Making additive complex cardinals without coordination

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Issue: This study investigates the syntax of additive complex cardinals such as "21". Ionin & Matushansky (2018) (hereafter, [I&M 2018]) pursue an analysis in which additive complex cardinals have a coordinate structure of two nominals. According to their analysis, additive complex cardinals are derived by NP-deletion of one of the nominals in the coordinate structure, as in (1).

(1) $[_{\&P}\ [_{NP1}$ TWENTY ~~$[_{NP1}$ GIRL~~$]]$ & $[_{NP2}$ TWO $[_{NP2}$ GIRL$]]] \Rightarrow$ 'twenty two girls' [I&M 2018]

This study argues that in addition to the coordinate structure as in (1), additive complex cardinals can also have a non-coordinate structure. Specifically, I propose that a lower-valued cardinal ("one" in "twenty one") can directly adjoin to a higher-valued cardinal ("twenty" in "twenty one"). The major motivation for the existence of the non-coordinate structure comes from ❶ the human classifier *ri* in Japanese and ❷ the opacity of "one" in Polish.

The human classifier *ri* in Japanese: Japanese is an obligatory classifier language, and cardinals must co-occur with an appropriate classifier to modify a noun. Japanese has two types of human classifier; *nin* and *ri*. Crucially, the classifier *ri* has a contextual restriction regarding the type of cardinal they combine with. It co-occurs with the native Yamato cardinals *hito* 'one' and *huta* 'two', as in (2a), but not with the Sino-Japanese cardinals *ichi* 'one' and *ni* 'two', as in (2b).

(2) a. *gakusei* {*hito* | *huta*}*-ri*
student one two-CLS
'{one | two} student(s)'

b. *gakusei* {**ichi* | **ni*}*-ri*
student one two-CLS
'{one | two} student(s)' [Japanese]

This contextual restriction of *ri* is violated when the native Yamato cardinals appear inside additive complex cardinals, as shown in (3a). In this environment, the classifier *nin*, which is an elsewhere exponent of the classifier head specified for human beings (Watanabe 2010, 2014), must be used together with the Sino-Japanese cardinals, as shown in (3b).

(3) a. *gakusei yonzyuu* {**hito* | **huta*}*-ri*
student forty one two
'forty {one | two} students'

b. *gakusei yonzyuu* {*ichi* | *ni*}*-nin*
student forty one two
'forty {one | two} students' [Japanese]

Under [I&M 2018]'s coordination analysis, additive complex cardinals are treated as cases of NP-coordination, and (3a) should include the whole noun phrase in (2a) as one of the conjuncts. Therefore, [I&M 2018]'s analysis does not expect the contrast between (2a) and (3a). If, however, a non-coordinate structure is available for additive complex cardinals, the contrast can be accounted for. Following Watanabe (2010) and Huang & Ochi (2014), I assume that Japanese post-nominal classifier phrases have the structure given in (4a). Here, the classifier takes a noun as its complement, and the complement noun moves to a higher position in the extended nominal projection.

(4) a. $[\ [_{NP}$ STUDENT$]\ [_{ClsP}$ {*hito* | *huta*} $[_{Cls'}\ [_{Cls}$ *ri* $]\ \Delta_{NP}\ ]\ ]\ ]$

b. $[\ [_{NP}$ STUDENT$]\ [_{ClsP}\ [_{\#P}\ [_{\#P}$ *yonzyuu* $]$ {*hito* | *huta*} $]\ [_{Cls'}\ [_{Cls}$ *ri* $]\ \Delta_{NP}\ ]\ ]\ ]$

I assume that *ri* can be used only when the classifier head is in a Spec-Head configuration with *hito* or *huta*. The unacceptability of (3a) can now be captured by assuming that (3a) has the non-coordinate structure given in (4b). Here, the lower-valued cardinal directly adjoins to the higher-valued cardinal (i.e. *yonzyuu* 'forty'). Since the lower-valued cardinal is not in a Spec-Head configuration with the classifier head, the contextual restriction of *ri* is violated. The same problem does not arise when *hito* and *huta* are used as simplex cardinals because they occur in Spec,ClsP, as in (4a). The contrast between (2a) and (3a) can thus be seen as support for the existence of the non-coordinate structure of additive complex cardinals.

The opacity of "one" in Polish: Support for the non-coordinate structure also comes from a non-classifier language; Polish. In Polish, the cardinal "one" is normally adjectival, and shows agreement with a noun in number, case and gender, as shown in (5a). However, when "one" appears in an additive complex cardinal, this agreement is blocked, as shown in (5b).

(5) a. *Jan zobaczył* { **jeden* | *jedną* } *dziewczynę.*
Jan saw one.NOM.M one.ACC.F girl.ACC.SG.F
'Jan saw one girl.' [Polish]

b. *Jan zobaczył dwadzieścia* { *jeden* | **jedną* } *dziewcząt.*
Jan saw twenty.NV.ACC one.NOM.M one.ACC.F girl.GEN.PL
'Jan saw twenty-one girls.' [Polish]

Under [I&M 2018]'s analysis, the object noun phrases in (5) will have the following structures.

(6) a. [$_{NP}$ ONE [$_{NP}$ GIRL]] b. [$_{\&P}$ [$_{NP1}$ TWENTY ~~[$_{NP1}$ GIRL]~~] & [$_{NP2}$ ONE [$_{NP2}$ GIRL]]]

In (6a), the cardinal "one" is an adjunct to the NP, and it exhibits agreement with the head noun. On the other hand, the object noun phrase in (5b) will have the structure in (6b) under [I&M 2018]'s analysis. Crucially, the cardinal "one" and the head noun locally form a constituent in (6b), just like (6a). Given this, it is not clear how to capture the contrast in (5) under [I&M 2018]'s analysis.

To account for the contrast in (5), I propose that the additive complex cardinal in (5b) has the non-coordinate structure represented in (7).

(7) [$_{NP}$ [$_{\#P}$ [$_{\#P}$ TWENTY] ONE] [$_{NP}$ GIRL]] [Non-coordinate structure]

What is important here is that the cardinal "one" is an adjunct to the higher-valued cardinal (i.e. "twenty") in (7), and it is not associated with the NP. As a result, "one" in (7) does not receive relevant features from the NP. We assume that *jeden* is an elsewhere exponent of the cardinal "one" in Polish. When other more specified exponents are independently blocked, "one" is realized as *jeden*. The elsewhere exponent *jeden* must be used in (7) because the cardinal "one" does not have relevant feature specifications. In contrast, when "one" is used as a simplex cardinal, it has the structure in (6a). Here, "one" is an adjunct to the NP, and it receives relevant features from the NP. The contrast in (5) can thus be accounted for by assuming the non-coordinate structure in (7).

It should be noted that I am not claiming that [I&M 2018]'s coordinate structure is unavailable in human languages. For instance, the opacity of a lower-valued cardinal is observed in Polish only when the cardinal "one" is used. As shown in (8), the paucal cardinal "two" must agree with the head noun, even when it occurs in an additive complex cardinal. (Note also that the opacity of "one" is not observed in other Slavic languages such as Russian and Serbo-Croatian.)

(8) a. *Jan zobaczył dwie dziewczyny.*
Jan saw two.ACC.F girl.ACC.PL.F
'Jan saw two girls.' [Polish]

b. *Jan zobaczył dwadzieścia dwie dziewczyny.*
Jan saw twenty.NV.ACC two.ACC.PL.F girl.ACC.PL.F
'Jan saw twenty-two girls.' [Polish]

The agreement pattern in (8) is expected under [I&M 2018]'s coordination analysis. As shown in (6b), a lower-valued cardinal is locally associated with the head noun in the coordinate structure, and it receives relevant features from the head noun. Given this, I conclude that the coordinate structure is in principle available. However, the non-coordinate structure is also needed to account for the data from Japanese and Polish.

Selected References: Ionin, T. and O. Matushansky. 2018. *Cardinals: The syntax and semantics of cardinal-containing expressions*. Cambridge, MA: MIT Press. Watanabe, A. 2010. Vague quantity, numerals, and natural numbers. *Syntax* 13: 37-77.