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On the processing of agreement morphology

This paper is about the role played by morphology in core syntax within a generative minimalist framework, it is specifically about the theory of valuation of agreement or φ–features (that is person and number features) and of tense or τ–features as realized on verbs, and it has a second part where I deal with the computation of agreement and tense features according to the neuroimaging literature.

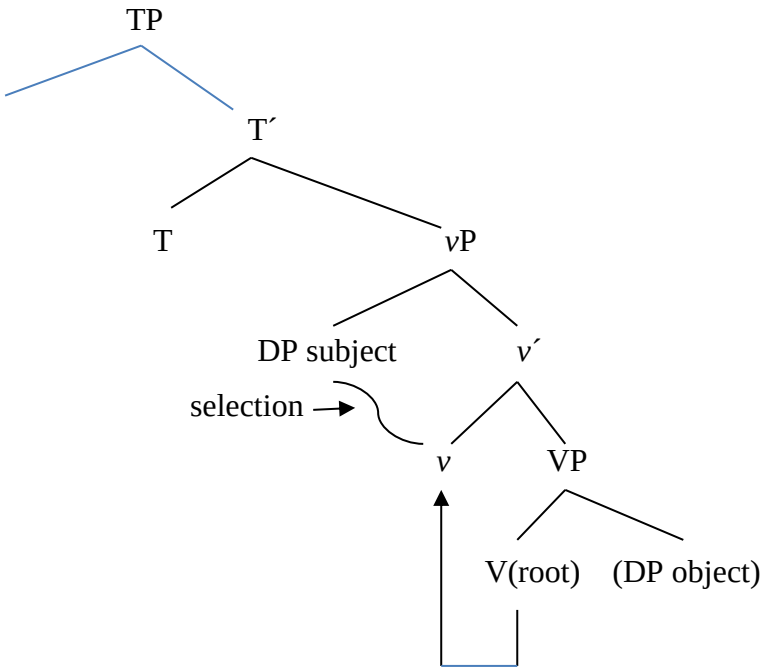
I assume that morphology is part of narrow syntax, at least the morphology of agreement features and tense features that is realized on verbs, since this morphology appears to be at the core of the interplay between T, *v*/V and the nominal (as regards inflectional languages). The idea that I would like to defend from the perspective of syntactic theory is that agreement features and tense features are valued by two distinct heads, namely *v* and T, rather than by T, as in standard frameworks (see the seminal work of Chomsky (2000, 2001), and also of Pesetsky & Torrego (2001, 2004/2007). That is, in contrast to the generalized account, where T is argued to have both agreement features and tense features to value or license, I would like to argue that it is the head *v* that values agreement features at a first stage in the derivation, and that later, at a subsequent stage, matching between agreement features as valued by *v* and tense features as valued by T applies.

For the head T to be considered to value both agreement and tense features is based in the standard framework on the fact that in several languages both kinds of features appear realized as indivisible morphological units (as when the *–s* ending in e.g. *walks* is characterized as 3rd person singular present). This can of course be contested by saying that agreement features and tense features appear as distinct realized morphemes in inflectional languages with a richer amount of morphological markers (that is segments with a phonological matrix). There appear to be solid arguments both from the point of view of linguistic theory and from an empirical point of view (but also still within the linguistic domain) in support of the hypothesis that agreement features and tense features are licensed by different heads at different stages in the process of

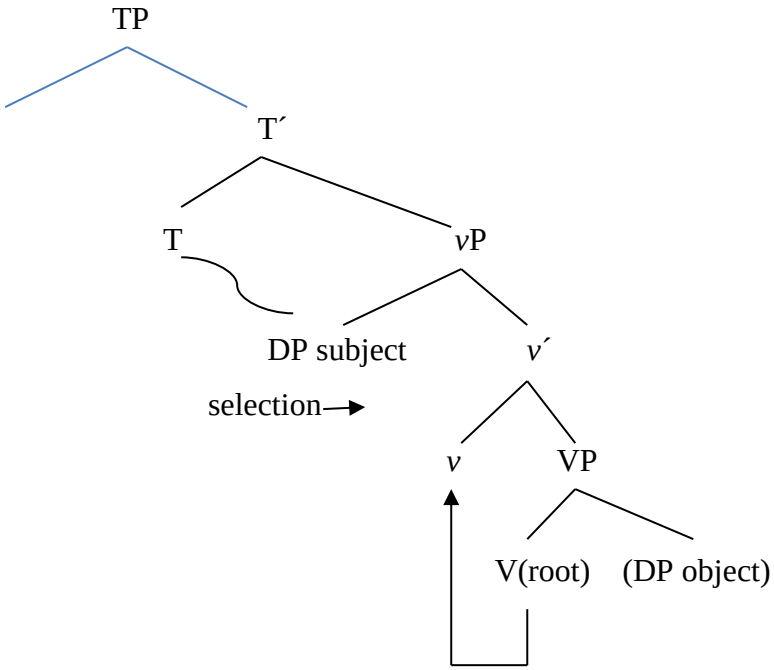
derivation. And this is actually what I would like to argue for initially. Later, I will focus on the argumentation from a neurobiological perspective.

From the point of view of the theory of derivation in minimalist syntax (which consists, as is widely-known, in the basic operations of Merge and Agree) and assuming that linguistic items merge in bottom-up fashion, it is the case that *v* gets to know the DP subject before T is merged. Thus, V merges first in the derivation (and it optionally s-selects a DP object in its sister position) and then on top of VP the functional head referred to as little *v* is merged, and this head s-selects a DP subject. The DP subject is merged with both interpretable and valued agreement features: that is, the DP is the element contributing person and number features, and it is selected by *v*, therefore a relation is established at this stage between the two, *v* and DP. This is shown in the tree in (1a), which is to be contrasted with the standard approach in (1b).

(1)a. (proposed account)



b. (standard account)



Before going on with the process of derivation, that is with the Merge of T and the valuation of tense features, I would like to introduce the second argument supporting the idea that it is *v* that values φ–features: this argument consists in that the set of morphological markers of agreement is as a rule quite uniform across tenses, a circumstance that is particularly relevant as regards languages like Spanish, Italian or Portuguese, which exhibit a large number of tenses. In the case of e.g. Spanish, the corresponding agreement–set is as in (2).

(2) 1st person sing.: –Ø or –o/–Ø

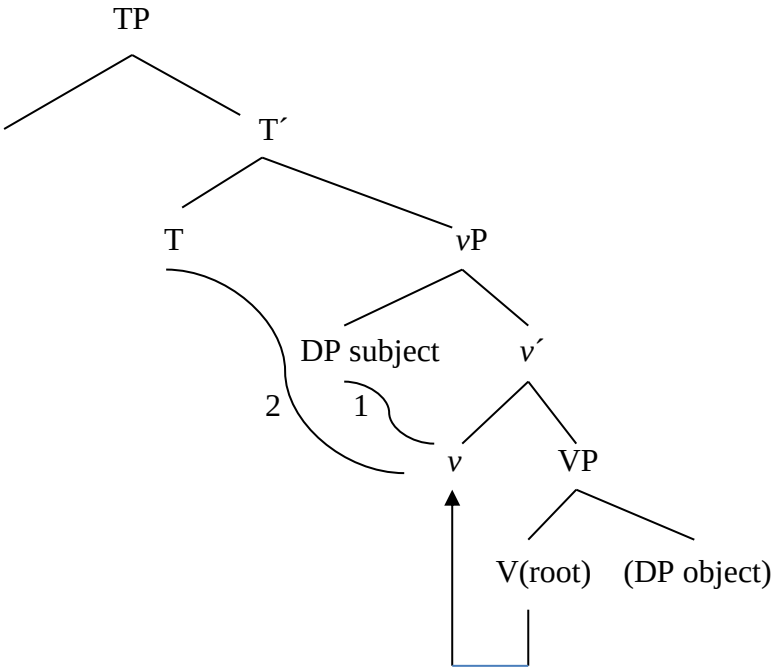
2nd person sing.: –s or –ste

3rd person sing.: –Ø
1st person plur.: –mos
2nd person plur.: –is
3rd person plur.: –n

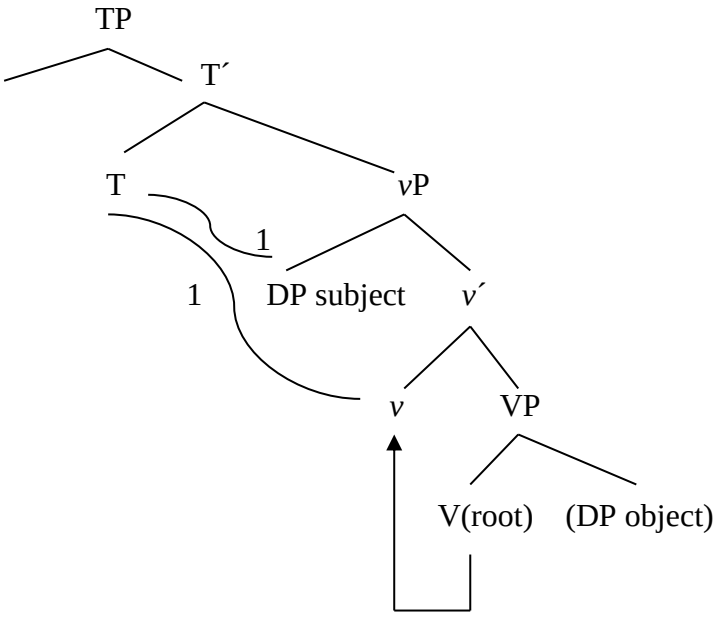
Turning to the specific process of derivation, the description of the latter is completed by assuming that T merges on top of *v*P, which means that the valuation of tense features of T against *v* applies. Note again the tree-diagram in (3a) on the one hand,

where the licensing of the cited tense or τ–features appears marked as *2*, and the corresponding standard account in (3b) on the other, where the notation *1* is used to indicate the licensing of both τ–features and φ–features, since both are generally argued to be valued by T.

(3) a. (Incorporation of the licensing of –features: proposed account)



b. (standard account)



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As observed in the text above, matching between agreement features and tense features must apply and, as I would like to argue, this is the case for a language with relative rich inflectional morphology as e.g. Spanish, where matching must apply as regards 1st and 2nd person sing. (see the twofold choice in (2)) and, crucially, it is also the case for a language with relative scarce morphology as English.

In other words, according to the standard account, the morphological realization corresponding to a language like English would be roughly as in (4).

(4) [+present]: all persons *–Ø* except 3p.sing.: *–s*

[–present]: all persons *–ed*

By contrast, the position that I do defend is that, if the valuation of agreement or φ–features and tense or τ–features is as in (3a), then the morphological division will be as in (5). In other words, two options are always initially kept available for agreement features until T values [+present] or [–present]. This means that a syntactic operation must apply regarding the combination of agreement features and tense features, even for a language like English.

(5) [+present]
all persons except 3rd p. sing.: *–Ø –Ø*
3rd person sing.: *–Ø –s*

[–present]
all persons: *–ed –Ø*

Incidentally, a generalized morphological template could be as in (6).

(6) root + stem vowel + tense/mood + agreement
stem
example: *cant-<u>á</u>-<u>ba</u>-<u>mos</u>* (‘we used to sing’)

It is therefore possible to postulate that agreement features are valued by *v* whereas tense features are valued by T. Incidentally, from the point of view of semantics or interpretation, each kind of feature has of course its own justification: agreement features identify the individuals involved in the event or situation described, and tense features contribute to providing a location in time for the event or situation.

The proposal that I have defended in the first part of the paper is thus the one in (7a) below.

(7) a. Regarding linguistic theory:

Postulation of the idea/hypothesis that agreement features and tense features are valued by two distinct heads: *v* and T, respectively.

In what follows, I would like like to focus on the neurolinguistic domain, and to defend the argumentation of the three aspects below.

b. Regarding the neuroanatomy of language:

1. Acknowledgement of the plausible identification of distinct areas for the computation/processing of agreement features on the one hand and tense features on the other.
2. Postulation of the idea/hypothesis that the computation of agreement features and tense features is the same cross-linguistically irrespective of whether the morphological marker(s) in question is/are *zero* or not.
3. Postulation of the idea/hypothesis that the processing of verbal 'morphological richness' actually corresponds to the activation of the frontal areas that neuro-scientists have typically identified as areas of 'phonological processing.'

I would like to begin by saying that my field of expertise is not neuroimaging, but I believe that this must arguably be the most accurate way to getting to know the 'real' processing of language. In the specific case at hand, aiming to detect whether agreement or φ–features and tense or τ–features have each a different neural signature should of course mean aiming to discern extremely subtle or delicate processes.

Now, two hallmarks can be distinguished generally speaking in the studies of the last 10 to 15 years as regards verbal inflectional morphology. One is that the parts of the LIFG (left inferior frontal gyrus) that are known as BA44 and BA45 (traditionally Broca´s area) are ones where both tense and agreement features are processed (see Sahin et al. 2009; Finocchiaro et al. 2010; Kielar et al. 2011; Friederici 2011, 2012; Shapiro et al. 2012). And another is that the computation of syntax and also of what many authors in the neuroimaging literature call the computation of morphology (which for me is actually also the computation of syntax) is not located exclusively in that frontal area, but that there are in fact what are known as fronto-temporal networks, where both dorsal and ventral pathways play a very relevant function (see Friederici 2013; van der Lely & Pinker 2014; Skeide & Friederici 2016).

With regard specifically to (7b.1) above, works like Shapiro et al. (2012) or van der Lely & Pinker (2014) appear to have detected slightly different brain areas for the computation of tense features and agreement features, respectively. Also, in a crucial way, neuropsychological discussions like Gavarró & Martínez-Ferreiro (2007) and references cited therein have argued that agrammatic subject speakers typically show a higher degree of impairment regarding tense features as compared to agreement features. The contribution that I would like to make here is relative to the conditions that the linguistic paradigm, that is the set of linguistic stimuli that are presented to the subject speakers in the experiment, must fulfil, namely: inclusion of both overt and covert tasks; verification that what is being measured is how the speaker processes/constructs a sentence, and not just how the speaker goes through/recites a full paradigm of forms; use of 'minimal' sentences; testing of different languages in the same experiment.

With regard to (7b.2), the hypothesis to be postulated on an account like the one proposed in this paper consists in that the computation of agreement features and tense features must be the same in a universal way, irrespective of whether the morphological marker is *zero* or not. That is, the idea that I defend is that, in case a *zero* morphological markers represents a syntactic feature (in the theory), then the processing of such *zero* marker must entail neural activation proper.

Now, plausible evidence in favour of the cited hypothesis is that, although the phonological realization of morphemes is the same as regards e.g. the singular-plural alternations of 3rd pers. for verbs and nouns in a language like English, the processing of verbs implicates more syntactic operations, a conclusion that is reached in manifold studies: see Yu et al. (2013) and references cited therein.

Very importantly, on the present proposal, present tense and past tense forms should consist of two syntactic operations, that is, they involve the computation of two syntactic features (see (5) above). The results of several studies (see e.g. Kielar et al. (2011) or works cited in Gavarró & Martínez-Ferreiro (2007)) appear to indicate that past tense forms involve the activation of more areas than present tense forms, or similarly that the production/comprehension of agrammatic subject speakers is more impaired as regards past tense verbs. However, this does not necessarily contradict the hypothesis in (7b.2) since, as noted by Kielar et al. (2011), several authors have referred to the past as involving the awareness of two locations or divisions in time (and the

same would go for any tense other than the present). That is, it can be the case that additional areas relative to semantics (and therefore strictly speaking independent of syntactic computation) must be involved in the processing of non-present cases.

As a second piece of evidence in favour of (7b.2), I would like to cite the big contrast reported in a study like Gavarró & Martínez-Ferreiro (2007) regarding the amount of mistakes made by Spanish (agrammatic) speakers vs. German (agrammatic) speakers, despite the fact that both languages have similar rich agreement morphology. Though the core of the study lies in that tense features involve further processing than agreement features, and the authors provide statistics in various languages comparing the cited tense morphology vs. agreement morphology, I am particularly interested in the contrast that the authors record between Spanish and German as regards tense. The explanation that I would like to give is based on the fact that German lacks a stem or thematic vowel (see (6) above), which I analyze in my own work as a specific feature within tense features. Regarding the specific discussion in this paper, the number of operations required for the processing of tense in Spanish is bigger than it is in German.

Finally, with regard to (7b.3), I would like to highlight the existence in the neuroimaging literature of two sets of studies that appear to be independent from one another and that should perhaps be put in connection in order to advance in the clarification of what could count as 'morphology as independent of syntax.' One is those studies that point to the LIFG as the brain area where selection among phonological (or also semantic) competitors is computed (there are incidentally in this respect neuroimaging studies in the literature that focus on the LIFG and do not even mention syntax or morphology, but only phonology, or also semantics: see e.g. Katzev et al. (2013)). The other set is formed by studies focusing on the diverse networks that appear to have been detected in the processing of syntax, of morphology, of phonology and of semantics (see e.g. works on p. 6 above) which make reference to a kind of overlap between the processing of phonology, and the processing of 'complex morphology' (which is the way some of the authors refer to the computing of tense and agreement features in richly inflected languages). A plausible hypothesis that I would like to defend is that maybe the computing of such 'complex morphology' in the precise area that is attributed to phonology corresponds to the rich realization of morphological markers (once the syntactic computation has been carried out). In other words, 'morphology as independent of syntax' would be identified as 'phonology.'

Conclusions: My aim in this paper has been to defend the idea that agreement or φ–features and tense or τ–features are each valued by two distinct heads, namely *v* and T. In consonance with this idea, I have defended the hypothesis that the number of steps in the 'real' processing or computation of agreement or φ–features and of tense or τ–features must be the same, irrespective of whether the morphological realization is *zero* or not.

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