# A Cartesian dream:

## A geometrical account of syntax

## In honor of Andrea Moro

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# A CARTESIAN DREAM

## A geometrical account of syntax
## In honor of Andrea Moro

*Edited by*
*Matteo Greco & Davide Mocci*

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To our *Maestro*
(Matteo and Davide)

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# Brief notes on the semantics of copular sentences

Gennaro Chierchia
Harvard University

"The cause of the riot was a picture on the wall."

## 1 The 'turn of millenium' stance

The syntax and semantics of Copular Sentences (CSs - of the rough form "DP be XP") has been a source of puzzlement and insight both in the pre- and the post-generative tradition.[1] Stowell 1978 proposed that CSs originate as small clause complements to the copula, viewed as a raising verb, an idea which has become the leading hypothesis on their syntax:

(1) a. John is tall/behind bars/a good friend
b. BE [$_{SC}$ John tall/behind bars/a good friend]
c. John$_2$ is [$_{SC}$ t$_2$ tall/behind bars/a good friend]

1. The literature on this topic is particularly rich and it is impossible to do any justice to it within the limits of the present note. Within the generative tradition, see e.g. Rothstein 1983, Moro 1988, 1997, Heycock 1994, Bennis, Corver & Dikken 1998, a.o. For a useful overview, see Moro 2017.

Of particular interest and much debated are the [DP V DP] variants of these structures, as they constitute the main basis for the old observation that the copula may convey both a predicational and an identity meaning (as, e.g., in 2a-b):

(2) a. That is a supernova.
'That object is in the extension of the supernova-concept'

b. i. That is Hesperus.
'That object is identical to Hesperus'

ii. Hesperus is Venus, actually.
'Hesperus is the same as Venus'

Among the several interesting features of these sentences, Moro 1988, 1997 has called attention to the fact that they show signs of a particular form of 'predicate inversion', where the predicative element of the Small Clause (i.e., the linearly rightmost DP in (1)-(2)) gets fronted to the canonical subject position. In other words, it seems that *both* options in (3) are possible:

(3) a. i. Una foto sul muro è stata la causa della rivolta
'A picture on the wall was the cause of the riot'

ii. [[una foto sul muro]$_2$ è stata [$_{SC}$ t$_2$ la causa della rivolta]]

b. i. La causa della rivolta è stata una foto sul muro
'The cause of the riot was a picture on the wall'

ii. [[la causa della rivolta]$_3$ è stata [$_{SC}$ una foto sul muro t$_3$]]

There are many reasons to hypothesize the dual structures in (3a-b), having to do with binding, extraction and theta-theoretic properties of CSs, but this short note is not the place to review them. In so far as Italian is concerned, the possibility of inversion as in (3b) is made particularly perspicuous by the agreement pattern in (4), where the verb agrees with the postverbal DP:

(4) a. [La causa della rivolta]$_2$ sono state [delle foto sul muro t$_2$]

b. The cause of the riot was/*were [ some pictures on the wall]

c. [La causa della rivolta]$_2$ [pro$_1$ sono state [delle foto sul muro$_1$ t$_2$]]]

The agreement option in (4a), impossible in English, is probably a consequence of the pro-drop character of Italian. Moro 1997 proposes in this connection an analysis along the lines in (4c), where the predicate-DP is moved beyond the standard external subject position, which is occupied by a *pro* in an agreement relation with the post verbal DP-subject. The discussion that follows assumes syntactic structures along these lines and addresses the question of their interpretation, first from the point of view of the type-driven semantics of the final decades of the past millennium, and then briefly taking into account the advent of event-semantics.[2]

Given the different interpretations of CSs as in, e.g., (2a-b), it became clear early on that we are dealing with a polymorphic operator, necessary to accommodate constituents of different logical type. This line of analysis was fully articulated in its modern form in Partee 1987. Updating and simplifying her stance, the core interpretation of CSs can be given along the following lines:[3]

| | | | |
|---|---|---|---|
| (5) | a. | John is tall | John BE [$t_2$ tall]<br>$\lambda w.tall_w(j)$ |
| | b. | John is a good friend | John BE [$t_2$ a good friend]<br>$\lambda w.good\ friend_w(j)$ |
| | c. | John is the new director | John BE [$t_2$ the new dir]<br>$\lambda w.j = \iota x.new\ dir_w(x)$ |

In (5), I indicate next to the syntactic structure associated with (5a-c) the corresponding propositions, represented here as functions from worlds into truth-values.[4] How do we get from the syntactic forms to the left to the interpretations to the right? Each basic predicate

2. For type driven semantics, see e.g. Chierchia & Connell-Ginet 1990, Heim & Kratzer 1998 a.o.; for event-based semantics, see Parsons 1990, Champollion & Coppock 2019. By 'interpretation' we mean a mapping from the syntactic structures in (3) onto logical structures such as those of the typed lambda calculus, the most widespread semantic lingua franca.

3. We are able to consider just one of the cases considered by Partee, within the limits of this short note, namely the one pertaining to the interpretation of the second argument of the predicative SC as predicate of type <e,t> vs. as an individual of type e, where the latter case results in the so called 'identity' reading.

4. The world argument is notated as a subscript, given its special role; i.e. we write,

(*tall, friend, director*) is taken to be a function of type <w,<e,t>> from worlds into a function from individuals into truth values. The element moved out of the small clause, if of type e, is simply lambda-converted back into its original site ('reconstructed', if you wish).[5]

The small clause is interpreted as an ordered pair. I will assume that a predication operator $\pi$ can be freely inserted in presence of a small clause and that the copula is merely a vehicle of tense and aspect. The $\pi$-operator is a polymorphic ($\neq$ ambiguous) predication marker that takes an ordered pair and returns a proposition. Its first argument is uniformly of type e; its second argument can be of either a predicative type <e,t>, or of an argumental one (for simplicity, let us consider here just type e). This yields a predication matrix of the following sort:

(6) The interpretation of predicative SCs:[6]

$$\|\text{BE } \pi[_{SC}\ \alpha, \beta]\| = \begin{cases} \beta(\alpha), \text{ if } \beta \text{ is of type <e,t>} & \text{(i)} \\ \lambda x[x = \beta](\alpha), \text{ if } \beta \text{ is of type e}^{7} & \text{(ii)} \end{cases}$$

e.g., $run_w(j)$ for *run(w)(j)*, 'John runs in w'. All relations are 'curried', as in the literature quoted in fn. 2.

5. Quantificational subjects such as those in (a) are either interpreted in situ (i.e. the Spec of the EPP position, whatever it may be), or they undergo Quantifier Raising and are interpreted in whatever its landing site.

(i) Everyone of them$_5$ was [$_{SC}$ t$_5$ a student of mine]

6. In some sense all SCs involve predication and are, therefore, 'predicative'. However, I use here the term 'predicative SC' to refer to SCs which constitute the nucleus of a main clause (or of a direct complement) in contrast with *adjunct* small clauses like:

(i) a. John arrived [pro dead]
b. [Arrivato Gianni] ci siamo messi a tavola
'Gianni having arrived, we sat at the table'

7. Alternatively, the predication operator may operate on intensions; I ignore this option here, for simplicity.

It is important to underscore the asymmetry in the logical types of the constituents of the SC, where the subject is always argumental, whereas the predicate can be predicative or argumental. By this approach the semantics for inverted structures such as those in (4a), repeated here as (7a), follows along the following lines. The subject *delle foto sul muro* is treated as quantificational and merged first in the subject position of the SC. The 'predicate' *la causa della rivolta* is raised as in (7a.i.). Then, the subject of the SC, being quantificational, further undergoes Quantifier Raising, yielding the structure in (7a.ii):

(7) a. i. *Pre-QR structure*: La causa della rivolta $_2$ [pro sono state $\pi$ [$_{SC}$ delle foto sul muro $t_2$]]

ii. *Post-QR structure*: Delle foto sul muro$_5$ la causa della rivolta $_2$ [pro sono state $\pi$ [$_{SC}$ $t_5$ $t_2$]]

b. i. la causa della rivolta $\Rightarrow$ $\iota$x causa della rivolta$_w$(x)

ii. [sono state $\pi$ [$_{SC}$ $t_5$ $t_2$]] ] $\Rightarrow$ $\pi$ ($x_5$, $x_2$)

iii. la causa della rivolta $_2$ [sono state [$_{SC}$ $t_5$ $t_2$]] $\Rightarrow$
$\lambda x_2$. $\pi$ ($x_5$, $x_2$)($\iota$x causa della rivolta$_w$(x))
= $\pi$ ($x_5$, $\iota$x causa della rivolta$_w$(x)) $\lambda$-Conv.

c. (a.ii) $\Rightarrow$ $\lambda P \exists y$[foto-sul-muro$_w$(y) $\wedge$ P(y)]( $\lambda x_5$ $\pi$ ($x_5$, $\iota$x causa della rivolta$_w$(x)))
= $\exists$y[foto-sul-muro$_w$(y) $\wedge$ $\pi$ (y, $\iota$x causa della rivolta$_w$(x))] $\lambda$-Conv.

---

Note that the presence of the $\pi$ operator makes copular sentences inherently asymmetric also in the semantics (as its effect is to create a subject and a predicate even when their basic semantic types are alike as, e.g., in case (6.ii))), in line with e.g. Moro 1997.

A second general point: predicative DPs, such as those in (a)-(b) are generally viewed in one of two ways. Either predicative DPs like *a good man* are of type <e,t> and get shifted to an argumental type when merged in argument position (and in this case predicate DPs fall under Case (6.i)). Or predicate DPs are of type <<e,t>,t> and then Montague's BE-functor must be included as part of the definition of the $\pi$-operator, along the lines discussed in Partee 1987 to extract the property that the quantifier lives on.

(i) a. John is a good man

b. Those are not prime numbers

d. Reductions of (7c)
$= \exists y[\text{foto-sul-muro}_w(y) \wedge \lambda z[z = \iota x \text{ causa della rivolta}_w(x)](y)]$
by (6.ii)
$= \exists y[\text{foto-sul-muro}_w(y) \wedge y = \iota x \text{ causa della rivolta}_w(x)]$
$\lambda$-Conv.

The main compositional steps in the interpretation of (7a.ii) are provided in (7b).The overall logical translation is given in (7c) and it gets reduced as in (7d). While this formula is an acceptable approximation to the truth conditions of (7a) it is unclear whether it is wholly adequate. Do we want to claim that a particular picture *is identical to* the cause of the riot? One might rather want to say that a picture *is a protagonist or component* of some event that caused the riot. To get to these truth conditions, we will need event semantics. But in the meanwhile, this example can be taken to be a base line 'existence proof' of how a compositional semantics for CSs may be set in motion, based on assumptions about the syntax-semantics map standard at the turn of millennium, and implementable in a number of variants. The main point is that predication must be based on a polymorphic type combinator, where the various cases are generated according to a principled syntax and an equally principled mapping onto logic.[8]

8. As noted by one of the anonymous referees, the approach sketched here must be generalized to other kinds of predicative structures like:

(a) I consider John a good person

(b) Gianni sembra un brav'uomo
'Gianni seems a good man'

There are various natural hypotheses on how to proceed in this connection. A straightforward one is to hypothesize structures of the following kind:

(c) I consider [Gianni$_3$ $\pi$ [$_{SC}$ t$_3$ a good person ]]

(d) Gianni$_3$ seems [ t$_3$ $\pi$ [$_{SC}$ t$_3$ a good person ]]

In these structures, the $\pi$-operator is adjoined to the SC-complements of the semi-predicative verbs *consider* and *seem*. The subject of the SC raises into the Spec of $\pi$; then, in the case of *seem* it further raises into the EPP external subject position. Once intensionality is factored in, textbook style general interpretive principles guarantee the right results for the interpretation of the structure in (c)-(d).

# 2 The event-argument

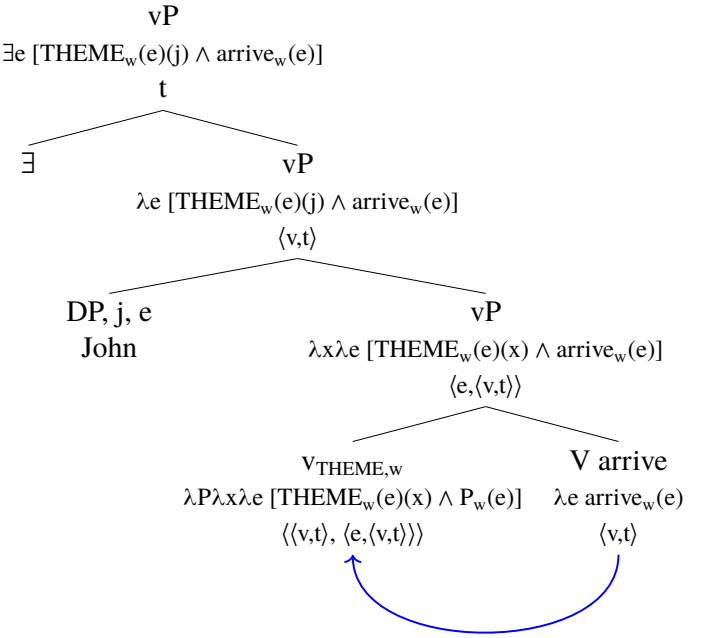
In the new millennium, the lingering influence of especially Davidson 1967 and Parsons 1990 swept through and the standard analysis of sentences like (8a) has become something like (8b). It is controversial how the event argument is to be compositionally factored in. On one analysis, the verb is lexically decomposed as in (8c). This approach requires an 'active' lexicon. On another approach, verbs are just *monadic* (intensional) predicates of events (of type <w,<v,t>>, where v is the type of eventualities). Applicative heads are introduced in the syntax to drive argument saturation. An example of how the latter approach works compositionally is provided in (8d). The verb in (8d) incorporates into the theme-applicative head, which is phonologically unrealized in English, but possibly realized in other languages. On either of the two takes (8c-d), the outcome of these 'first phase' mergers is a property of eventualities, which then undergoes existential closure, yielding a proposition (I am ignoring throughout, for simplicity, tense and aspect). Each non-terminal node in (8d) is constituted by a syntactic category, its logical translation and its semantic type.

(8) a. John arrived late

b. $\exists e\ [\text{arrive}_w(e)\ \wedge\ \text{THEME}_w(e)(\text{john})\ \wedge\ \text{late}_w(e)]$
"There is an arrival e in world w and the 'theme' of e is John and e (the arrival) was late"

c. $\lambda w \lambda x \lambda e\ [\text{THEME}_w(e)(x) \wedge \text{arrive}_w(e)]$ Parsons 1990

d. Champollion & Coppock 2019




How to extend event semantics to CSs is even more controversial. What are the effects of adding the Davidsonian argument to Common Nouns? Do we want to adopt a lexicalist hypothesis and merely add a Davidsonian argument to Nouns by analogy with the approach in (8c)? Or do we want to assume that nouns are just like verbs, i.e. predicates of eventualities, as proposed in e.g. Schwarzschild 2022? Obviously, we cannot resolve these questions within the limits of this brief note. What I'll try to do is sketch one possible way to go, which minimally extends the approach outlined in the previous section in (6). I then will show how our proposal may address the problem raised by inverted CSs pointed out at the end of section 1.

The main change necessary to incorporate the event argument into CSs consists in the fact that the type of the predication operator π must be changed so as to create properties of eventualities, rather than propositions. Let us assume, for simplicity, that nouns are properties of individuals P of type <w, <e,t>>, as on the traditional Montagovian approach, but that each such property is in a one-one correspondence

to a Schwarzschild-like property of states (of type <w,<v,t>>). For example, at each world w, $cat_w$ is true of things that are cats in w; this cat- property has a state-oriented counterpart $^{\Sigma}cat_w$ that holds of cat-states. I.e. $^{\Sigma}cat_w(e)$ is true iff e is the state of being a cat/cats in w, whose holder is a cat or a set thereof.[9] This gives us a way to modify our semantics of copular sentences along the following lines:

(9) The interpretation of predicative SCs in an event-based semantics:

$$\|BE\ \pi[_{SC}\ \alpha, \beta]\| = \begin{cases} \lambda e\ {}^{\Sigma}\beta_w(e) \wedge Theme_w(e)(\alpha) & \\ \text{if } \beta \text{ is of type <e,t>} & \text{(i)} \\ \\ \lambda e\ {}^{\Sigma}\lambda x[x = \beta_w](e) \wedge Theme_w\ (e)(\alpha) & \\ \text{if } \beta \text{ is of type e} & \text{(ii)} \end{cases}$$

As an illustration, I give in (10) the reduced logical translations of two simple cases of predicative SCs, leaving to the reader the steps of the reductions.

(10) a. i. $John_3$ is $\pi$ [ $t_3$ a linguist ]

ii. $\exists e\ [{}^{\Sigma}linguist_{\ w}\ (e) \wedge Theme_{\ w}\ (e)(j)]$

'There is a state e which is a state of being a linguist in w and John is the Theme of e'

b. i. $John_3$ is $\pi$ [ $t_3$ the director ]

ii. $\exists e\ [{}^{\Sigma}\lambda z[z = \iota x\ director_w(x)](e) \wedge Theme_w(e)(j)]$

'There is a state e which is a state of being the director in w and John is the Theme of e'

Predicative SCs, in other words, systematically introduce Davidsonian arguments within predicative DPs. The main justification for

9. The relation between the individual-oriented version of a noun and the state-oriented one is as follows:

(a) $^{\Sigma}P = \lambda w \lambda e\ \forall i\ \forall x\ [\ P_{w,i}(x) \rightarrow Theme_w(e)(x) \wedge \tau(e) = i]$

For example:

(b) $^{\Sigma}cat = \lambda w \lambda e\ \forall i\ \forall x\ [\ cat_{w,i}(x) \rightarrow Theme_w(e)(x) \wedge \tau(e) = i]$

We are adding here also the time coordinate, for completeness. '$\tau$' is the temporal trace function that maps eventualities into their running time.

this move is that adverbial modification works in largely parallel ways across the domain of verbal and non-verbal predicates. Famously, for example, for-PPs modify only atelic eventualities regardless of whether they are coded as verbs or as predicative DPs:

(11) a. John ran for an hour/*in an hour
b. John was a good friend for many years/*in many years

Representations such as the one in (10) pave the way for a uniform treatment of phenomena of this sort (and more generally of tense and aspect).[10]

This approach also has the potential of unveiling further aspects of our favorite sentence (7a) repeated here yet again:

(12) a. i. *Pre-QR*: La causa della rivolta$_2$ [sono state [$_{SC}$ delle foto sul muro $t_2$]]
ii. *Post-QR*: Delle foto sul muro$_5$ [la causa della rivolta$_2$ [sono state [$_{SC}$ $t_5$ $t_2$]]]
b. $\exists x[\text{foto-sul-muro}_w(x) \wedge \exists e\ [^{\Sigma}\lambda z[z = \iota e_3 \text{ causa della rivolta}_w(e_3)](e) \wedge \text{Theme}_w(e)(x)]$
'There are pictures on the wall X such that for some eventuality/state e which is the cause of the riot, X is the theme of e.'

A cause is naturally analyzed as an eventuality. The truth-conditions for the sentence in (12a) are spelled out along the lines in (12b). They appear to be more adequate than those in the event-free version of the semantics for CSs provided in (7), because we are not forced to view, e.g., pictures as being *identical* to eventualities. Pictures are themes of some eventuality/state which caused the riot.[11]

What we have sketched in this note underscores once more the richness of CSs and how modern event-based semantics can contribute to their understanding.

10. There are dissenting voices, like e.g. Maienborn 2005. For a recent defense of the idea that even common nouns are predicated of eventualities, cf. Schwarzschild 2022.

11. This idea is related to what is discussed under the rubric of "pseudo-extraction" in Moro 2017.

# Acknowledgements

These brief reflections on the rich and complex net of issues stimulated by Andrea Moro's work owe a lot to the long conversations with him over the years. I am very grateful for his insight and his friendship. We keep hoping that life will let us eventually co-teach a seminar on these matters to get 'to the bottom of it'. I've taken the liberty of changing the original example "a picture **of** the wall" to "a picture **on** the wall", for I find the latter slightly more natural in an out of the blue context. I am also grateful to two anonymous referees for useful criticisms and suggestions.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