Abstract

This paper presents a descriptive overview and a formal analysis of the syntax of pronominal arguments, pronominal conjuncts and bound pronouns in Arabic. I argue that Arabic allows first conjuncts to be null and that this is an instance of a more general pattern of zero anaphora that may affect pronominal arguments or their first conjuncts. First Conjunct Agreement and constraints on the distribution of zero anaphora are accounted for by a new feature sharing mechanism which allows a uniform treatment without appeal to the internal structure of argument NPs. I then argue that Arabic bound pronouns should be analyzed as affixes and present an analysis of their relation to argument structure and coordination. Finally, it is shown how constraints on case marking in Arabic coordination can be formalized. The analysis is part of an Arabic grammar fragment implemented in the TRALE system.

1 Introduction

The goal of this paper is twofold. First, I will examine the structure of Arabic NP coordination and argue that it is a genuine coodination structure which allows first conjuncts to be null. An HPSG analysis will be presented which accounts for zero realization of and agreement with pronouns in a uniform way. I will then examine bound pronouns and show how their relation to argument structure and coordination can be analyzed in HPSG. The analysis presented here is part of ongoing work on a grammar fragment of Arabic implemented in the TRALE grammar development environment (Meurers et al., 2002, Müller, 2007).

The varieties of Arabic dealt with here are Classical Arabic and Modern Standard Arabic. Classical Arabic (CA) in the narrow sense was the spoken and written language of the Arab tribes roughly from the seventh to the ninth century. It forms the basis for Modern Standard Arabic (MSA), which is the (mainly) written language of the Arab world today. Especially in morphology and syntax, these two languages are extremely similar, and they are often treated as having the same syntax in generative work. This paper follows this approach and attempts to develop a syntactic analysis for both languages. Although intuitive grammaticality judgments are not directly available for CA, as it is extinct, there is an extensive syntactic literature, starting with the seminal *Al-Kitaab* (Sibawayh, 1988) by Sibawayh (ca. 760-796). Furthermore, extensive corpus material is available for both varieties.

Figure 1: Arabic Personal Pronouns

	Case-neutral		Accusative		Bound	
	Singular	Plural	Singular	Plural	Singular	Plural
1	'anaa	nahnu	'iyyaaya	'iyyaanaa	-ii, -nii	-naa
2 m	'anta	'antum	'iyyaka	'iyyakum	-ka	-kum
2 f	'anti	'antunna	'iyyaki	'iyyakunna	-ki	-kunna
3 m	huwa	hum	'iyyahu	'iyyahum	-hu	-hum
3 f	hiya	hunna	'iyyahaa	'iyyahunna	-haa	-hunna

2 The Data

Pronouns in Arabic   Arabic has three sets of personal pronouns (Figure 1, without dual forms). The first and second group are free, the third group is bound. The second group is restricted to positions where a lexical NP would show accusative marking. Members of the first group are not restricted to a specific case, although their distribution in nonnominative, i.e. genitive and accusative, environments is restricted. I gloss their case with $\emptyset$. Bound pronouns appear in genitive and accusative positions. The cases are distinguished only in the first person singular, with *-ii* being the genitive and *-nii* the accusative form.

Subjects   Arabic pronominal subjects can be realized as null subjects or by a free case-neutral pronoun (1a). Conjoined postverbal subjects usually trigger first conjunct agreement and their first conjunct can be null (1b). Without implying a specific analysis, I will refer to the implicit element as *null conjunct*. On the other hand, preverbal subjects always trigger resolved agreement and do not allow null conjunct realization (1c).

(1) a. 'atayta   ('anta)
        came.2SG.M (you.$\emptyset$)

        'you came'

     b. 'atayta   ('anta) wa=Zayd-un
        came.2SG.M (you.$\emptyset$) and=Zayd-NOM

        'Zayd and you came'

     c. * ('anta) wa=Zayd-un   'ataytum
          you.$\emptyset$ and=Zayd-NOM came.2PL.M

        'Zayd and you came'

Accusative Complements   Pronominal accusative arguments can be marked by certain combinations of bound pronouns, free accusative pronouns and case-neutral pronouns: just by a bound pronoun (a), just by a free accusative pronoun (b), or by a bound and a free pronoun at the same time (c):

(2) a. ra'aytu-ka
        saw.1SG-you.OBL

   b. ra'aytu   'iyyaaka/*'anta
       saw.1SG you.ACC/you.∅

   c. ra'aytu-ka   'iyyaaka/'anta
       saw.1SG-you.OBL you.ACC/you.∅

       'I saw you'

Bound pronouns can never mark nonpronominal arguments:

(3) a. * ra'aytu-hu   r-rajul-a
          saw.1SG-he.OBL DEF-man-ACC

       'I saw the man'

Genitive Complements   Pronominal genitive arguments can be marked by bound pronouns or bound pronoun plus case-neutral pronoun. The options available are similar to those for accusative complements, but Arabic does not have free genitive pronouns:

(4) a. baytu-ka
        house-you.OBL

   b. * baytu 'anta
        house you.∅

   c. baytu-ka   'anta
       house-you.OBL you.∅

       'your house'

First Conjuncts of Complements   Pronominal first conjuncts of complements following their head have essentially the same realization options as simple pronominal arguments: They can be realized only by a bound pronoun, only by a free accusative pronoun or by a free and a bound pronoun at the same time:

(5) a. ra'aytu-ka   wa=Zayd-an
        saw.1SG-you.OBL and=Zayd-ACC

   b. ra'aytu   'iyyaaka/*'anta wa=Zayd-an
       saw.1SG you.ACC/you.∅ and=Zayd-ACC

   c. ra'aytu-ka   'iyyaaka/'anta wa=Zayd-an
       saw.1SG-you.OBL you.ACC/you.∅ and=Zayd-ACC

       'I saw you and Zayd'

(6) a. baytu-ka   wa=Zayd-in
        house-you.OBL and=Zayd-GEN

b. * baytu 'anta wa=Zayd-in
house you.∅ and=Zayd-GEN

c. baytu-ka 'anta wa=Zayd-in
house-you.OBL [you.∅ and=Zayd-GEN]

'your and Zayd's house'

Noninitial pronominal conjuncts do not allow bound or case-neutral pronouns and can only be realized by a free accusative pronoun. Thus, noninitial genitive conjuncts are never pronominal.

Opinions of Medieval Grammarians Almost all medieval grammarians considered nominative and genitive null conjuncts at most marginal (e.g. Sibawayh (1988) I 48, Ibn Al-Sarraj (1985) II 119). However, it is doubtful that these claims reflect actual CA use. The grammaticality of the (positive) examples is confirmed by corpus data (Reckendorf, 1921, 331, 344) and was accepted by the early Kufan school (Ibn Al-Anbari, 1913, 193-198). Furthermore, grammarians rejecting the constructions did give positive examples.[1]

It seems plausible that the original contrast was one between dialects, but I will leave this question open. Since no other part of the analysis is potentially dialect-dependent, it seems safe to assume that the variety of CA under consideration allowed null conjuncts.

3   Pretheoretical Analysis

3.1   Coordination or Comitatives?

Stassen (2000) shows that many languages mark coordination with an asymmetrical, comitative strategy.[2] The resulting surface pattern in pro-drop languages equals what we have called null conjuncts here. An analysis of Arabic coordination as comitatives would provide a simple account of agreement of verbs and bound pronouns, and of the possibility of (apparent) conjuncts being null, which would be a simple consequence of the avilability of zero anaphora.

In fact, the Arabic coordination clitic *wa=* can undisputably mark comitatives. However, comitative *wa=* is distinguished from the coordination marker in that it always governs accusative and appears to be semantically distinguishable in that it does not necessarily entail the corresponding version with coordination (Al-Mubarrad, 1986, II 836).

Another argument for a comitative analysis could be made based on (7), where the conjuncts seem to be inverted, which is expected under a modifier analysis. However, the distribution of this pattern, which was possible in poetic CA, differed

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[1]See (9a). Other examples: *kun-naa wa='antum dhaahib-iina* 'we and you were going' Sibawayh, 1988, II 352, *'akram-tu-ka wa=Zayd-un* 'Zayd and I honored you' (Ibn Aqiil, 1962, II 187).

[2]Thanks to Emily Bender for pointing this out to me.

from standard NP coordination (Ibn Al-Sarraj, 1985, II 76). Therefore, I will assume that it should be analyzed as a specific construction rather than as a word order variant of (1b).

(7) qaam-a   wa=Zayd-un   'Amr-un
    stood-3SG.M and=Zayd-NOM Amr-NOM

    'Zayd and Amr stood (Ibn Al-Sarraj, 1985 II 76)'

On the other hand, there is empirical evidence that the presumed coordination marker is a real coordination marker. A prototypical property of comitatives is that they do not form a constituent with the other NP. In Arabic, a free pronoun as a first conjunct is always adjacent to the second conjunct (8a), although a bound pronoun and a corresponding free pronoun need not be adjacent (8b):

(8) a. * ḍarab-tu   'anaa Zayd-an   wa-'anta   fii ddaar-i
         beat.PAST-2SG.M I.∅   Zayd-ACC and=you.∅ in the.house-GEN

       'You and I beat Zayd in the house.'

    b. yahtiku-haa   nnaasu   [hiya wa=saa'ira   'ahli-haa]
       shame.3SG-she.OBL the.people [she.∅ and=rest-ACC family-she.OBL]

       'people shame her and the rest of her family'

This suggests that conjoined NPs form a constituent, from which a bound pronoun realizing the first conjunct is excluded.

Conjoined NPs with first-conjunct agreement can control the subject of clausal complements of raising verbs and subject-to-object-raising complementizers like *'inna*, as shown by dual/plural agreement on the embedded verb:

(9) a. kun-ta   wa=ṣaaḥib-u-ka   ḍarab-tumaa
       be.PAST-2SG.M and=friend-NOM-you.SG.OBL beat.PAST-2DU

       rajul-an   ḍarab-a-ka
       man-ACC.INDEF beat-3SG-you.SG.OBL

       'you and your friend struck a man [that] had beaten you (Ibn Al-Sarraj, 1985, II 330)'

    b. 'innii   wa=Zayd-an   munṭaliq-aani
       indeed.I.ACC and=Zayd-ACC leaving-NOM.DU.M

       '(indeed,) Zayd and I are leaving (Ibn Al-Sarraj, 1985, II 117)'

Crucially, subjects of clausal complements can only be controlled by the preceding argument of the matrix verb, but not by modifiers or by an argument and a modifier simultaneously:

(10) a. * kun-tu   ma'a Zayd-in   taqaabal-naa
          be.past-1SG with Zayd-GEN meet.PAST-1PL

        'Zayd and I had met'

b. * ẓanna-nii   maʿa Zayd-in   taqaabal-naa
    think.past.3SG-I.ACC with Zayd-GEN meet.PAST-1PL
    'He thought that Zayd and I had met'

Another strong indication that the data involve real NP coordination is that conjoined subjects can co-occur with a plural anaphor (11) and with verbs obligatorily requiring a nonsingular subject (12):[3]

(11) a. ra'ay-tu ('anaa) wa=Zayd-un   'anfusa-naa   fii lmir'aati
      saw-1SG I.∅   and=Zayd-NOM selves-1PL.OBL in the.mirror
      'Zayd and I saw ourselves in the mirror.'

     b. ra'ay-tu ('anaa) wa=Zayd-un   baʿḍ-a-naa-lbaʿḍ
      saw-1SG I.∅   and=Zayd-NOM each.other.ACC.1PL
      'Zayd and I saw each other.'

(12) a. taqaabal-tu ('anaa) wa=Zayd-un
      met-1SG   I.∅   and=Zayd-NOM
      'I met with Zayd.'

     b. tashaarak-a   Zaydun   wa=ʿAmrun
      cooperate.PAST-3SG.M Zayd-NOM and=Amr-NOM
      'Zayd and Amr cooperated (Ibn Aqiil, 1962, II 179)'

Incidentally, such verbs do not allow comitatives or other coordination markers than *wa=* (Ibn Aqiil, 1962, II 179). This suggests that *wa=* is not only a real coordination marker, but also the only marker of genuine NP coordination.

3.2 Pronouns and Coordination

It can be noted that there is a parallelism between null conjuncts in subject NPs and pro-drop observed with simple NPs. In both cases, the zero element is the subject pronominal which is used for verbal agreement. This suggests that subject null conjuncts are *pro*-like elements:

	'You came'		'Zayd and you came'		
(13)	'atayta	['anta]	'atayta	['anta	wa=Zaydun]
	'atayta	[*pro*]	'atayta	[*pro*	wa=Zaydun]
	you.came	you	you.came	you	and Zayd

It is straightforward to assume the same status for nonnominative null conjuncts. This entails that oblique pronominals can be *pro* if they are accompanied by a bound pronoun. Further exploiting the analogy between simple pronominals

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[3]The examples without citation were judged correct by speakers of MSA, but I have not been able to find corresponding positive or negative data from CA.

and first conjuncts, I claim that pronominal arguments which are realized by a bound pronoun without being a conjunct should also be analyzed as *pro* elements. The parallelism between the postulated *pro* element and overt pronouns in simple and conjoined NPs is illustrated by (14):

	'I saw you'		'I saw you and Zayd'		
	ra'aytu(-ka$_i$)	['iyyaaka$_i$]	ra'aytu(-ka$_i$)	['iyyaaka$_i$	wa=Zaydan]
(14)	ra'aytu-ka$_i$	['anta$_i$]	ra'aytu-ka$_i$	['anta$_i$	wa=Zaydan]
	ra'aytu-ka$_i$	[*pro$_i$*]	ra'aytu-ka$_i$	[*pro$_i$*	wa=Zaydan]
	I.saw-you	you	I.saw-you	you	and Zayd

I assume that free pronouns, conjoined NPs and the abstract *pro* element are standard ways of realizing arguments. A conjoined NP represents the entire argument including arbitrary nonpronominal conjuncts, while a bound pronoun represents only a single set of index features. Free pronouns and conjoined NPs seem to occur in exactly the same positions as other lexical NP arguments. The agreement of anaphors and embedded predicates confirms that all conjuncts semantically belong to the argument position (11, 12).

This analysis closely follows standard assumptions about the syntax of Celtic languages, where pronouns and coordination interact in a very similar way, as noted by Borsley (1995) and Harbert and Bahloul (2002). In Welsh and Irish, heads can agree with pronominal arguments or the pronominal first conjunct of an argument. While Irish does not permit the appearance of a corresponding free pronoun, this is allowed in Welsh. The usual analysis is that the markers on the head are morphological agreement markers, while the argument or conjunct they represent is a pronoun, which is allowed or (in Irish) required to be empty (McCloskey and Hale, 1984, Sadler, 1988).

4 An HPSG Analysis

4.1 Licensing Null Conjuncts

Following Manning and Sag (1998) and more recent proposals, I assume that the realization of arguments is determined by the subtyping of *synsem* into *canonical-ss* and *non-canonical-ss*. *Canonical-ss* objects are realized syntactically by a sign, while *non-canonical-ss* objects which include gaps and *pro* are not realized and do not occur as the SYNSEM value of *sign* objects. Thus, any type of zero anaphora, including null conjuncts, is 'passively' licensed by allowing synsem objects to be *non-canonical-ss*. I will now show how the distribution of zero anaphora can be constrained.

Following previous HPSG analyses of coordination phenomena such as Yatabe (2004), Mouret (2006) and Chaves and Paperno (2007), I assume that coordination phrases have, in addition to their normal DTRS list, a feature CONJUNCTS containing the *synsem* objects of the conjuncts. Following these analyses, I will assume

that it is a HEAD feature, but this is immaterial for the analysis proposed here. The noninitial conjuncts on CONJUNCTS are required to be marked by the coordination clitic *wa=*, which is enforced via the feature CRD (Beavers and Sag, 2004). *wa=* is analyzed as a marker forming a constituent with the marked conjunct and therefore is not a daughter of the coordination phrase. Note that Arabic, unlike English, requires both final and middle conjuncts to be marked by *wa=*. Hence, all noninitial conjuncts are specified as [CRD +]. The only new ingredient that is needed to license null conjuncts is that CONJUNCTS is allowed to contain *pro*-elements, which are not mapped to DTRS:

(15) *coord-phrase* $\rightarrow$

$$
\begin{bmatrix}
\ldots\text{HD}|\text{CONJUNCTS} & \boxed{0} \left\langle \begin{bmatrix} \text{L}|\text{C}|\text{CRD} & - \end{bmatrix}, \\ \begin{bmatrix} \text{L}|\text{C}|\text{CRD} & + \end{bmatrix} \ldots \begin{bmatrix} \text{L}|\text{C}|\text{CRD} & + \end{bmatrix} \right\rangle \\
\text{DTRS} & \left\langle \text{SYNSEM} \quad \boxed{1}, \ldots \text{SYNSEM} \quad \boxed{n} \right\rangle
\end{bmatrix}
$$
$$
\wedge \boxed{0} = \left(\text{list}\left(\begin{bmatrix} \textit{pro-ss} \end{bmatrix} \right) \oplus \left\langle \boxed{1}, \ldots \boxed{n} \right\rangle \right)
$$

The constraint applies to all types of coordination phrases, as there is no constraint on the syntactic categories of the conjuncts or the number of conjuncts. Since conjuncts are allowed to be *pro*, pronominal null conjuncts are possible in principle. Noninitial conjuncts have to be marked, but since the only lexical item with the relevant marking is the coordination marker, they necessarily are phrases. This means that their head, the conjunct itself, is not null and only the first conjunct can be null.

This constraint accounts for the possibility of zero anaphora including null conjuncts, but it leaves open how the agreement of bound pronouns and verbs with first conjuncts (whether null or not) can be derived, and how the distribution of zero anaphora can be constrained. The remaining part of the section will address these questions.

4.2 Deriving First Conjunct Agreement

As was argued in 3.2, there is a close analogy between arguments and first conjuncts of conjoined arguments. I will attempt to develop a formal anaysis which captures this analogy and allows an account of agreement and bound pronouns for argument NPs without appeal to their internal structure.

Subject agreement and features of bound pronouns depend on features of the first conjunct. The agreement features could come either from INDEX or from a designated HEAD feature such as CONCORD, which Wechsler and Zlatic (2001) introduce to account for agreement patterns which diverge from INDEX. Since Arabic subject-verb agreement diverges from INDEX in NUMBER and sometimes GENDER and is influenced by the morphological structure of word, in particular

plural formation (Reckendorf, 1921, 24), it seems reasonable to use CONCORD for first-conjunct agreement.

An attractive idea is to treat coordination with first-conjunct agreement as headed by the first conjunct.[4] Such an analysis was developed in HPSG by Kim (2011) for verbal coordination in Korean. Applied to Arabic NP coordination, it makes the required information about the first conjunct available via the HEAD feature of the conjoined NP and provides a uniform analysis, in which all relevant features can be accessed using the HEAD value of the argument Thus, it provides a simple and elegant account of the parallelism between pronominal arguments and pronominal first conjuncts. However, there seem to be HEAD features of the conjoined NP which should not be identified with those of its first conjunct in Arabic. As mentioned earlier, preverbal subjects trigger resolved agreement and subjects of raising verbs can trigger first-conjunct agreement and resolved agreement simultaneously (9a). If the first conjunct is the head, only the CONCORD value of the first conjunct will be available on the level of the conjoined NP and resolved agreement would be expected to come from INDEX. However, agreement with preverbal subjects does not always correspond to the expected INDEX value and is influenced by morphology, mainly the type of plural formation (Reckendorf, 1921, 27). Thus, it seems that resolved agreement should be analyzed via HEAD rather than INDEX, which is difficult to implement if one conjunct is the head.

Thus, I will adopt a non-headed analysis in which both resolved and first-conjunct CONCORD values are available on the level of the conjoined NP. If CONJUNCTS is appropriate for *head*, this is already possible. However, such an analysis will have to stipulate agreement of verbs and bound pronouns for simple and conjoined argument NPs separately, missing the basic parallelism of agreement with arguments and first conjuncts. To account for this parallelism, I introduce a feature INTERNAL-HEAD (IH) which is appropriate to *cat* and mediates agreement, case and category information of the first conjunct. For words and most phrases, HEAD and INTERNAL-HEAD are identical. Coordination phrases (usually) share INTERNAL-HEAD with the HEAD value of the first conjunct.

(16)
$$
\begin{bmatrix}
\textit{coordination-phrase} \\
\text{S}|\text{L}|\text{C}
\begin{bmatrix}
\text{HEAD}
\begin{bmatrix}
\text{CONCORD} & \text{resolve}(\boxed{2}, \boxed{3}, ...) \\
\text{CONJUNCTS} & \langle \text{SS}|\text{L}|\text{C}|\text{H} \quad \boxed{1}_{\boxed{2}}, \text{NP}_{\boxed{3}}, ... \rangle
\end{bmatrix} \\
\text{INTERNAL-HEAD} \quad \boxed{1}
\end{bmatrix}
\end{bmatrix}
$$

Thus, the analysis simulates the structure sharing which would be automatically available if the first conjunct was treated as the head, but preserves information about the conjoined NP which would be lost under such a treatment. The use of such a feature is similar to the analysis of Portuguese single-conjunct agreement by Villavicencio et al. (2005), who introduce the head features LAGR and RAGR for concord values of conjuncts. The idea that heads are able to access features of single conjuncts has also been used in LFG to account for single-conjunct agreement

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[4]Special thanks to Jong-Bok Kim for suggesting this idea and stimulating discussion.

(Dalrymple and Hristov, 2010). However, INTERNAL-HEAD is used uniformly for all NPs. Thus, it allows a modular and unified account of simple and conjoined arguments, since the head can always use the argument's INTERNAL-HEAD value to decide about agreement and bound pronouns.

4.3   Optional Resolved Agreement

The analysis can be extended to account for (17), where a conjoined NP triggers resolved index features on verbs and bound pronouns. I will refer to this pattern as 'opaque coordination'. It is possible only if the NP contains a case-neutral pronominal conjunct:

(17) a. ji'naa   [Zayd-un   wa='anaa]
         came.1PL Zayd-NOM and=I.∅

         'Zayd and I came'

      b. 'alay-naa   ['anaa wa='anta] 'an...
         upon-us.OBL I.∅   and=you.∅ that...

         'it is my and your duty to...'

I analyze them simply as conjoined NPs where the INTERNAL-HEAD value is shared with the HEAD value of the entire NP, which will have resolved index features, thus providing a uniform agreement mechanism for all NPs: agreement with a verb or a bound pronoun is established by a uniform mechanism operating on the argument NP without any recourse to its internal structure.

Opaque coordination phrases are subject to some constraints (18). They never contain a null-conjunct (a) and resemble case-neutral pronouns in that they require a bound pronoun in nonnominative positions (b):

(18) a. ra'aa-naa   wa='Amran
         saw.3SG-we.OBL and=Amr.ACC

         'He saw us and Amr
         not: He saw me and Amr'

      b. * 'alaa   ['anaa wa='anta] 'an...
           upon-us.OBL I.∅   and=you.∅ that...

         'it is my and your duty to...'

Technically, the distinction between 'transparent' coordination and the 'opaque' structure in (17) can be implemented by partitioning *coordination-phrase* into *transparent-coordination* (19) and *opaque-coordination* (20), the latter being required to have a case-neutral conjunct. This is formalized using the head feature CASE-MARKED which is − for case-neutral pronouns and + for almost all other signs. *Opque-coordination* also is [CASE-MARKED −] in order to enforce the appearance of bound pronons.

(19) *transparent-coordination* →

$$
\begin{bmatrix}
\text{S|L|C} & \begin{bmatrix} \text{HD|CONJUNCTS} & \left\langle \begin{bmatrix} \text{L|C|HD} & \boxed{1} \end{bmatrix}, ... \right\rangle \\ \text{IH} & \boxed{1} \end{bmatrix}
\end{bmatrix}
$$

(20) *opaque-coordination* →

$$
\begin{bmatrix}
\text{DTRS} & \left\langle ... \begin{bmatrix} \text{S|L|C|HEAD} & \begin{bmatrix} \textit{pronoun} \\ \text{CASE-MARKED} & - \end{bmatrix} \end{bmatrix} ... \right\rangle \\
\text{S|L|C} & \begin{bmatrix} \text{HD} & \boxed{1} \begin{bmatrix} \text{CONJUNCTS} & \left\langle \textit{canonical-ss}, ... \right\rangle \\ \text{CASE-MARKED} & - \end{bmatrix} \\ \text{IH} & \boxed{1} \end{bmatrix}
\end{bmatrix}
$$

In addition to CASE-MARKED, I will use a boolean-valued head feature PRO to mark HEAD values of empty pronouns. This information must be visible for heads because empty pronouns obligatorily trigger marking on the head. Since only the HEAD value will always be accessible for the head (via INTERNAL-HEAD), this information must be encoded there.

Examples The following AVMs exemplify the analysis. In all four structures, the value used for agreement or a bound pronoun is $\boxed{0}$, but its source depends on the internal structure of the NP: In (21), it comes from the pronoun, in (22) from the null conjunct, in (23) from the overt first conjunct, and in (24) from the resolved CONCORD value of the opaque coordination phrase.

(21)
$$
\begin{bmatrix}
\textit{word} \\
\text{PHON} & \left\langle \textit{'anta} \right\rangle \\
\text{SS|LOC|CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \begin{bmatrix} \textit{pronoun} \\ \text{CONCORD} & \boxed{0} \end{bmatrix} \\ \text{IH} & \boxed{1} \end{bmatrix}
\end{bmatrix}
$$

(22)
$$
\begin{bmatrix}
\textit{transparent-coordination-phrase} \\
\text{CONJS} & \left\langle \begin{bmatrix} \text{L|C|HEAD} & \boxed{2} \begin{bmatrix} \textit{pronoun} \\ \text{CONCORD} & \boxed{0} \\ \text{PRO} & + \end{bmatrix} \end{bmatrix}, \boxed{3} \right\rangle \\
\text{DTRS} & \left\langle \begin{bmatrix} \text{PHON} & \left\langle \textit{wa=Zayd} \right\rangle \\ \text{SYNSEM} & \boxed{3} \end{bmatrix} \right\rangle \\
\text{S|L|C|IH} & \boxed{2}
\end{bmatrix}
$$

(23)
$$\begin{bmatrix} \textit{transparent-coordination-phrase} \\ \text{CONJS} \quad \left\langle \boxed{1}\begin{bmatrix} \text{L|C|HEAD} \quad \boxed{2}\begin{bmatrix} \textit{pronoun} \\ \text{CONCORD} \quad \boxed{0} \end{bmatrix} \end{bmatrix}, \boxed{3} \right\rangle \\ \text{DTRS} \quad \left\langle \begin{bmatrix} \text{PHON} \quad \langle \textit{'anta} \rangle \\ \text{SYNSEM} \quad \boxed{1} \end{bmatrix}, \begin{bmatrix} \text{PHON} \quad \langle \textit{wa=Zayd} \rangle \\ \text{SYNSEM} \quad \boxed{3} \end{bmatrix} \right\rangle \\ \text{S|L|C|IH} \quad \boxed{2} \end{bmatrix}$$

(24)
$$\begin{bmatrix} \textit{opaque-coordination-phrase} \\ \text{CONJS} \quad \left\langle \boxed{1}\begin{bmatrix} \text{LOC|CAT|HEAD} \quad \textit{pronoun} \end{bmatrix}, \boxed{2} \right\rangle \\ \text{DTRS} \quad \left\langle \begin{bmatrix} \text{PHON} \quad \langle \textit{'anta} \rangle \\ \text{SYNSEM} \quad \boxed{1} \end{bmatrix}, \begin{bmatrix} \text{PHON} \quad \langle \textit{wa=Zayd} \rangle \\ \text{SYNSEM} \quad \boxed{2} \end{bmatrix} \right\rangle \\ \text{S|L|C} \quad \begin{bmatrix} \text{HEAD} \quad \boxed{3}\begin{bmatrix} \text{CONCORD} \quad \boxed{0} \end{bmatrix} \\ \text{IH} \quad \boxed{3} \end{bmatrix} \end{bmatrix}$$

4.4 Bound Pronouns

Now that we have the basic machinery for licensing null conjuncts and first conjunct agreement in place, it remains to show that the account given for pronominal arguments and coordination properly interacts with subject agreement and bound pronouns.

Subject agreement in Arabic is a complex issue, the main difficulty being that postverbal nonpronominal subjects show a special, usually reduced agreement pattern (cf. Aoun et al. (2010) for MSA, Reckendorf (1921) for CA). However, there seem to be no differences between postverbal simple and conjoined subjects other than those captured by the INTERNAL-HEAD feature. Thus, we will assume that subject agreement can be captured by an extension of usual HPSG mechanisms for morphological subject agreement, targeting INTERNAL-HEAD for postverbal and HEAD for preverbal subjects. Bound pronouns are more interesting here, since their syntactic status has not yet been established with certainty in the literature. This section will outline an analysis of bound pronouns and show how it interacts with the previous parts of the analysis.

4.4.1 Affixes or Clitics?

Bound pronouns in Arabic have been treated in previous generative studies mostly as clitics (Borsley, 1995). Similar data has been discussed in the context of several other languages, most notably Romance languages. Based on criteria by Zwicky and Pullum (1983), Miller and Sag (1997) and more recent studies argue that

French bound pronouns are best treated not as clitics, but as inflectional affixes.

If a word hosts more than one bound pronoun, several ordering constraints apply (Wright, 1896-98, Ibn Aqiil, 1962, I 94, Ibn Al-Sarraj, 1985, II 120). Usually, pronouns have to be ordered according to person and in an ordering which seems to correspond to the obliqueness hierarchy which becomes visible in binding and passivization. While it is possible to have two pronouns of the same person, it is not possible for them to agree on all index features. Although untypical for words, such ordering restrictions could be implemented syntactically as a constraint on valence lists.

Two classical affix criteria, *high degree of selection* and lack of *wide scope over coordination*, also apply to genitive NPs, which behave exactly like bound pronouns in these respects. On the other hand, bound pronouns show a wide range of morphophonological idiosyncrasies.[5]

Some can be described by conditioning the morphological form on the appearance of bound pronouns on a valence list. For instance, some prepositions do not host bound pronouns (*wa=* 'with' and *ka=* 'like') or show idiosyncratic forms (*li* 'to' and *'alaa* 'on' become *la* and *'alay*). *min* 'from' and *'an* 'from' change to *minn* and *'ann* only in front of the first person singular pronoun *ii*.

Some could described phonologically by stipulating sandhi effects between adjacent words by machinery such as that described by Tseng (2009). The conjugational suffix *-tum* 'PAST.2PL' and the bound pronoun *-kum* become *-tumuu* and *-kumuu*, respectively if followed by a bound pronoun or by a word starting with two consonants (Ibn Al-Sarraj, 1985, II 124). This approach is less attractive in some other cases: Pronouns starting with *hu-* change to *hi-* after *i* or *y*, and *-ii* is realized as *ya* after long vowels or *y*, erases preceding short vowels, and assimilates preceding *uu/w* to *iy/y*.

Furthermore, there are optional idiosyncratic forms whose description crucially requires information about the morphological structure of the host. For instance, the conjugational suffix *-ti* PAST.2SG.F can be lenghthened, stem-final *-aa* can become *ay* if the underlying root ends in *y* and *-na* IMPF.M.PL/2SG.F can be erased by a bound pronoun starting with *-n*. Notably, these rules only apply to inflected verbs, but not to phonologically similar nominal hosts. Furthermore, *-ii* I.GEN has optional variants (*-i*, *-iya*, *-aa*) after vocative nouns. Certain complementizers have optional idiosyncratic contracted forms with first person pronouns, such as *laytii* for *layta-nii* 'if only I'.

These idiosyncrasies present strong evidence for a morphological analysis of bound pronouns. However, binding theory presents a potential counterargument. According to a generalization proposed by Mohammad (2000), a bound pronoun *X* is not allowed to precede a coreferent (nonpronominal) NP *Y* if the host of X c-commands Y. It seems that a morphological analysis of bound pronouns would

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[5]The discussion is based on Wright (1896-98) I 102, 285. Most of the optional ones seem not to be found in MSA. Some idiosyncrasies were dialect-specific in CA, see e.g. Ibn Aqiil (1962) I 100 for *min, 'an*, Ibn Al-Sarraj (1985) II 123-125 for *ka=* and *-kum-uu*

require that the Arabic version of Condition C 'looks into' the morphological structure of words, or else that dependents or conjuncts realized by a bound pronoun are marked as such somewhere on a valence list, which is not motivated independently. On the other hand, a syntactic analysis would require additional machinery making morphological information available to the computation of the phonology of adjacent words. Since the amount of additional machinery in this case seems to outweigh that apparently needed to formalize the binding restrictions, I take the morphological idiosyncrasies, in particular the last group, as convincing evidence that Arabic bound pronouns are best analyzed as affixes. In any case, this conclusion has no bearing on the analysis of coordination, since the access to INTERNAL-HEAD in the morphological computation of affixes can be reimplemented syntactically.

4.4.2   Bound Pronouns and Argument Structure

It seems that not all arguments which are realized or accompanied by a bound pronoun are on ARG-ST. First, adverbial modifiers like *yawma ljum'ati* 'on Friday' can be extracted, leaving a resumptive realized by a bound pronoun (Sibawayh, 1988, I 84). Second, complements of subject-to-object raising verbs, whether realized as a bound pronoun or otherwise, seem not to be locally o-commanded by the subject in CA and (earlier) MSA. This is suggested by the fact that the complement of such verbs, even if coreferent with the subject, cannot be an anaphor (Sibawayh, 1988, cf. Cantarino, 1974-5, II 424 for MSA). This contrasts with all other verbs, which require an anaphor in this case:

(25) a. ḥasib-tu   Zayd-an   fa'al-a   kadhaa wa=kadhaa
          consider.PAST-1SG Zayd-ACC do.PAST-3SG so   and=so
          'I thought Zayd had done this and that'

   b. ḥasib-tu-nii   fa'al-tu   kadhaa wa=kadhaa
       consider.PAST-1SG-I.ACC do.PAST-1SG so   and=so

   c. * ḥasib-tu   nafs-ii   fa'al-tu   kadhaa wa=kadhaa
       consider.PAST-1SG self-1SG.GEN do.PAST-1SG so   and=so
       'both: I thought I had done this and that (Sibawayh, 1988, II 367)'

(26) a. ḍarab-tu   nafs-ii
          strike.PAST-1SG self-I.GEN

   b. * ḍarab-tu-nii
       strike.PAST-1SG-I.ACC
       'I struck myself'

Under the standard HPSG assumption that ARG-ST is the locus of binding theory (Manning and Sag, 1998), this can be accounted for easily by assuming that such complements are not on the ARG-ST list of the raising verb. This also makes

sense in that such complements do not fill a semantic role of the raising verb and can also be an expletive, the so-called *ḍamiir al-sha'n*.

Thus, I will assume that such complements are not present on ARG-ST and are added by the mapping from ARG-ST to the valence lists. I will adopt an extension of the argument structure mechanism introduced by Bouma et al. (2001). Elements of the form described are introduced by the *Argument Extension Principle* to a valence list called DEPS, which contains the members of ARG-ST and certain adjuncts. Its *canonical-ss* elements are mapped to SUBJ and COMPS (27).

Adopting this style of analysis is motivated language-internally also by the fact that case-marked adjuncts (e.g., *amaama* 'in front of', *saa'atayni* 'two hours' and cognate objects) can have nominative case in intransitive passives (Sibawayh, 1988).

This account can now be extended straightforwardly to capture Arabic bound pronouns. We briefly summarize the relevant generalizations. Whether a complement is realized by a bound pronoun depends on its INTERNAL-HEAD value: *pro* and case-neutral pronouns require a bound pronoun, other pronouns may have an optional bound pronoun, while nonpronominals are not doubled by a bound pronoun. This is formalized by constraint (28). The DEPS list can first be partitioned into the subject list $\boxed{4}$ and the remainder $\boxed{3}$, consisting of *canonical* and *non-canonical* complements and adjuncts. $\boxed{3}$ is passed to a function which adds bound pronouns to the word's morphology, following Miller and Sag (1997).

(27) **Argument Realization:** (adapted)

$$word \rightarrow \begin{bmatrix} \text{SS}|\text{L}|\text{C} & \begin{bmatrix} \text{SUBJ} & \boxed{1} \\ \text{COMPS} & \boxed{2} \ominus \text{list(non-canonical-ss)} \\ \text{DEPS} & \boxed{1} \oplus \boxed{2} \end{bmatrix} \end{bmatrix}$$

(28) **Bound Pronoun Realization:** (new, language-specific)

$$word \rightarrow \begin{bmatrix} \text{MORPH} & \begin{bmatrix} \text{FORM} & \textbf{F\_PRON}(\boxed{1}, \boxed{2}, \boxed{3}) \\ \text{I-FORM} & \boxed{1} \end{bmatrix} \\ \text{SS}|\text{L}|\text{C} & \begin{bmatrix} \text{HEAD} & \boxed{2} \\ \text{SUBJ} & \boxed{4} \\ \text{DEPS} & \boxed{4} \oplus \boxed{3} \end{bmatrix} \end{bmatrix}$$

F_PRON has to account for several morphological phenomena and its precise definition is outside the scope of this paper. Nonetheless, the possible patterns of optional and obligatory realization of bound pronouns presented in (14) can be described straightforwardly using the representation for pronouns and coordination structures proposed in 4.3. Whether the function adds a bound pronoun for some argument only depends on the INTERNAL-HEAD value of the argument. Only elements whose INTERNAL-HEAD value satisfies [*pronoun*] or [C-M −] can give rise to a clitic. Descriptively, this corresponds to pronouns and also opaque coordination patterns. On the other hand, elements satisfying [PRO +] or [C-M −],

which correspond to empty pronouns, case-neutral pronouns and opaque coordination, obligatorily trigger the appearance of a bound pronoun. The computation of **F**-PRON is nondeterministic in the sense that bound pronouns are optional for an element which satisfies [*pronoun*], [PRO −] and [C-M +], i.e. a free accusative pronoun. The choice of the appropriate bound pronoun for a certain argument is also based on INTERNAL-HEAD and depends only on the values of INTERNAL-HEAD|CONCORD and INTERNAL-HEAD|CASE.

4.5   Example: Verb Combining with Conjoined NP

The following example, repeated from (5a), illustrates the proposed analysis. It features a pronominal null conjunct in the complement and a corresponding bound pronoun on the verb:

(29) ra'ay-tu-ka   wa=Zaydan
     see.PAST-1SG-you.OBL and=Zayd.ACC

     'I saw you and Zayd'

The conjoined NP [*pro wa=Zaydan*] and the verb *ra'aytuka* receive the structures in (30). The transitive verb *ra'aytuka* has two arguments, of which the subject is null and the complement *canonical*. The latter is a coordination phrase whose first conjunct is null. Its INTERNAL-HEAD value mediates the HEAD features of the first conjunct, which are needed by the computation of the corresponding singular affix on the verb.

$$
(30) \begin{bmatrix} \textit{transparent-coordination-phrase} \\ \text{PHON} \quad \text{wa=Zaydan} \\ \text{DTRS} \quad \left\langle \begin{bmatrix} \text{PHON} \quad \text{wa=Zaydan} \end{bmatrix} \right\rangle \\ \text{SS} \quad \boxed{1} \begin{bmatrix} \textit{canonical-ss} \\ \text{L|C} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \text{CASE} \quad \textit{acc} \\ \text{CONCORD} \quad \text{2PL.M} \\ \text{CONJUNCTS} \left\langle \boxed{3} \begin{bmatrix} \textit{pro\_ss} \\ \dots\text{HEAD} \quad \boxed{2} \end{bmatrix}, \textit{canonical\_ss} \right\rangle \end{bmatrix} \\ \text{IH} \quad \boxed{2} \begin{bmatrix} \textit{pronoun} \\ \text{CASE} \quad \textit{acc} \\ \text{CONCORD} \quad \text{2SG.M} \\ \text{PRO} \quad + \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}
$$

$$\begin{bmatrix} word \\ \text{PHON} \quad \text{ra'aytuka} \\ \text{ARG-ST} \quad \left\langle \boxed{0}\,pro\_ss\text{:NOM},\ \boxed{1}\ canonical\text{-}ss\text{:ACC} \right\rangle \\ \text{MORPH|FORM} \quad \text{F\_PRON}(...,...,\langle\boxed{3}\rangle) \\ \text{SS|L|C} \quad \begin{bmatrix} \text{DEPS} \quad \langle \boxed{0},\boxed{1} \rangle \\ \text{COMPS} \quad \langle \boxed{1} \rangle \\ \text{SUBJ} \quad \langle \boxed{0} \rangle \end{bmatrix} \end{bmatrix}$$

4.6 Appendix: Case in Coordination

Up to now, most coordination examples had the same case-marking on all conjuncts. However, if the first conjunct is a case-neutral pronoun, non-initial conjuncts are allowed to have nominative marking:

(31) a. taẓaafuru-*hu* [*huwa* wa='Abuu   Sa'd]
       help-he.OBL [he.∅   and=Abu.NOM Sa'd]

       'his and Abu Sa'd's help (Reckendorf, 1921)'

Given the architecture for coordination employed here, it is straightforward to spell out the generalizations formally:

(32) $\begin{bmatrix} \text{CONJUNCTS} \quad \text{list(nominal)} \end{bmatrix} \rightarrow$

$\begin{bmatrix} \text{CONJUNCTS} \quad \text{list(L|C|H|CASE} \quad \boxed{1}) \\ \text{CASE} \qquad\qquad \boxed{1} \end{bmatrix}$

$\vee \begin{bmatrix} \text{CONJUNCTS} \quad \left\langle \text{L|C|H} \begin{bmatrix} \text{CASE} \qquad\qquad \boxed{1} \\ \text{CASE-MARKED} \quad - \end{bmatrix} \right\rangle \\ \qquad\qquad\quad \oplus \text{list(L|C|H|CASE} \quad \text{nom)} \\ \text{CASE} \qquad\qquad \boxed{1} \end{bmatrix}$

Furthermore, case-neutral pronouns are not allowed to occur as non-initial conjuncts in positions where a lexical NP would show nonnominative case marking:

(33) a. *ra'aytu [Zayd-an   wa=hum]
       saw.1SG Zayd-ACC and=they.∅

       'I saw Zayd and them'

Note that (17b) is not a counterexample to this generalization, because the first conjunct is case-neutral, i.e. allows the second conjunct to have nominative case according to (32). The generalization is formalized by the following constraint:

(34)
$$\begin{bmatrix} \text{CONJS} & ne\_list \oplus \left\langle \ldots\text{HD} \quad \boxed{1}\begin{bmatrix} pronoun \\ \text{CASE} & \neg\ nom \end{bmatrix} \right\rangle \oplus list \\ \rightarrow \boxed{1}\begin{bmatrix} \text{CASE-MARKED} & + \end{bmatrix} \end{bmatrix}$$

The complex antecedent and the disjunction in (32) and (34), which mirror the structure of the pretheoretical linguistic generalization, could be eliminated by splitting *coordination-phrase* into several types.

As these additional rules affect only noninitial conjuncts, whose CASE feature is irrelevant for the appearance of bound pronouns according to the analysis proposed here, (32) and (34) do not interfere with the remainder of the analysis in any undesired way and provide a straightforward formalization of the data.

5 Conclusions

I have argued that Arabic first conjuncts can be null and that this phenomenon is an instance of a more general pattern of zero anaphora. It was shown that null conjuncts can be licensed using common assumptions about coordination strutures in HPSG. First-conjunct agreement and constraints on bound pronouns suggest feature sharing via a new head feature INTERNAL-HEAD, which allows a uniform analysis of agreement and bound pronouns and of simple and conjoined argument NPs. Furthermore, I argued that Arabic bound pronouns should be analyzed as affixes and presented an analysis of their relation to argument structure and their interaction with coordination. It was also shown how constraints on case marking in Arabic coordination can be formalized. The analysis has been computationally implemented as part of an Arabic grammar fragment in the TRALE system.

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