[
\begin{aligned}
(x / \text{bâridan} &
: \text{ARG0} (x2 / \text{bârân} \\
: \text{mod} (x3 / \text{shâyad}))
\end{aligned}
\]

shâyad bârân bebârad
maybe rain fall-1SG
'Perhaps it will rain.'

ehtemâl dârad bârân bebârad
probability has-3SG rain fall-3SG
'It is probable that it rains.'

3.4 Causative Alternation

Causative alternation is another area in which Persian shows formal variation compared to English. Generally, there are two main types of causative-inchoative alternation: lexical and periphrastic (syntactic). In Persian, the lexical type consists of three categories including labiles, suppletives, and suffixation, where the verb has a single form in both causative and inchoative alternations. In such cases, AMR selects the same event for the causative and inchoative forms, however, the difference becomes evident in the argument structure. For example rixtan (to spill) can be both causative and inchoative. Examples (14) and (15) show this fact.
The second type of alternation is periphrastic (syntactic) in which we encounter with verbs that contain the same nominal lemma, however, the alternation is revealed by a change in the light verb in the LVCs or causative affixation. An example of altering LVs can be the inchoative verb åb shodan (to melt) and its causative counterpart åb kardan (to make melt) which share the same nominal root. Examples (16) and (17) show the PAMR graph of such alternations. Furthermore, as examples (18) and (19) show, a simple verb such as charxīdan (to spin), which is inchoative, can become causative by the use of a causative suffix: charkhāndan (to make spin) (Shojaie 2015).

As we have mentioned before, the NV carries the major semantic load. Hence, we follow the same pattern as the first category and map the inchoative form to its causative counterpart. Therefore, yaz åb shod (the ice melted) in (16) and måri yax rā åb kard (Mary melted the ice) in (17) have similar PAMRs, the only different being the absence of :ARG0 in the former.

Example 18:

(x / charxīdan
 :ARG1 (x2 / charx))

charx charxīd
wheel spun-3SG
‘The wheel spun.’
3.5 Null Arguments

Being a pro-drop language, Persian allows null subjects which are realized only through verb morphology. However, “pro” is present in the underlying construction (Karimi 2008). For example, in (20) we see that ‘u (he/she) is not the subject of xâbidan (to sleep). This is explicitly drawn from the verb’s suffix mim (3sg suffix). However, inanimate subjects, exceptionally, might not follow subject verb agreement in number and a plural inanimate subject may appear with a singular agreement morphology (Karimi 2008). For example, although ketâbhâ (books) in ketâbhâ ruy-e miz bud (the books were on the table) is plural, the verb is singular (Karimi 2008). In such cases, if the subject is present, it is clear what should enter the graph and if the subject is null, we assume subject and verb are in agreement and the appropriate pronoun enters the graph.

Example 20:

(x / xâbidan
 :ARG0 (x2 / man)
 :time (x3 / xaste kardan
 :ARG1 (x4 / ‘u)))

‘u ke xaste shod xâbidam
 PRO-3SG that tired became-3SG slept-1SG
 ‘When he/she got tired, I slept.’

Since AMR specifications allow for implicit roles to be considered in the AMR graph, the mentioned cases can be seamlessly incorporated into PAMR.

3.6 Clitics

Persian as a pro-drop language has its own pronominal enclitics which appear as inflectional suffixes at the end of the verbs showing subject-verb agreement. These suffixes agree with subject in person and number and are classified into two main groups: verbal and non-verbal positions (Mahand 2011). In this paper, we discuss the verbal position of the Persian clitics which puts a language-specific challenge before AMR annotation.

3.6.1 Subject Clitics. Persian third person singular intransitive verbs may become subject to clitic doubling. This phenomena usually occurs in colloquial speech. The subject clitic ‘esh (3sg suj) is always used with a subject. For example the dalghak raftesh (The clown went) and oftâdesh (it/he/she fell) is referring to subject of the sentence
which is already realized. These clitics have no effect on the PAMR representation of the sentence (21) (Megerdoomian et al. 2000).

Example 21:

\[(x / \text{raftan} : \text{ARG0} (x2 / \text{dalghak}))\]

\[
\begin{align*}
\text{dalghak raftesh} & \quad \text{clown left-3SG} \\
\text{‘The clown left.’} & \quad \text{‘The clown left.’}
\end{align*}
\]

Example 22:

\[(x / \text{oftâdan} : \text{ARG0} (x2 / ‘u))\]

\[
\begin{align*}
\text{oftâdesh} & \quad \text{fell-3SG} \\
\text{‘he/she fell.’} & \quad \text{‘he/she fell.’}
\end{align*}
\]

Note that in (22) \text{ân/’}u (it/he/she) (ân (it) in the case of inanimate subject) enters the graph on the account of the verbs third person singular suffix, which is null.

In LVs, a clitic may be attached to the NV or LV. This fact is illustrated in examples (23) and (24) where in dalghak talâsh kardesh (The clown made an effort), the clitic is attached to the LV and in vajdalghak talâshesh ro kard (The clown made his effort) it is attached to the NV. As it can be seen in the translation, the second example has a subtle shift in meaning. In fact, the enclitic attached to the NV is a possessive pronoun.

Example 23:

\[(x / \text{talâshkardan} : \text{ARG0} (x2 / \text{dalghak}))\]

\[
\begin{align*}
\text{dalghak talâsh kardesh} & \quad \text{clown effort made-3SG} \\
\text{‘The clown made an effort.’} & \quad \text{‘The clown made an effort.’}
\end{align*}
\]

Example 24:

\[(x / \text{talâshkardan} : \text{ARG0} (x2 / \text{dalghak}) : \text{poss} x2)\]

\[
\begin{align*}
\text{dalghak talâshesh ro kard} & \quad \text{clown effort-his-DDO made-3SG} \\
\text{‘The clown made an effort.’} & \quad \text{‘The clown made an effort.’}
\end{align*}
\]

3.6.2 Object Clitics. While in the previous section we saw that a clitic could be considered as the subject argument of a verb, here we discuss how enclitic pronouns could be
used as the verb’s object argument. Example (25) shows that \textit{ash} (he/she/it) is referring to the object of the verb \textit{didan} (to see) (Samvelian and Tseng 2010).

\textbf{Example 25:}

\begin{verbatim}
(x / didan
 :ARG0 (x3 / man)
 :ARG1 (x2 / 'u))
\end{verbatim}

\textit{man didamash}
I saw-1SG-3SG
‘I saw (him/her).’

\textit{man 'u râ didam}
I PRO-3SG-DDO saw-1SG
‘I saw him/her.’

The case of object clitics in LVCs is different from subject clitics. The enclitic attached to both LV and the NV plays the same role. Example (26) illustrates this fact.

\textbf{Example 26:}

\begin{verbatim}
(x / bâzkardan
 :ARG0 (x3 / man)
 :ARG1 (x2 / ân))
\end{verbatim}

\textit{bâzkardamash}
open did-1SG-3SG
‘(I) opened (it).’

\textit{man bâzkardamash}
I open did-1SG-3SG
I opened (it)

\textit{bâzashkard}
‘(I) opened (it).’

\textit{man bâzashkard}
I open-3SG did-1SG
‘I opened (it).’

\textit{man ân râ bâzkardam}
I that-DDO open did-1SG
‘I opened it.’

As shown in the examples, the appropriate full pronoun enters the PAMR graph. It is also worth mentioning that some verbs like \textit{bâzkardan} (to open) in (26) can only take an inanimate object, hence, the \textit{ân} (it) enters the graph. However, other verbs like \textit{didan} (to see) in (25) can have both inanimate and animate objects. If there is no indication of the type of the object, PAMR normalizes and chooses the animate pronoun.

\textbf{3.6.3 Possessor clitics.} Some constructions in Persian may have no overt subject. Karimi divides these constructions into three categories: inalienable possessor constructions, inalienable pseudo-possessor constructions and short infinitives (impersonal constructions) (Karimi 2008).
The first two categories are very much the same with the difference being that in inalienable possessor constructions, the construction is made with the light verb budan (to be) but in inalienable pseudo-possessor constructions the light verb is not budan (to be). In both constructions (27 and 28), a pronoun may optionally enter the clause initial DP position. Moreover, the pronoun is co-indexed with a clitic (i.e. am (1sg) in (man) gorosneam ast (I'm hungry)) attached to the NV of a complex predicate which is always third person singular (Karimi 2008).

Example 27:

(x / dâshtan
:ARG1 (x2 / man)
:ARG2 (x3 / gorosne))

gorosname
hungry-POSS is-3SG
'I'm hungry.'

Example 28:

(x / dâshtan
:ARG1 (x2 / ânhâ)
:ARG2 (x3 / dard
:mod (x4 / xeili)))

xeili dardeshun miâd
very pain-POSS-3PL come-3SG
'(they) Have so much pain.'

Unlike examples in section 3.5, these clitics are not the subjects of the complex predicate. Karimi proposes that these constructions 'have an underlying possessor construction containing HAVE' (Karimi 2008). PAMR annotates such constructions with inserting dâshtan (to have) into the root of the graph. The frame for dâshtan (to have) which is similar to have-03 is shown below:

dâshtan (have-03)

Arg1: mâlek (owner)
Arg2: melk (possession)

In the last category, curtailed infinitive, which is the bare past stem of a verb usually paired with the impersonal modal bâyad (must) or the auxiliary shodan (become), is left without an overt subject. For example, in bâyad xod ra shenâxt (one must know oneself) or mishavad vâred-e xâne shod (one can enter the house), shenâxt (he/she recognized) and vâredshod (he/she entered) are the curtailed infinitives of shenâxtan (to recognize) and vâredshodan (to enter) respectively, and the verbs do not have an overt subject. Unlike the first two categories, these constructions must have a "covert grammatical subject". Moreover, "this covert subject cannot be an expletive" (Karimi 2008). According to Karimi, Ghomeshi argues that the verb in these constructions have an arbitrary subject like the English arbitrary pronominal one (Ghomeshi 2001).

4. PAMR Annotation Process and Corpus

To annotate the Persian version of the little prince, first we aligned Persian sentences to the English version by making minor adjustments to the translated version. Two
linguistics students were trained and were provided with the PAMR manual. Each annotator was assigned a portion of the 1562 sentences of the little prince to annotate. In the end there was at least one annotation for every sentence of the little prince. To ease the annotation process, the original AMR annotation tool was fine tuned to accept Persian concepts and was used by the annotators in the annotation process.

Due to lack of resources 25 sentences were randomly chosen and annotated by 3 annotators to calculate the Smatch score of inter-agreement between annotators. The overall Smatch score between the 3 annotators is 0.81.

Looking at the disagreements between annotators we realized that the major setback in the annotation process was the lack of Persian ProbBank. There were instances where the only differences in the graphs were labels of relations. This can be seen in the Smatch score of 0.88 on graphs disregarding the labels on edges. On the other hand, different interpretations of the meaning of a sentence were another source of disagreement between annotators.

5. Conclusion

In this paper, we introduced Persian Abstract Meaning Representation (PAMR) specifications and an annotation guideline for AMR annotating sentences in Persian based of which the first gold standard for Persian AMR is built. We annotated the whole translation of The Little Prince which contains 1,562 sentences in line with its English AMR annotated corpus. Based on the differences between Persian and English annotations, in the parallel corpus, we recognized some Persian-specific syntactic constructions which result in different AMR annotations. The next step was to change the annotations based on these constructions. Although there is a lack of natural language processing tools and resources in Persian, we made use of our limited resources effectively to overcome the shortcomings. One of the major challenges of PAMR annotation was the lack of a decent Persian Proposition bank or any semantic valency lexicon. In the absence of such pivotal data, we had to start building PAMR frames before AMR annotating sentences. Therefore, we started to use Perspred (Samvelian and Faghiri 2013) and Syntactic Valency Lexicon (Rasooli et al. 2011) to extract the syntactic argument structures of the verbs. In the next step, semantic roles of the arguments were extracted from the closest English frame in Propbank. Here, we also explained how future AMR refinements may equip the framework to fit Persian-specific constructions. We strongly believe that developing AMR annotation guidelines for different languages, based on their specific constructions, is beneficial for it reveals the shortcomings of the present framework in dealing with languages other than English which, eventually, result in further refinements of the original guideline.

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