

## A Non-Superlative Semantics for Ordinals and the Syntax and Semantics of Comparison Classes

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**Abstract** The semantics of ordinal expressions has been neglected in the literature until very recently, and only a few concrete proposals have been put forward so far. Curiously, these previous studies all adapt the relatively well-understood syntax and semantics of superlatives for ordinals. This strategy is natural given initial motivation from certain similarities between the two types of expressions. However, the present paper brings up a previously unnoticed contrast between ordinals and superlatives that points to a crucial difference between them. Specifically we observe that unlike superlatives, ordinals do not give rise to upstairs *de dicto* readings. This leads us to renounce the idea that ordinals and superlatives are alike in all respects. In particular, adopting the movement theory of superlatives, we propose that ordinals, unlike superlatives, are always interpreted *in situ*. As for their similarities pointed out by the previous studies, we claim that they all stem from the fact that both superlatives and ordinals refer to ‘comparison classes’ in the same manner.

**Keywords** Ordinal · Superlative · Upstairs *de dicto* · Comparison class

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## 1 Introduction

The semantics of ordinal expressions has been neglected in the literature until very recently, and to the best of our knowledge, only a few concrete proposals have been put forward, most notably Bhatt (2006) and Sharvit (2010), and two unpublished handouts, Bhatt & Pancheva (2012) and Ivlieva & Podobryaev (2012). This state of affairs is quite surprising, especially given that related expressions such as superlatives have garnered decades of constant attention by formal linguists. The reason for this curious blindspot in the literature is unknown to us, which might as well be a mere accidental gap.

In exploring a topic like this, it is a good strategy to make use of an analysis of a closely related phenomenon that one has a better theoretical hang on as one's guide in the exploration, and this is exactly what the above four studies did. Interestingly, they essentially trod down the same path: they adapted the relatively better worked-out analysis of superlatives for ordinals. This is not at all haphazard or ungrounded, as these authors uncovered striking empirical similarities between ordinals and superlatives.<sup>1</sup>

Following the footsteps of our predecessors, we take the similarities between ordinals and superlatives as our starting point. Yet, we bring up a previously unnoticed contrast between ordinals and superlatives that points to their crucial difference. In particular, we argue that our observation threatens completely uniform treatments of the two classes of items of the kind advocated by the four previous studies.

The nub of our observation is that superlatives, but not ordinals, give rise to so-called 'upstairs *de dicto* readings'. As will be explained in greater detail in Sect. 3, upstairs *de dicto* readings of superlatives have been taken as primary evidence for the 'movement theory' of superlatives (Heim 1985, Szabolcsi 1986, Heim 1999, among others; see Sharvit & Stateva 2002 for a different view), according to which the superlative morpheme *-est* can covertly move out of the local DP. Furthermore, this covert movement is not only a crucial step in deriving upstairs *de dicto* readings, but also gives a nice account of so-called 'comparative readings' in general, of which upstairs *de dicto* readings are a special kind.

Straightforwardly adopting this idea to ordinals, Bhatt (2006), Bhatt & Pancheva (2012), and Ivlieva & Podobryaev (2012) propose that ordinals also can undergo the same covert movement. However, if so, they wrongly predict that, everything else being equal, ordinals should also give rise to upstairs *de dicto* readings.<sup>2</sup>

This consideration leads us to part ways from the previous studies and pursue a non-uniform account of superlatives and ordinals. That is, assuming that ordinals,

<sup>1</sup>Some authors, e.g. Bhatt & Pancheva (2012), Farkas & Kiss (2000) and Harris (2008), have gone one step further and treat ordinals as a subclass of superlatives, at least at the terminological level, and perhaps beyond, without giving explicit arguments. However, the observations made in the present paper regarding 'upstairs *de dicto* readings' (see below) cast serious doubt on such naive treatments.

<sup>2</sup>Unlike these three studies, Sharvit (2010) proposes an *in situ* analysis of ordinals, and an analogous analysis for superlatives. Although she does not discuss how to account for upstairs *de dicto* readings of superlatives, her account is compatible with the *in situ* analysis of upstairs *de dicto* readings propounded by Sharvit & Stateva (2002). However, Sharvit's analysis augmented with Sharvit & Stateva's theory of upstairs *de dicto* readings also runs into the problem of wrongly predicting upstairs *de dicto* readings for ordinals. See fn.6 for related discussion.

unlike superlatives, cannot move out of the local DP, we develop an *in situ* semantics of ordinals accordingly. Since we renounce a uniform treatment, the above overgeneration problem of upstairs *de dicto* readings for ordinals is skirted. However, it is now incumbent on our non-uniform account to explain the commonalities between ordinals and superlatives unveiled by the earlier studies. To this end, we pursue the idea that they fall out of the way in which the two classes of items make use of ‘comparison classes’ in their syntax and semantics.

Thus, this paper has two main goals. Firstly, we will provide a novel analysis of the syntax and semantics of ordinal expressions that is empirically more adequate than the previously proposed analyses. Secondly, we attempt to uncover the syntactic and semantic properties of ‘comparison classes’, which have non-trivial consequences on our understanding of the syntax and semantics of superlatives as well.

The paper is organised as follows: In Sect. 2, we start our discussion by reviewing three main properties shared by ordinals and superlatives, which the previous studies took to motivate their uniform accounts. However, we point out the crucial difference between them in Sect. 3 that ordinals, unlike superlatives, do not give rise to upstairs *de dicto* readings. After presenting in Sect. 4 some temporal properties of ordinals to be accounted for, we present our *in situ* analysis of ordinals in Sect. 5. Sect. 6 is devoted to explanations of the properties of superlatives, in particular their similarities with ordinals discussed in Sect. 2. We contend that the similarities arise due to the common syntactic and semantic mechanism that these two classes of expressions employ to refer to ‘comparison classes’. There we also discuss consequences of our analysis for the syntax and semantics of superlatives. Finally, Sect. 7 contains conclusions and further problems and questions.

## 2 Ordinals and Superlatives

That ordinals and superlatives share certain grammatical features might not be so surprising, considering the fact that they often express the same concepts. For example, one can refer to the same train by *the first train*, with an ordinal, or *the earliest train*, with a superlative. Thus, the two sentences in (1) can be truth-conditionally identical, though the context-sensitivity of these expressions does not guarantee synonymy in general (more on this later).

- (1) a. The first train from Gare du Nord left at 6:43 am.  
b. The earliest train from Gare du Nord left at 6:43 am.

Another hint at their grammatical likeness peeks out in languages like Japanese where these two classes of items are expressed by the same or related morphemes. For example, both sentences in (1) can be translated into Japanese using the word *ichiban*:

- (2) a. kita-eki-hatsu-no        **ichiban**-me-no densha-wa 6:43-ni deta.  
North-Station-from-GEN ICHIBAN-ME-GEN train-TOP 6:43-at left  
‘The first train from Gare du Nord left at 6:43.’  
b. kita-eki-hatsu-no        **ichiban** hayai densha-wa 6:43-ni deta.  
North-Station-from-GEN ICHIBAN early train-TOP 6:43-at left

‘The earliest train from Gare du Nord left at 6:43.’

Besides these superficial similarities, previous studies have identified three important common features between ordinals and superlatives that are particularly important for the syntax and semantics of ordinals. As we will argue later, they all have to do with ‘comparison classes’ in one way or another.

## 2.1 Absolute and comparative readings

Superlatives are known to give rise to so-called ‘absolute’ and ‘comparative’ (sometimes also called ‘relative’) readings (see Farkas & Kiss 2000, Gutiérrez-Rexach 2006, Heim 1985, 1999, Ross 1964, Sharvit & Stateva 2002, Szabolcsi 1986, Teodorescu 2009, among others). For instance, consider the following example.

(3) John gave Mary the oldest telescope.

This sentence can be read as about the telescope that was made before any other (relevant) telescope, which is called an absolute reading. Quite intuitively, this reading can be characterised as comparing different telescopes. But this is not the only reading that the sentence has, because it can also be true if John gave Mary a relatively new telescope, but it happened to be older than any of the telescopes that other people gave her. Roughly put, this reading, unlike the absolute reading, involves comparison between John and his alternatives in terms of how old the telescopes were that they gave to Mary. This is called a comparative reading. The two readings can be paraphrased using comparative constructions as follows:<sup>3</sup>

- (4) a. **Absolute:** John gave Mary the telescope older than other telescopes.  
 b. **Comparative:** John gave Mary an older telescope than other people did.

As we will see shortly, there are other possible comparative readings. Thus, the sentence is actually truth-conditionally many-ways ambiguous.

As noticed by Bhatt (2006), Bhatt & Pancheva (2012) and Ivlieva & Podobryaev (2012), ordinals also give rise to absolute and comparative readings. This is illustrated by the version of (3) with an ordinal in place of the superlative:

(5) John gave Mary the first telescope.

The absolute reading of the sentence, which compares different telescopes, is essentially identical to the absolute reading of (3). Likewise, it also can receive a comparative reading that compares John with his cohorts in terms of when they gave a telescope to Mary. These two readings are paraphrased by (6).

<sup>3</sup>One might at this point wonder if a comparative reading is a kind of absolute reading where the relevant telescopes are limited to the ones given to Mary. This very idea has been advocated by Farkas & Kiss (2000), Gutiérrez-Rexach (2006), Sharvit & Stateva (2002) and Teodorescu (2009), and we will also assume that it is a grammatical possibility. However, we also claim that for superlatives (but not for ordinals) there is an alternative way of deriving comparative readings, which involves covert movement out of the local DP, as proposed by Heim (1985, 1999) and Szabolcsi (1986). See Sect. 3 and Sect. 6 for details of this. For the moment, we make the absolute-comparative distinction at an intuitive level.

- (6) a. **Absolute:** John gave Mary the telescope older than other telescopes.  
 b. **Comparative:** John gave Mary a telescope before other people did.

Notice at this moment that for both the superlative sentence (3) and the ordinal sentence (5), the comparative reading in question naturally arises when a focus prominence is placed on *John*. This leads to another similarity between ordinals and superlatives, namely focus sensitivity.

## 2.2 Focus sensitivity

For both ordinals and superlatives, focus has truth-conditional effects when they receive comparative readings. For instance, if *Mary* is in focus in (3), a different reading becomes prominent, which is true when the telescope John gave to Mary was older than the telescopes that he gave to other people. Thus, roughly, the comparison is now between Mary and her alternatives, rather than between John and his alternatives. This focus sensitivity of superlatives has been noted and discussed by many, including Ross (1964), Jackendoff (1972), Heim (1985), Szabolcsi (1986), Gawron (1995), Heim (1999), Farkas & Kiss (2000), Gutiérrez-Rexach (2006), Sharvit & Stateva (2002) and Beaver & Clark (2008).<sup>4</sup>

Similar remarks apply to the ordinal sentence in (5), as previously pointed out by Bhatt (2006:55,63). With a focus prominence on *Mary*, a comparative reading different from (6b) becomes more prominent. This reading, again intuitively, compares Mary and her alternatives, and is true if John gave Mary a telescope before he gave one to other people.

## 2.3 Non-modal subject infinitival clauses

Thirdly, both ordinals and superlatives license ‘non-modal subject infinitival clauses’ (Bhatt 2006, Bhatt & Pancheva 2012, Sharvit 2010), as demonstrated by (7).

- (7) John bought the first/oldest telescope **to be made**.

One might not be so startled by this sentence, given the fact that such infinitival modifiers can occur with any NP without an ordinal or superlative, as shown by (8).

- (8) John bought a telescope to be made.

However, there is a stark interpretive difference between the above two sentences. In the absence of an ordinal or superlative, as in (8), the infinitival clause obligatorily receives a modal or ‘futate’ interpretation, e.g. the telescope that was going/planned

<sup>4</sup>Teodorescu 2009 argues that focus sensitivity of superlatives is not absolute, unlike for items that ‘conventionally associate with focus’ like *only*, for which the interpretive effects of focus more rigidly determine the truth-conditions. Our analysis of the focus sensitivity of ordinals and superlatives to be developed below is in line with Teodorescu’s view. Specifically, we will claim that focus can and often does affect the choice of the comparison class, but is neither sufficient nor necessary for the determination of the meaning.

to be made. While there are reasons to believe that (7) also has such an interpretation (to which we will come back later), it has a different interpretation that does not involve modality or is futurate and can be paraphrased simply as follows.

- (9) John bought the telescope that was made before any other telescope.

Thus, non-modal subject infinitival clauses requires a licenser and are licensed in the presence of an ordinal or superlative.<sup>5</sup>

As we will see, non-modal subject infinitival clauses on ordinals have a number of semantic properties that play an essential role in our account. Thus, in discussing examples, it will be convenient to zoom in on the non-modal interpretation of an infinitival clause by somehow precluding the modal interpretation. However, the ambiguity being systematic, this turns out to be not so easy, and at this moment we are not aware of a systematic way of disambiguating the reading across the board (see Appendix for relevant discussion). Luckily, however, for certain examples, the modal interpretation is highly unlikely to be true, and for such examples, we can safely disregard it from the discussion. One such example is given in (10).

- (10) John visited the first/oldest church to be built by Romans.

The non-modal interpretation is the most prominent one for this sentence, since its modal interpretation is simply implausible, because one can only visit a church that has been build. In fact, the version of the sentence without *first* or *oldest* is unacceptable.

- (11) #John visited the church to be build by Romans.

We will use this technique to brush aside the modal reading in some of our crucial examples, e.g. in Sect. 4.1.

There are several intriguing properties of non-modal subject infinitival clauses. One of them is worthwhile mentioning at this moment. As noticed by Bhatt (2006:62–64), when non-modal subject infinitival clauses are present, superlatives and ordinals cease to exhibit focus sensitivity. Thus, the following pairs of sentences are truth-conditionally identical, though they differ in pragmatic effects associated with (contrastive) focus.

- (12) a. Joan<sub>F</sub> gave Mary the most expensive telescope to be built in the 9th century.  
 b. Joan gave Mary<sub>F</sub> the most expensive telescope to be built in the 9th century. (Bhatt 2006:(110))
- (13) a. John<sub>F</sub> gave Mary the first telescope to be built in the 9th century.  
 b. John gave Mary<sub>F</sub> the first telescope to be built in the 9th century. (Bhatt 2006:(114))

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<sup>5</sup>In Sect. 7, we will briefly discuss nominal *only* which also licenses non-modal subject infinitival clauses. See also Bhatt (2006) for extensive discussion on this construction.

Bhatt (2006), Bhatt & Pancheva (2012) and Sharvit (2010) make further important observations regarding temporal interpretations of such non-modal infinitival clauses. We will come back to these in Sect. 4.

### 3 Upstairs *De Dicto* Readings

Given the similarities between ordinals and superlatives we have just witnessed, it is natural to expect their syntax and semantics to be very similar. Indeed, as we already mentioned at the outset, the previous studies on the semantics of ordinals alluded to there pursued this route, and developed a uniform account of ordinals and superlatives based upon the syntax and semantics of superlatives that we have a better grip on (although this is of course not to deny the controversy over the latter, which we will touch on in the present section, as well as in Sect. 6).

In the present section, however, we raise novel data pointing to a crucial difference between ordinals and superlatives that poses serious challenge to these approaches. The problem has to do with the availability of so-called ‘upstairs *de dicto* readings’, which are a special type of comparative reading. Specifically, we observe that superlatives, but not ordinals, give rise to upstairs *de dicto* readings.

We will first introduce upstairs *de dicto* readings for superlatives and review how they are accounted for under the movement theory of superlatives developed by Heim (1985, 1999) and Szabolcsi (1986), among others. Then, we will observe that ordinals do not give rise to upstairs *de dicto* readings, and discuss consequences of this observation for the previously proposed analyses of ordinals.

#### 3.1 Upstairs *de dicto* readings with superlatives

Upstairs *de dicto* readings arise in sentences like (14) that involve an intensional operator like *want* and a superlative phrase underneath it.

- (14) John wants to take the earliest train.

This sentence has a number of readings, including an absolute reading, but crucially, it has a particular type of comparative reading that is true in the following scenario.

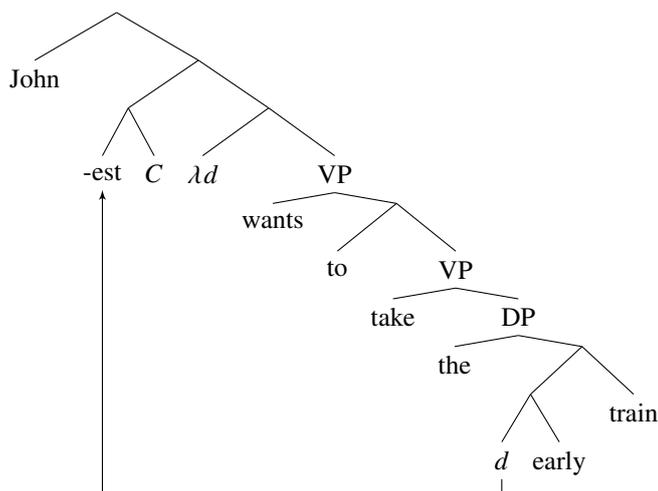
- (15) There are many trains throughout the day. John wants to take a train. Any of the trains between 3 pm and 4 pm is fine for him. Similarly, Bill and Steve want to take a train, and they are fine as far as the departure time is between 5 pm and 6 pm and between 7 pm and 8 pm, respectively. These people do not know anything about one another.

Notice that in this scenario there is no specific train that John wants to take. Thus, the wide scope *de re* reading of *the earliest train* would not make the sentence true. Furthermore, it is not part of John’s desire that he take a train earlier than Bill or Steve, because he is not even properly acquainted with these individuals. Thus, the superlative part of the structure should not be *de dicto*. In other words, neither of the following scope relations adequately captures the reading we are after.

- (16) a. the earliest train > wants  
b. wants > the earliest train

Upstairs *de dicto* readings like the one above are considered to be crucial (and perhaps the only) evidence for movement of the superlative morpheme *-est* out of the local DP (Heim 1985, 1999, Szabolcsi 1986).<sup>6</sup> According to this idea, the relevant reading of (14) is derived from the following LF (where *C* is a phonologically silent ‘comparison class’; we will come back to this shortly).<sup>7</sup>

(17)



As this LF illustrates, the idea is that only the superlative part of the phrase *the earliest train* receives a *de re* reading with respect to *wants*. Since the superlative morpheme is ‘upstairs’ while the rest of the DP is *de dicto*, the reading is called an upstairs *de*

<sup>6</sup>One might have qualms with the covert movement of *-est*, which is part of a modifier, out of the local DP for syntactic reasons, i.e. an infraction of Left-Branch Condition. Alternative theories that attempt to dispense with the movement have been put forward. Let’s call them *in situ* theories. However, it turns out to be quite challenging to give an adequate analysis of upstairs *de dicto* readings without covert movement, and we think none of the currently available *in situ* theories are fully satisfactory in this regard. Sharvit & Stateva (2002) is the most serious attempt of this sort, but as they acknowledge in their fn.15, their account has nothing to say about locality restrictions on upstairs *de dicto* readings, e.g. they are much harder to get with finite complements. On the other hand, under the movement theory, this could be explained as a tensed-clause-boundedness of the covert movement, which is akin to the independently known restriction on Quantifier Raising. Another *in situ* theory put forward by Teodorescu (2009) suggests that upstairs *de dicto* readings are species of so-called ‘Fodor’s third reading’ (Fodor 1970), but she does not specify how exactly this idea could be formulated. As far as we can see, this is not trivial at all. In particular, many existing analyses of Fodor’s third readings (e.g. von Stechow & Heim 2010, Keshet 2010, 2011, Maier 2009) fail to generate upstairs *de dicto* readings altogether in contexts like (15). And even with mechanisms suggested in Schwager (2011) and Sudo (2014a), it is still predicted that upstairs *de dicto* readings are not so easily available without (arguably pragmatically marked) contextual support, which is not available in our context (15). In addition, and more importantly, her predictions are falsified by ordinals. The other non-movement theories we are aware of, i.e. Farkas & Kiss (2000) and Gutiérrez-Rexach (2006), do not explicitly discuss upstairs *de dicto* readings, and we cannot see how they could be amended to capture them.

<sup>7</sup>To simplify the exposition, we will ignore assignment functions, and use metalanguage expressions (e.g. *C*,  $\lambda d$ , *d*, etc.) in the object language. We adopt this convention throughout the paper.

*dicto* reading. Glossing over the details for the moment, which we will come back to immediately below, the LF in (17) receives the following interpretation (assuming that Bill and Steve are the alternatives to John).

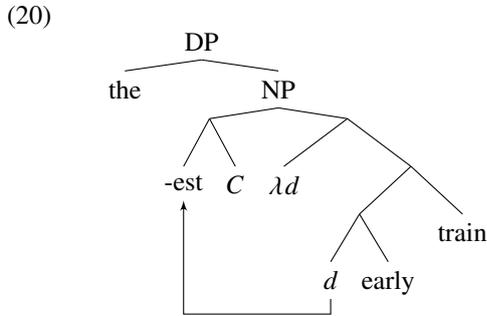
- (18) John wants to take a  $d_j$ -early train.  
 Bill wants to take a  $d_b$ -early train.  
 Steve wants to take a  $d_s$ -early train.  
 And  $d_j$  is earlier than  $d_b$  and  $d_j$  is earlier than  $d_s$ .

This is indeed true in the context in (15). To reiterate the crucial assumption here, *-est* is assumed to be able to move out of the local DP and take scope above an operator outside of the DP.

Here are the details of the movement theory (based on Heim 1985, 1999, among others). Let us start with the denotation of *-est*, given in (19).  $C$  here is the comparison class and  $P$  is a predicate of type  $\langle d, et \rangle$ .<sup>8</sup>

- (19)  $\llbracket \text{-est} \rrbracket^w(C)(P_{\langle d, et \rangle})(x_e)$   
 a. is defined only if  
     (i)  $|C| > 1$ ; and  
     (ii) for all  $y \in C$ , there is  $d \in D_d$  such that  $P(d)(y) = \top$ .  
 b. whenever defined, denotes  $\top$  iff there is  $d \in D_d$  such that  $P(d)(x) = \top$  and for all  $y \in C$ , if  $x \neq y$ , then  $P(d)(y) = \perp$ .

A nice feature of the movement theory is that it accounts for both absolute and comparative readings, including upstairs *de dicto* readings, without postulating multiple lexical entries for *-est*. To see this more concretely, let us first analyse an absolute reading of *the earliest train*, for which the following LF for the DP is assumed. Notice that *-est* moves in this case as well, but internally to the local DP. This movement is necessary to resolve the type-mismatch in the base-generated position. It create a derived predicate of type  $\langle d, et \rangle$  that serves as the second argument of *-est*.



The subtree ' $\lambda d$   $d$ -early train' denotes the following function of type  $\langle d, et \rangle$ .

- (21)  $\llbracket \lambda d \llbracket [d\text{-early}] \text{train} \rrbracket \rrbracket^w = \lambda d \in D_d. \lambda x \in D_e. \mathbf{early}_w(d)(x) \wedge \mathbf{train}_w(x)$

<sup>8</sup>To avoid confusion, we assume  $D_t = \{ \perp, \top \}$  where  $\perp$  represents falsity and  $\top$  represents truth.

Combining this with the meaning of *-est*, we obtain the following function of type  $\langle e, t \rangle$  for the constituent headed by NP in (20) (if it is defined for  $\llbracket \cdot \rrbracket^w$ ).

$$(22) \quad \lambda x \in D_e. \exists d \in D_e. \left[ \mathbf{early}_w(d)(x) \wedge \mathbf{train}_w(x) \wedge \forall y \in C [y \neq x \rightarrow \neg [\mathbf{early}_w(d)(y) \wedge \mathbf{train}_w(y)]] \right]$$

Consequently, the denotation of the entire definite DP is the unique  $x$  that is an earlier train than any other train in  $C$  (if there is one). The actual referent depends on what the comparison class  $C$  is, which is assumed to be determined contextually in this case. One pragmatically plausible value for  $C$  is the trains that depart today from a particular station. Then the DP denotes the first train to depart from that station.

As mentioned above, for the upstairs *de dicto* reading, which is a species of comparative readings, the LF in (17) is assumed, where the superlative morpheme has moved out of the local DP. This LF has a derived predicate of type  $\langle d, et \rangle$  as in (23). Here,  $\mathbf{Bul}_w(x)$  is the set of possible worlds that are compatible with  $x$ 's desires in  $w$ .<sup>9</sup>

$$(23) \quad \llbracket \lambda d \in D_d [\text{wants to take the } d \text{ early train}] \rrbracket^w = \lambda d \in D_d. \lambda x \in D_e. \forall w' \in \mathbf{Bul}_w(x) \exists y \in D_e [\mathbf{take}_{w'}(x)(y) \wedge \mathbf{early}_{w'}(d)(y) \wedge \mathbf{train}_{w'}(y)]$$

Notice that the definite determiner is interpreted as an existential quantifier in the denotation ( $\exists y$  here). Generally, in order to derive correct comparative readings with movement, it needs to be assumed that when *-est* moves out of the local DP, the definite article receives an existential interpretation. Although this assumption might look stipulative, and indeed has sometimes been considered a foible of the analysis, it is not entirely unsupported. See Szabolcsi (1986) and Heim (1985, 1999) for discussion on this.

Combining this function of type  $\langle d, et \rangle$  with '*-est C*', we obtain the following function of type  $\langle e, t \rangle$  (if it is defined for  $\llbracket \cdot \rrbracket^w$ ).

$$(24) \quad \lambda x \in D_e. \exists d \in D_d. \forall w' \in \mathbf{Bul}_w(x) \exists y \in D_e [\mathbf{take}_{w'}(x)(y) \wedge \mathbf{early}_{w'}(d)(y) \wedge \mathbf{train}_{w'}(y)] \wedge \forall z \in C [z \neq x \rightarrow \neg \forall w' \in \mathbf{Bul}_w(x) \exists y \in D_e [\mathbf{take}_{w'}(z)(y) \wedge \mathbf{early}_{w'}(d)(z) \wedge \mathbf{train}_{w'}(z)]]$$

In words, this function is true of an individual  $x$  iff for some degree  $d$ ,  $x$ 's desire is that  $x$  takes some train or other that is  $d$ -early, and also, for all alternatives  $z \in C$  distinct from  $x$ , it is not  $z$ 's desire to take a  $d$ -early train. Thus, the entire LF in (17) is true iff John is such an  $x$ . This indeed captures the upstairs *de dicto* reading. Importantly, unlike under the absolute reading,  $C$  is a set of people including John, rather than a set of trains.

For other comparative readings that do not involve intensional operators like the ones we saw in Sect. 2, the theory offers two ways to account for them.<sup>10</sup> One way

<sup>9</sup>Nothing hinges on this analysis of the bouletic predicate *want*. See Crnič (2011:Appendix), von Stechow (1999), Heim (1992), Rubinstein (2012:Ch.3), and Villalta (2008) for discussion on proper semantic analyses of bouletic predicates.

<sup>10</sup>Not every advocate of the movement theory of superlatives might agree with this position. However, as we will argue, the similarities and differences between superlatives and ordinals discussed below will

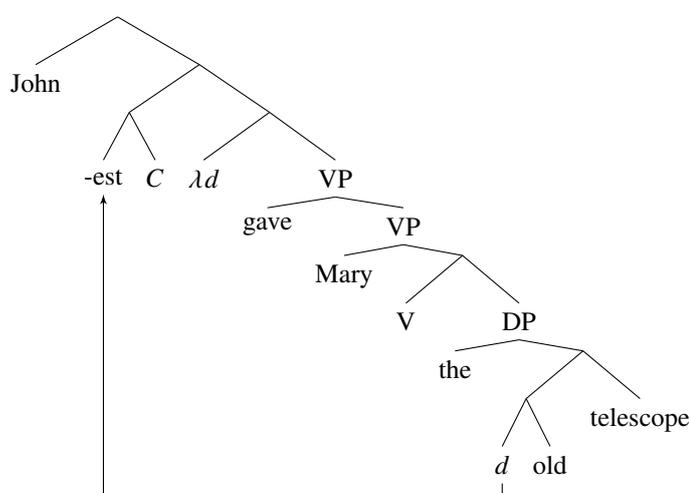
treats them as a species of an absolute reading with a very restricted  $C$ . More concretely, consider the comparative reading (4b) of (3), repeated here.

(3) John gave Mary the oldest telescope.

(4b) John gave Mary an older telescope than other people did.

This reading can be derived with an LF analogous to the one in (20) with a comparison class  $C$  consisting of telescopes that various people, including John, gave to Mary. In that case, the phrase *the oldest telescope* denotes the unique telescope that is older than any other telescope in  $C$ , which captures (20). Alternatively, the same truth-conditions can be derived by moving *-est* to the VP-level in the following manner (we assume a VP-shell structure here, but nothing crucial hinges on this).

(25)



With this movement, the VP will be true of an individual  $x \in C$  if  $x$  gave a telescope to Mary that is older than any other telescope that other members of  $C$  gave to Mary. Notice again that in this case it is necessary to assign an existential interpretation to the definite determiner.

Since both *in situ* and movement strategies can account for ordinary comparative readings, they do not directly motivate the movement theory, as emphasised by Farkas & Kiss (2000) and Sharvit & Stateva (2002) (see also Gutiérrez-Rexach 2006 and Teodorescu 2009 for related points). By contrast, upstairs *de dicto* readings are not amenable to such an *in situ* analysis, for reasons explained above (see also the discussion in fn.6).

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give some credence to the seemingly undesired redundancy in the theory. We will come back to this point in Sect. 6, after presenting our analysis of ordinals.

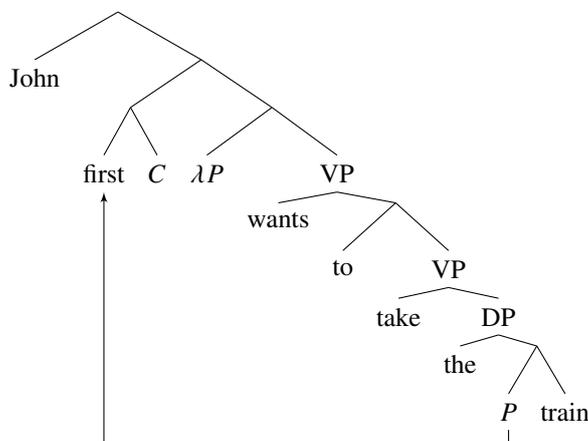
### 3.2 No upstairs *de dicto* readings with ordinals

We observe that the sentence (26) with an ordinal, instead of a superlative, is not true in the same scenario (15), unlike its superlative counterpart (14) above. This is quite surprising given the semantic proximity of *the earliest train* and *the first train*.

(26) John wants to take the first train.

This observation has an immediate theoretical consequence. That is, if ordinals move out of the local DP like *-est* does, then they should also give rise to upstairs *de dicto* readings, i.e. (26) should be judged as true in the context (15), contrary to fact.<sup>11</sup> However, this is exactly what is predicted by the previous movement analyses of ordinals put forward by Bhatt (2006), Bhatt & Pancheva (2012) and Ivlieva & Podobryaev (2012).<sup>12</sup> Abstracting away from the semantic details, under these analyses, one would expect (26) to be able to have the following LF, parallel to (17), which should yield an unattested upstairs *de dicto* reading.<sup>13</sup>

(27)



For this reason, we will pursue an *in situ* semantics for ordinals where ordinals do not move out of the local DP, unlike superlatives. If this is viable, then the overgeneration problem simply dissolves. Before presenting our *in situ* analysis, however, we will

<sup>11</sup>As noted in fn.6, it also constitutes a strong argument against Teodorescu's (2009) position that upstairs *de dicto* readings are due to a mechanism responsible for generalised *de re*.

<sup>12</sup>Our observation is potentially problematic for Sharvit's (2010) *in situ* analysis as well. See fn.2.

<sup>13</sup>Bhatt & Pancheva (2012) suggest that the variable *P* in (27) is a degree variable, and in the original position, there is a hidden degree predicate 'ranked', which would make the LF completely parallel to (17). However the semantics of ordinals they present seems to be fundamentally flawed, involving a vacuous  $\lambda$ -operator. For this reason, we will not delve into the details of their analysis here. Bhatt (2006), on the other hand, does not specify what the variable should be, remarking as follows: "[Ordinals] differ from *est* in that it is not clear what, if any, variable they are binding inside the NP where they originate. [...] A movement that does not leave behind a trace is conceptually problematic" (Bhatt 2006:57). Nonetheless, he suggests a possibility that the movement of *first* does not leave a trace. Either way, our point stands: the lack of upstairs *de dicto* readings is problematic for his analysis.

mention some temporal properties of non-modal subject infinitival clauses on ordinals that need to be accounted for.

#### 4 Temporal Properties of Non-Modal Subject Infinitival Clauses

Bhatt (2006), Bhatt & Pancheva (2012) and Sharvit (2010) make important observations regarding certain temporal properties of non-modal subject infinitival clauses. In particular, we mention two here.<sup>14</sup>

##### 4.1 Non-modal subject infinitival clauses determine the ordering

One striking interpretive effects of non-modal subject infinitival clauses is observed by Sharvit (2010). Simply put, a non-modal subject infinitival clause fixes the ordering that the ordinal refers to. In order to see this, consider the following situation.

- (28) There are five books (Books 1–5) stacked on each other in the following order. They have different publication dates:

Book 1	published in May 2011
Book 2	published in August 2013
Book 3	published in December 2012
Book 4	published in March 2013
Book 5	published in January 2013

Now against this context, consider the following two sentences containing ordinals. Notice that the prominent reading of the infinitival clause in (29a) is a non-modal one, since usually one reads a book after publication (although editors and reviewers often read books before publication). Thus, we can safely disregard the modal interpretation (see the discussion in Sect. 2.3).

- (29) a. John read the first book to be published in 2013.  
 b. John read the first book that was published in 2013.

These two sentences exhibit an interesting contrast. In the above context, the object DP of (29a) unambiguously refers to Book 5, whereas the object DP of (29b) can refer to Book 2 or Book 5.

What these data reveal is that a non-modal subject infinitival clause fixes the relevant ordering to the temporal ordering based on the content of the infinitival clause. In the case of (29a), it is the order of publication in 2013, and consequently the referent is unambiguously Book 5. On the other hand, a tensed relative clause does not force this interpretation, though it is compatible with it. And an alternative, contextually

<sup>14</sup>Bhatt (2006) and Sharvit (2010) claim that there is another temporal property of non-modal subject infinitival clauses that they cannot temporally follow the matrix clause, but as we explain in Appendix, it is extremely difficult, if possible at all, to find cogent evidence for this generalisation, due largely to the fact that infinitival clauses are inherently ambiguous between modal and non-modal interpretations. For this reason, we will not try to explain this putative observation in the present paper.

salient ordering is available for (29b), e.g. the order of stacking, according to which the object DP refers to Book 2.

It should be remarked that modal subject infinitival clauses, unlike non-modal ones, behave like tensed relative clauses in this regard. Consider a variation of the above context given in (30).

- (30) There are five books (Books 1–5) stacked on each other in the following order. Three of them will be assigned in different lectures in my course offered next year.

Book 1	will not be assigned
Book 2	will be assigned in Lecture 8
Book 3	will not be assigned
Book 4	will be assigned in Lecture 3
Book 5	will be assigned in Lecture 1

Now consider the following sentence.

- (31) John read the first book to be assigned in my class next year.

There is a palpable difference between (29a) and (31): the object DP in (31) is ambiguous and can refer to Book 2 or Book 5. This contrast is explained if a modal subject infinitival clause does not force a linguistically determined ordering. Specifically, although the infinitival clause in (31) should be able to receive a non-modal reading, it also has a modal reading, unlike in (29a). That the sentence is ambiguous suggests that when the infinitival clause receives a modal interpretation, the ordinal can refer to a contextually determined ordering such as the order of stacking, which results in the reference to Book 2, as in the case of (29b) with a tensed relative clause.

In summary, non-modal subject infinitival clauses require the ordinal to refer to a particular ordering, namely the temporal order determined by the linguistic content of the infinitival clause. Neither a tensed relative clause nor a modal subject infinitival clause forces such an interpretation, although they are compatible with it.<sup>15</sup>

#### 4.2 Temporal simultaneity between NP and TP

A second temporal property of non-subject modal infinitival clauses that needs to be explained is that they must temporally overlap with the NP, as Bhatt (2006:§6.3) originally points out (see also Bhatt & Pancheva 2012). This is illustrated by the following example with an NP that has a stage-level interpretation.

- (32) #I met the first professor to attend this elementary school.

<sup>15</sup>In the next section, we will discuss cases where a tensed relative clause seems to have the same effect, an observation due to Bhatt (2006). We claim that this is an indirect interpretive effect and demonstrate that our analysis explains exactly when this effect arises.

This sentence is infelicitous as it is associated with an inference that the person in question was attending the elementary school while being a professor at the same time, a very unlikely state of affairs. To put it differently, the object cannot refer to someone who is a professor *now* and who attended the elementary school *at some point in the past*.<sup>16</sup>

Similarly to the previous point, non-modal subject infinitival clauses contrast with tensed relative clauses and modal subject infinitival clauses, which are not subject to this requirement. Thus, the tensed relative counterpart of (32), given in (33a), is perfectly felicitous. The same point can be made with a modal infinitival clause, although due to the future-oriented reading of the modal interpretation, the modal infinitival clause must temporally follow the NP. Thus, we change the content of the infinitival clause as in (33b).

- (33) a. I met the first professor who attended this elementary school.  
 b. I met the first employee to receive his pension under the novel scheme.

In situations where (33b) is judged as true, the professor does not have to be an employee (and usually will not be) when they receive their pension. Although this sentence is compatible with a non-modal interpretation, which presumably requires temporal overlap between the NP and the infinitival clause, the availability of the modal interpretation gives rise to a pragmatically more natural reading where the NP and the infinitival clause are temporally disjoint.

It should be mentioned at this moment that the same requirement is observed with superlatives. Thus the following sentence is as infelicitous as (33).

- (34) #I met the oldest professor to attend this elementary school.

Similarly, tensed relative clauses and modal infinitival clauses do not impose the restriction.

- (35) a. I met the oldest professor who attended this elementary school.  
 b. I met the oldest employee to receive his pension under the novel scheme.

We will come back to this in Sect. 6, when we extend our analysis of ordinals to superlatives.

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<sup>16</sup>When we say the temporal properties of infinitival clauses, what matters is the temporal property of the whole infinitival clause, rather than the run-time of the event or state described by the predicate in the infinitival clause, which can be affected by other items in the infinitival clause. This matters in examples involving auxiliaries. For instance, the event time of the infinitival clause has been shifted to the past and future respectively due to *have* and *be*.

- (i) a. The first 80 year old to have walked on the moon is American.  
 b. The first 80 year old to be walking on the moon is American.

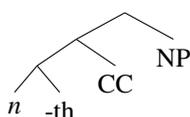
Thus, neither of these sentences require that the person be 80 year old at the time they walked or walks on the moon. Rather, it is required that they be 80 year old or younger when they walked on the moon in the past for (ia), and 80 year old or older when they walk on the moon in the future for (ib), because the NP must be simultaneous with *some time relative to which the event time is located in the past and future*, respectively.

## 5 An *In Situ* Semantics for Ordinals

We will now present our analysis of ordinals that accounts for the observations made in the preceding sections. In particular, in order to account for the lack of upstairs *de dicto* readings for ordinals, we assume that ordinals never move out of the local DP, contrary the proposals by Bhatt (2006), Bhatt & Pancheva (2012) and Ivlieva & Podobryaev (2012), and unlike what the movement theory of superlatives says about superlatives, albeit we do not have an insightful explanation at this moment as to why the two items differ in this respect. Below, we will lay out our analysis of ordinals and explain how it accounts for the key observations, and will discuss superlatives in the next section.

Let us start with the syntax. Following Bhatt & Pancheva (2012), we assume that ordinals decompose into a natural number (of type  $n$ ) and an ordinal forming morpheme *-th*. This decomposition is sometimes obscured by suppletion, e.g. *one+th* → *first*, which we take to be a matter of morphophonology. The following structure is assumed for ordinals in the nominal domain in general (see Sect. 7.2 for adverbial uses of ordinals), where  $n$  is a natural number.<sup>17</sup>

(36)



The position labeled as CC (for ‘Comparison Class’) in (36) is assumed to be the position that a non-modal subject infinitival clause occupies (with Bhatt & Pancheva 2012, and contra Bhatt 2006 and Sharvit 2010, who take it to be relative clauses modifying the NP), although on the surface it gets extraposed to a DP peripheral position.<sup>18</sup> Thus, according to this analysis, the non-modal subject infinitival clause

<sup>17</sup>In (35), the sister to *-th* is taken to be  $n$ , but we could alternatively make CC the sister, without any significant changes in the proposal. At present we have no decisive evidence for or against either possibility.

<sup>18</sup>This process might be better analysed with Late Merger along the lines suggested by Bhatt & Pancheva (2012) (see Fox & Nissenbaum 1999 for complex DPs and Bhatt & Pancheva 2004 for comparatives). According to this analysis, the derivation proceeds as follows.

- (i) [one-th<sup>R</sup> telescope]  
 [[one-th<sup>R</sup> telescope] one-th<sup>R}] (covert movement)  
 [[one-th<sup>R</sup> telescope] [one-th<sup>R</sup> [to be made]]] (Late-Merge)</sup>

Assuming that the extraposed infinitival clause semantically reconstructs, this structure will receive the same interpretation as (37). Related to this point, Bhatt (2006) remarks in an endnote that an analysis involving extraposition like Bhatt & Pancheva’s and ours might be more ‘intuitive’ than an analysis like his where a non-modal subject infinitival clause is treated as a relative clause modifying the NP.

[W]e seem to go against the ‘intuition’ that in *the first man to solve the problem*, *first* is somehow more closely related to the infinitival clause. According to this ‘intuition’, we start off with *the [first [to walk on the moon]] man*, which is then followed by extraposition of the infinitival clause to the edge of the NP. I think that ‘intuition’ has something to it—the relationship between *first* and the infinitival clause is a very local one [...].  
 (Bhatt 2006:n.44)

has a very close syntactic relation to the ordinal forming morpheme *-th*. As we will see shortly, it also plays an important semantic role, and derives the observations made in Sect. 2.3 and Sect. 4.

Of course, overt non-modal subject infinitival clauses are not obligatory and sentences are grammatical without them, as we saw in Sect. 2 (furthermore, as Sharvit & Stateva 2002 remarks, many languages lack expressions that correspond to non-modal subject infinitival clauses in English). We assume that in such cases, there is a covert pronominal element, which we call *pro-CC*, in CC.<sup>19</sup> Thus, there is always some material in CC. As explained below, *pro-CC* plays a crucial role in our account of the focus sensitivity of ordinals (and superlatives).

Turning now to the semantics of the ordinal forming morpheme *-th*, we propose (37). Here, variables  $t, t'$  etc. are variables over temporal intervals (of type  $i$ ).<sup>20</sup>

(37)  $\llbracket \llbracket [n \text{-th}] \text{ CC} \rrbracket \text{ NP} \rrbracket (x)$

- a. is defined only if  $A = \{y \in D_e \mid \exists! t' [\llbracket \text{NP} \rrbracket^{t'}(y) = \llbracket \text{CC} \rrbracket^{t'}(y) = \top]\}$  is such that:
- (i)  $n \leq |A|$ ; and
  - (ii)  $x \in A$ .
- b. whenever defined, denotes  $\top$  iff for the temporal ranking function  $R$  induced by NP and CC (see below),  $R(x) = n$ .

According to this semantics, *n-th* takes the intensions of CC and NP, which are functions of type  $\langle i, et \rangle$  and returns a function of type  $\langle e, t \rangle$ . The intensions of CC and NP are used to determine a set  $A$  of alternatives, which is a set of individuals  $y$  that make NP and CC true for some unique temporal interval  $t'$ , and which is presupposed to contain at least  $n$  members, including  $x$ , the ‘subject’ of *-th*. It is important that each member of  $A$  has a unique time at which NP and CC are true for it, because the ranking function  $R$  crucially makes use of the uniqueness (cases where this assumption is violated will be discussed below).<sup>21</sup> More specifically, we define the temporal rank-

<sup>19</sup>It should be stressed that we do not exclude the possibility of ellipsis in examples like the following where there is a discourse antecedent.

- (i) John will take the first train to arrive. Bill will take the first bus ~~to arrive~~.

One reason to assume an ellipsis in addition to *pro-CC* is because sloppy identity is observed in examples like (ii).

- (ii) John<sub>*j*</sub> will take the first train to arrive in his<sub>*j*</sub> hometown. Bill<sub>*b*</sub> will take the first bus ~~to arrive in his<sub>*b*</sub> hometown~~.

Since ellipses require antecedents, simple examples do not give rise to this option.

<sup>20</sup>The indexical theory of tense we assume here is too simplistic, especially when it comes to issues of nominal tense and temporal *de re*, but for our limited purposes, it is sufficient. Also it is not particularly hard to reformulate our proposal in a different theory of tense. For relevant discussion, see Eng (1981), Keshet (2010), Kusumoto (1998, 2005), Musan (1995), Partee (1973, 1984), Sharvit (2014), von Stechow (1995), among others.

<sup>21</sup>With temporally homogeneous predicates such as *live*, there will not be a unique time, but such predicates can appear in non-modal subject infinitival clauses:

- (i) John met the first man to live in this place.

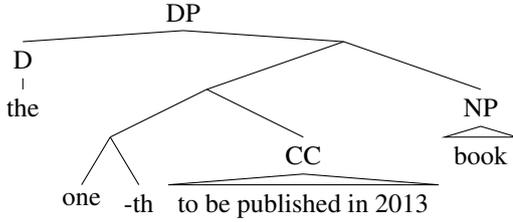
ing function  $R$  induced by NP and CC as in (38). Here  $t \leq t'$  means ‘ $t$  precedes or identical to  $t'$  on the temporal scale’.

- (38) Let  $A = \{y \in D_e \mid \exists!t'[\llbracket\text{NP}\rrbracket^{t'}(y) = \llbracket\text{CC}\rrbracket^{t'}(y) = \top]\}$ . Then the temporal ranking function induced by NP and CC is that ranking function  $R$  of type  $\langle e, n \rangle$  such that for any  $y \in A$ ,
- $$R(y) = \left| \left\{ z \in A \mid \begin{array}{l} ut_z[\llbracket\text{NP}\rrbracket^{t_z}(z) = \llbracket\text{CC}\rrbracket^{t_z}(z) = \top] \\ \leq ut_y[\llbracket\text{NP}\rrbracket^{t_y}(y) = \llbracket\text{CC}\rrbracket^{t_y}(y) = \top] \end{array} \right\} \right|$$

The idea is that for any member  $y \in A$ ,  $y$  has  $R(y) - 1$  individuals who have made the NP and CC true before  $y$ . Notice that in order to compute this, it is necessary that each member has a unique temporal interval. In reality, the uniqueness does not always hold. For such cases, we will propose a type-shifted version of the semantics here, to which we will come back shortly.

Let us illustrate how this works with a concrete example. The important point to remember is that the NP and CC are used to determine both the set of alternatives  $A$  and the temporal ranking function  $R$ . For example, for (29a), the LF of the object DP *the first book to be published in 2013* looks like the following.

(39)



The extensions of CC and NP are assumed to be as in (40).

- (40) a.  $\llbracket\text{book}\rrbracket^t = [\lambda x \in D_e. \mathbf{book}_t(x)]$   
 b.  $\llbracket\text{to be published in 2013}\rrbracket^t = [\lambda x \in D_e. \mathbf{published}_t(x) \wedge t \subseteq 2013]$

The intensions of these phrases determine the set of alternatives  $A$  to be:

$$A = \{x \in D_e \mid \exists!t'[\mathbf{book}_{t'}(x) = \mathbf{published}_{t'}(x) = \top \wedge t' \subseteq 2013]\}$$

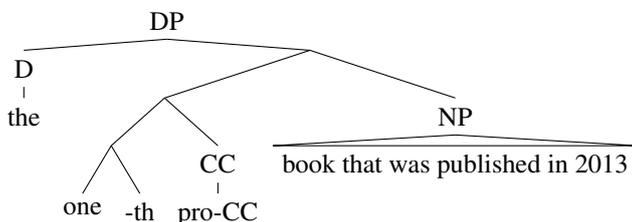
This is the set of books that were published in 2013 (the uniqueness is trivially satisfied, assuming that the same book is not published twice in the same year).

The temporal ranking function  $R$  induced by CC and NP ranks these books according to when they were published. As a result the entire phrase denotes the book among the ones published in 2013 that was published before others. In the situation depicted in (28), this is Book 5.

We assume that for sentences like (i), the relevant time interval is the beginning of the state, which is a unique moment. Such implicit reference to the either end point of a time interval has been proposed for the semantics of *before* and *after* by Beaver & Condoravdi (2003) among others. Additionally, it might also be necessary to add a presupposition in (37), requiring that the times associated with the members of  $A$  do not overlap. But since the example we will discuss all involve punctual events and the issue of overlapping times does not arise, we will leave this out.

As for (29b), which has a tensed relative clause instead, we assume that the relative clause is modifying the noun *book* and *pro-CC* occupies CC. Thus, the structure of the object DP looks as follows.

(41)



Depending on the value of *pro-CC*, the DP gets a different interpretation. One possibility is that it denotes  $\llbracket \text{to be published in 2013} \rrbracket$ , which will derive the same reading as (29a). Alternatively, its value could be retrieved from the context. More concretely, in the context given in (28), it may denote something akin to the denotation of *to appear as you go through the pile from top to bottom* (this function need not be expressed linguistically). Then, the DP denotes Book 2. A similar account can be given to modal subject infinitival clauses, which we assume are also modifying NP directly, just like tensed relative clauses.

The present analysis gives a straightforward account of the two temporal properties of non-modal subject infinitival clauses mentioned in Sect. 4. Sharvit's (2010) observation that the non-modal subject infinitival clause fixes the ordering to the temporal one directly follows from the semantics above. That is, the ordering  $R$  is determined jointly by the NP and the non-modal infinitival clause in CC. Furthermore, this semantics also requires that for all members of  $A$ , there be a (unique) time at which NP and the non-modal subject infinitival clause hold *simultaneously*, which captures Bhatt's (2006) observation that the NP and non-modal subject infinitival clause must temporally overlap.

In addition, the analysis gives a natural explanation to another related observation due to Bhatt (2006). He notes that the same temporal simultaneity inference obtains sometimes with tensed relative clauses, as demonstrated by (42).

(42) The first 80 year old (person) who walked on the moon was American.  
(Bhatt 2006:(136))

This sentence entails that the American person in question walked on the moon when he was 80 years old. Bhatt also remarks that under a comparative interpretation with a focus, the temporal simultaneity is no longer required. To see this, take the following example with a focus prominence on *Miguel*. Under the intended interpretation, the ordinal ranks people who Olafur introduced to an 80 year old that walked on the moon, according to the time at which the introductions took place.

(43) Olafur introduced Miguel<sub>F</sub> to the first 80 yr. old who walked on the moon.  
(Bhatt 2006:(143a))

This sentence does not entail that the person who Olafur introduced Miguel has walked on the moon at age 80. Furthermore, we observe that with a contextually determined ordering, e.g. as in our examples with a pile of books from Sect. 4, the temporal simultaneity requirement between the NP relative clauses is not observed. To see this more clearly, consider the context in (44) and the sentence in (45).

- (44) There are ten 70 year olds and ten 80 year olds queued up in different queues. Some of them have walked on the moon when they were young.
- (45) I have seen the first 80 year old who walked on the moon (but I don't remember his name).

In the context described by (44), the object of (45) can denote the 80 year old who is closest to the speaker and has walked on the moon in the past. Crucially, the person in question is not required to have walked on the moon at age 80.

All of these data are accounted for as follows. In Bhatt's example in (42), the implicit comparison class is denoted by *pro-CC*. Given the reading, *pro-CC* denotes the same thing as *to walk on the moon*, which according to our semantics of *-th*, needs to temporally overlap with the NP. Hence the inference that the relevant person was 80 years old when they walked on the moon. When the denotation of the CC is different from the content of the relative clause, as in (43) and (45), the temporal simultaneity is no longer required between the NP and relative clause, because the temporal simultaneity only has to hold between the NP and the implicit comparison class *pro-CC*. In (43), *pro-CC* denotes the same thing as *to be introduced by Olafur*, and the temporal simultaneity requirement demands that the person to be 80 years old when the introduction took place, which accords with our intuitions. But crucially it is not required that they walked on the moon when they are 80 years old. Similarly, the comparison class for (45) is something like *to appear if you go through the queue from the closest person to the farthest*, so the person has to be 80 years old right now, but does not required to be when they walked on the moon.

To summarise so far, the crucial feature of our analysis is that the NP and CC determine the temporal ordering and the set of alternatives. Since a non-modal subject infinitival clause is in CC, its linguistic content always matters for the ordering. On the other hand, when *pro-CC* occurs there instead, it does not always correlate with other linguistic material such as relative clauses, although its value does matter in the same way that the semantics of a non-modal subject infinitival clause does.

Before proceeding, several remarks are in order. Firstly, one might think that the set of alternatives *A* is too large. For instance, the set of alternatives for (29a) includes all books that were published in 2013, not just the ones in the pile. The same point can be made by an example like (46).

- (46) The first train to leave Gare du Nord arrived in London at 7:13 am.

One can easily understand this sentence to be about the first train today, for example, rather than the first train that ever left Gare du Nord (which would be in 1846, when there was no train from Paris to London, of course). Thus, some sort of contextual restriction seems to be needed. However, we think that it need not be hardwired into

the semantics of ordinals, given how ubiquitous contextual restrictions are in natural language.

It is well observed that contextual restrictions are at play with a number of different kinds of expressions (the literature is particularly copious, e.g. Elbourne 2008, von Stechow 1994, Martí 2006, Stanley 2000, Stanley & Szabó 2000, Westerståhl 1984, among many others). To give an example, suppose you ask me in London how much it costs to get to Oxford, and I tell you *Trains are more expensive than buses*. You naturally understand my utterance to be about trains and buses *from London to Oxford*, rather than about trains and buses of all kinds in the world. Similarly, suppose that if I ask a colleague of mine in the Linguistics department *Is there an MA student who's interested in semantics?*, what I mean is whether there is an MA student *in our department*, or at least *at our university*, who is interested in semantics, rather than any MA student whatsoever. We do not make commitments here about the highly contentious issue of how exactly contextual restrictions come about in natural language (see the citations above for various ideas), which is clearly beyond the purview of this paper, but we think that contextual restrictions of this kind do not need to be encoded directly in the semantics of ordinals. For instance, one could account for the above observations by restricting the nouns *book* and *train* (as in the case of the above example about trains and buses from London to Oxford), or possibly some other phrases in the infinitival clause.

Secondly, it is crucially assumed in our semantics that each individual in  $A$  satisfies NP and CC simultaneously exactly once. However, situations violating this uniqueness assumption are rampant, and moreover, one can in fact use ordinals in such situations perfectly felicitously. For example, Marie Skłodowska-Curie was awarded a Nobel prize twice, once in Physics in 1903 and once in Chemistry in 1911, which were, incidentally, the first and fourth Nobel prizes to be awarded to women. Thus, there are two times  $t_1$  and  $t_2$  that satisfy the following predicate of temporal intervals:

$$\lambda t. \llbracket \text{to be awarded a Nobel prize} \rrbracket^t(\text{MSC}) = \llbracket \text{woman} \rrbracket^t(\text{MSC}) = \top$$

Thus this is a kind of situation where the uniqueness does not hold. Yet, the following sentences are perfectly felicitous and uncontroversially true.<sup>22</sup>

- (47) a. The first woman to be awarded a Nobel prize was Marie Skłodowska-Curie.  
 b. The fourth woman to be awarded a Nobel prize was Marie Skłodowska-Curie.

In order to account for these cases, we propose to type-shift the semantics of *-th* so that the comparison class consists of *temporal slices of individuals*, rather than

<sup>22</sup>Interestingly, there seems to be a contrast between the following two sentences.

- (i) a. Marie Skłodowska-Curie was the first woman to be awarded a Nobel prize.  
 b. ?#Marie Skłodowska-Curie was the fourth woman to be awarded a Nobel prize.

It appears to us that this contrast has to do with the identificational vs. predicative uses of the copula construction, but we do not have an account of it at this moment.

individuals *simpliciter* (cf. Musan 1995).<sup>23</sup> Temporal slices of individuals are modeled here by individual-time pairs, which we represent as  $x_t$  for an individual  $x$  and a temporal interval  $t$ . Concretely,  $MSC_{1903}$  represents the temporal slice of Marie Skłodowska-Curie that occupies throughout the year 1903. Using temporal slices of individuals, we propose the following type-shifted semantics of *-th* where the members of the set  $A$  of alternatives are temporal slices of individuals.<sup>24</sup>

- (48)  $\llbracket [n \text{-th}] \text{CC} \text{NP} \rrbracket^t(x)$
- a. is defined only if for  $A = \{y_{t'} \in (D_e \times D_t) \mid \llbracket \text{NP} \rrbracket^{t'}(y) = \llbracket \text{CC} \rrbracket^{t'}(y) = \top\}$ 
    - (i)  $n \leq |A|$ ; and
    - (ii)  $x_t \in A$ .
  - b. whenever defined, denotes  $\top$  iff for the temporal ranking function  $R$  such that for any  $y_{t'} \in A$ ,  $R(y_{t'}) = |\{z_{t''} \in A \mid t'' \leq t'\}|$ ,  $R(x_t) = n$ .

For the examples in (47), the set  $A$  of alternatives looks like this:

$$A = \left\{ \begin{array}{l} \text{Marie Skłodowska-Curie}_{1903}, \\ \text{Bertha von Suttner}_{1905}, \\ \text{Selma Lagerlöf}_{1909}, \\ \text{Marie Skłodowska-Curie}_{1911}, \\ \text{Grazia Deledda}_{1926}, \\ \dots \end{array} \right\}$$

The ranking function  $R$  ranks these pairs according to the temporal intervals associated with these temporal slices of individuals. Thus, (47a) is true with  $t = 1903$  and (47b) with  $t = 1911$  (where  $t$  is assumed to be introduced by the past tense in the matrix clause).

This type-shifted semantics also provides a foothold for explaining the following curious contrast noticed by Ivlieva & Podobryaev (2012).

- (49) a. The first American to walk on the moon walked on the moon in 2011.  
b. The first American walked on the moon in 2011.

(49a) can mean that Neil Armstrong walked on the moon in 2011 (again), but (49b) cannot and sounds false, given that Neil Armstrong already walked on the moon in 1969. In other words, (49b) can only mean that the first American to ever walk on the moon did so in 2011. This is quite puzzling. If the implicit comparison class of (49b)

<sup>23</sup>Barker (1999) and Doetjes & Honcoop (1997) discuss cases that involve quantification over ‘stages of individuals’, a primary example of which is *Four thousand ships passed through the lock* (see also Krifka 1990 and references therein for earlier discussions of this and similar examples). In order to account for the relevant readings, these authors make use of pairs consisting of an individual and an event, rather than an individual and a temporal interval. We leave open here whether we could also use events instead of temporal intervals.

<sup>24</sup>To be more precise, it is necessary to add a contextual restriction on what  $t'$  can be, since we do not wish to count two temporal slices of the same individuals whose temporal parameter differ in 1 sec, for instance. In this case, it is natural to assume that  $t'$  spans for an entire year, as Nobel Prizes are awarded annually. As discussed above, we remain silent as to how such contextual restrictions are brought about in the compositional semantics.

could mean the same thing as *to walk on the moon*, the two sentences should be able to have the same reading.

We suggest the following solution to this puzzle. Notice that under the intended reading of (49a), the uniqueness assumption is violated. That is, for (49a) to be true, Neil Armstrong needs to have walked on the moon at least twice. We conjecture that the type-shifted interpretation of *-th* necessitates an overt non-modal subject infinitival clause (or maybe the latter triggers the former). With pro-CC, therefore, no type-shifted interpretation is possible, and consequently (49b) lacks the relevant reading. Admittedly, however, this solution is quite *ad hoc*, and a more principled explanation should be sought. But that needs to await another occasion.

Having laid out our analysis of the syntax and semantics of ordinals and how non-modal subject infinitival clauses work, we will devote the rest of the present section to explaining the remaining properties commonly observed for ordinals and superlatives that we reviewed in Sect. 2, namely: (i) absolute-comparative ambiguities, and (ii) focus sensitivity. We will focus on ordinals for the moment, and come back to superlatives in the next section.

### 5.1 Absolute vs. comparative readings

With the above semantics of ordinals, we can derive absolute and comparative readings of ordinals by varying the comparison class, pretty much in the same way as we derived absolute and comparative readings of superlatives in Sect. 3.1. To illustrate, let us analyse (5), repeated here.

(5) John gave Mary the first telescope.

According to our *in situ* semantics, the definite DP *the first telescope* involves a covert pronominal pro-CC. Suppose that it denotes  $\llbracket$ to be made $\rrbracket$  (this is not to imply that the phrase *to be made* is linguistically realised in the structure or discourse). Then the set  $A$  of alternatives include all (relevant) telescopes that have been made or will be made, and the definite DP denotes the unique telescope  $x$  in this set that was made before any of the others. This is indeed the absolute reading.

Now suppose that pro-CC denotes  $\llbracket$ to be given to Mary $\rrbracket$ . Then the set  $A$  of alternatives will be the set of telescopes that Mary received from somebody at some point, and the DP denotes the telescope that she received before the rest of the telescopes in  $A$ . This is the comparative reading paraphrased by (6b).

The other comparative reading we discussed in Sect. 2 is also derivable in a similar way. This time, pro-CC denotes  $\llbracket$ to be given by John to somebody $\rrbracket$ . Consequently  $A$  contains the set of telescopes that John gave or will give to somebody, and the definite DP denotes the first telescope to be given by John to somebody.

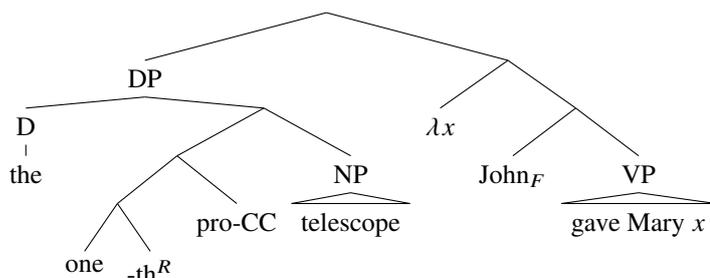
### 5.2 Focus sensitivity

Recall now that these two comparative readings are prosodically differentiated, and this needs to be captured in some way. We claim that this has to do with how the

value of pro-CC is determined. Specifically, we pursue the following idea. The value of pro-CC is either contextually retrieved or determined by the meaning of some other phrase in the same sentence, and in the latter case, focus plays a crucial role.

We will illustrate the idea with the comparative reading (6b) of (5) that John gave Mary a telescope before anybody else gave her one. One crucial ingredient of our analysis is that LF involves covert movement of the object DP, as depicted in (50) (Gutiérrez-Rexach 2006 and Sharvit & Stateva 2002 postulate similar covert movement for superlatives).

(50)



Since there is no overt non-modal subject infinitival clause in this sentence, the comparison class is denoted by the pronominal element pro-CC. In this structure, we assume, its value can be equated with the union of the focus value of the derived predicate as in (51).<sup>25</sup>

$$(51) \quad \llbracket \text{pro-CC} \rrbracket = \bigcup \llbracket \lambda x \text{ John}_F \text{ gave Mary } x \rrbracket^f.$$

Here  $\llbracket \alpha \rrbracket^f$  is the Roothian focus semantic value of  $\alpha$ . In the above tree,  $\alpha$  is the derived constituent ‘ $\lambda x \text{ John}_F \text{ gave Mary } x$ ’, whose focus semantic value is:

$$\{ \lambda x. \text{gave}(y, x, m) \mid y \in D_e \}$$

which is the set of (functions that characterise) sets of things that are given to Mary. By taking the grand union of this set, we obtain (the function that characterises) the set of things that somebody gave to Mary. With this being the value of pro-CC, we arrive at the correct truth-conditions for the comparative reading (6b).

Importantly, in order to obtain the derived predicate, ‘ $\lambda x \text{ John}_F \text{ gave Mary } x$ ’, the covert movement is indispensable. The postulation of this movement is further buttressed by the fact that it exhibits locality restrictions. Generally, the covert movement obeys the same constraints that QR obeys. More concretely, consider the sentences in (52) involving a complex NP, for instance.

(52) a.  $\text{John}_F \text{ gave Mary } [\text{CNP a telescope made by the first American}].$

<sup>25</sup>We are not the first to exploit the union of the focus value of part of the sentence to resolve anaphora of this kind. Both Rooth (1985:Ch.5) and von Stechow (1994) use it to explain how focus affects the domain of adverbs of quantification, Musan (1995:105) suggests that an analogous mechanism is at play for domain restrictions of the so-called inverse proportional reading of *many* and *few*, and Heim (1999) puts forward a similar mechanism for comparison classes of superlatives.

- b. Someone gave Mary [<sub>CNP</sub> a telescope recommended by every American].

The sentence in (52a) does not have a comparative reading that John gave Mary a telescope that was made by the first American to make a telescope to be given to Mary. This reading would require covertly moving *the first American* out of the Complex NP island, which would create the derived predicate ‘ $\lambda x$  John<sub>F</sub> gave Mary [a telescope made by  $x$ ]’. The constraint forbids the inverse scope reading of *every American* over *someone* in (52b). The same point can be made with a coordinate structure, as in (53).

- (53) a. John<sub>F</sub> [<sub>CS</sub> gave Mary the first telescope and kissed her].  
b. Someone [<sub>CS</sub> gave Mary every telescope and kissed her].

The sentence in (53a) cannot mean that John’s telescope was the first to be given to Mary with a kiss. This would require a movement that would violate the Coordinate Structure Constraint that would create the derived predicate ‘ $\lambda x$  John<sub>F</sub> [gave Mary  $x$  and kiss her]’. This is parallel to the lack of inverse scope reading of *every telescope* in (53b). Also, the scopes of both kinds of movement are bounded by a tensed-clause boundary, as shown by (54).

- (54) a. John<sub>F</sub> said that Mary bought the first telescope.  
b. Someone said that Mary bought every telescope.

The sentence in (54a) lacks a reading that the telescope that John said Mary bought was the first among the telescopes that someone said Mary bought. The constraint here is of the same nature as the one that prohibits the inverse scope reading of *every telescope* in (54b).

To reiterate the crucial feature of the present account, focus indirectly determines the content of the implicit comparison class. In (50), the subject *John* is in focus, and hence the grand union of the focus value of the derived predicate is the set of things that somebody gave to Mary. On the other hand, if the indirect object *Mary* is focused, the grand union of the focus value of the derived predicate becomes the set of things that John gave to somebody. Then, the comparison class will be the set of things that John gave to somebody, and this will affect the overall truth-conditions.

One nice prediction of this analysis is that under a comparative reading where the implicit comparison class is determined by the focus structure of the derived predicate, the ordering should also be determined accordingly. This prediction is borne out, as illustrated by (55).

- (55) John<sub>F</sub> gave Mary the first telescope.

Under the comparative reading, the set of alternatives is the set of (relevant) telescopes that were given to Mary, and the ordering is the one that orders these telescopes according to when they were given to Mary. Thus, the sentence is predicated to be *false* in the following context, where John is the second to give a telescope to Mary.

- (56) a. On August 1st, Bill gave Mary a telescope that was made in 1993.  
 b. On August 2nd, John gave Mary a telescope that was made in 1880.  
 c. On August 3rd, Steve gave Mary a telescope that was made in 2011.

If the ordering could order the telescopes according to when they were made, rather than according to when they were given to Mary, the sentence would have a true reading, which it does not.

It should be stressed, however, that although focus does play a role in cases like above, it is not required. For instance, (57) does not seem to involve a focus prominence, as noticed by Ivlieva & Podobryaev (2012).

- (57) In 1969 the first man landed on the moon.

Our analysis accounts for this state of affairs as follows. In this sentence pro-CC is equivalent to  $\bigcup \llbracket \text{land on the moon} \rrbracket^f = \bigcup \{ \llbracket \text{land on the moon} \rrbracket \} = \llbracket \text{land on the moon} \rrbracket$  (where *land on the moon* is the constituent embedded under the past tense *-ed*).

Furthermore, we allow *pro-CC* to refer to a contextually determined property, in which case focus again has no role to play. For instance, for the following example, the value of pro-CC can be something that is totally irrelevant to the meanings of other linguistic expressions in the sentence or in the discourse, e.g.  $\llbracket \text{to arrive here} \rrbracket$ .

- (58) You should take the second train.

Lastly, let us come back to Bhatt's (2006) observation mentioned at the end of Sect. 2 that overt non-modal subject *to*-infinitival clauses make superlatives focus insensitive. This is expected under the current analysis, simply because such sentences do not involve pro-CC, and the focus does not affect the meaning of the non-modal subject infinitival clause.

### 5.3 Interim summary and further issues

To sum up our analysis, assuming that ordinals do not move out of the local DP, unlike superlatives, we have proposed that their semantics refer to comparison classes that yield various truth-conditionally distinct readings. Comparison classes are denoted either by non-modal subject infinitival clauses or a covert pronominal pro-CC. The value of pro-CC can be determined purely contextually, or in relation to another phrase in the sentence. In the latter case, focus plays a crucial role, although it is not a necessary factor.

Before leaving this section, let us mention other intriguing properties of ordinals that Bhatt (2006) has uncovered, which need to remain unsolved here. Firstly, Bhatt (2006) discusses a great deal about what he calls high and low readings of ordinals with relative clauses like the following.<sup>26</sup>

<sup>26</sup>He also notes that high and low readings are also available with nominal *only* and superlatives:

- (i) a. the only book that John said that Tolstoy had written  
 b. the longest book that John said that Tolstoy had written (Bhatt 2006:29,(50))

- (59) the first book that John said that Tolstoy had written (Bhatt 2006:29, (49))
- a. High reading: the book  $x$  such that John's saying that Tolstoy had written  $x$  preceded his saying that Tolstoy had written  $y$  for any  $y$ .
  - b. Low reading: the book  $x$  such that John said Tolstoy had written  $x$  before writing any other book.

Secondly, Bhatt (2006:42,60f) points out that ordinals (but not superlatives or nominal *only*) license non-modal subject infinitival clauses from inside them, although he notes in n.24 that many speakers find (60a) degraded.

- (60) a. the boy to climb Mt. Everest first/last  
 b. the first/last boy to climb Mt. Everest (Bhatt 2006:p. 42,(69))
- (61) a. The student to finish the marathon first got the gold medal.  
 ( $\approx$ The first student to finish the marathon got the gold medal.)  
 b. The student to finish the marathon last got a consolation prize.  
 ( $\approx$ The last student to finish the marathon [got] a consolation prize.)  
 (Bhatt 2006:p. 60,(103))

Our analysis has little to say about these observations, and we will leave them for future research. However, we will have some preliminary discussion on the adverbial use of ordinals in Sect. 7.2, which should eventually be related to the second point here.

## 6 Superlatives and Their Comparison Classes

Having presented our analysis of ordinals, we are now ready to explain their similarities with superlatives we reviewed in Sect. 2. As repeatedly remarked above, the idea we pursue here is that their similarities are due to the shared property that they refer to comparison classes in the same fashion. Specially, we assume that just like for ordinals, non-modal subject infinitival clauses serve as comparison classes for superlatives, and when there is no overt one, a covert pronominal pro-CC does.

In order to graft our analysis of comparison classes onto the movement theory of *-est*, we revise the semantics of *-est* as follows, which is slightly different from (19) in Sect. 3.1, but not in any essential respects. Here XP is of type  $\langle d, \langle e, t \rangle \rangle$ .

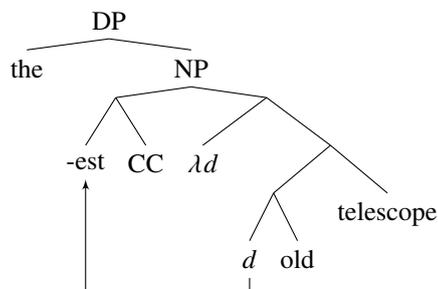
- (62)  $\llbracket [-\text{est CC}] \text{XP} \rrbracket^t(x)$
- a. is defined only if  $A = \{y \in D_e \mid \exists t' \exists d [\llbracket \text{XP} \rrbracket^{t'}(d)(y) = \llbracket \text{CC} \rrbracket^{t'}(y) = \top]\}$  is such that:
    - (i)  $|A| > 1$ ; and
    - (ii)  $x \in A$ .
  - b. whenever defined, denotes  $\top$  iff there is  $d \in D_d$  such that  $\llbracket \text{XP} \rrbracket^t(d)(x) = \top$  and for all  $y \in A$ , if  $x \neq y$ , then  $\llbracket \text{XP} \rrbracket^{t'}(d)(y) = \perp$  for any  $t' \in D_t$ .

The crucial assumption here is that CC is realised as a non-modal subject infinitival or the covert pronominal pro-CC. Unlike with ordinals, CC only matters for the set of

alternatives, since for superlatives, the ‘ordering’, so to speak, is already determined by the gradable predicate denoted by XP.

Let us see how this works with some concrete examples. As explained in Sect. 3.1, and similarly to ordinals, both absolute and comparative readings can be derived with the following structure. Recall that the DP-internal movement is necessary to resolve the type-mismatch at the base-generated position.

(63)



If CC is realised a non-modal subject infinitival clause *to be made*, this DP denotes the telescope that is older than other relevant telescopes, which is an absolute reading. The same truth-conditions ensue with pro-CC denoting the same property as *to be made*, of courses. A comparative reading can be derived with a different CC. Concretely, the comparative reading of (3) in (4b), repeated below, can be derived with a covert pro-CC denoting  $\llbracket$ to be given to Mary $\rrbracket$ .

(3) John gave Mary the oldest telescope.

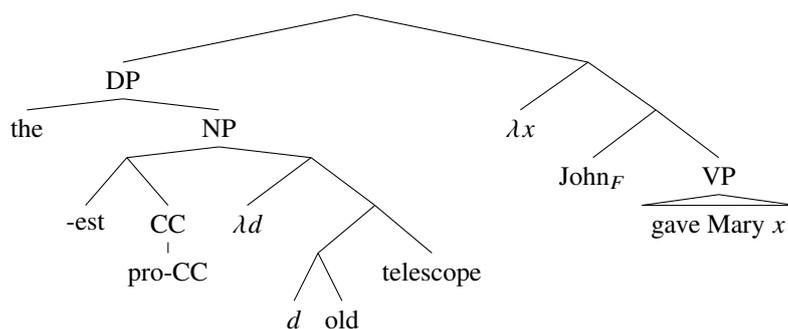
(4b) **Comparative:** John gave Mary an older telescope than other people did.

The same truth-conditions can be expressed with an overt non-modal subject infinitival clause, as demonstrated by (64).

(64) John gave Mary the oldest telescope to be given to her.

Just as in the case of ordinals, when pro-CC is employed, the focus structure of a derived predicate can be referenced. Concretely, the reading in (4b) can be derived via a covert movement depicted in (65), which is analogous to the LF (50) for ordinals.

(65)



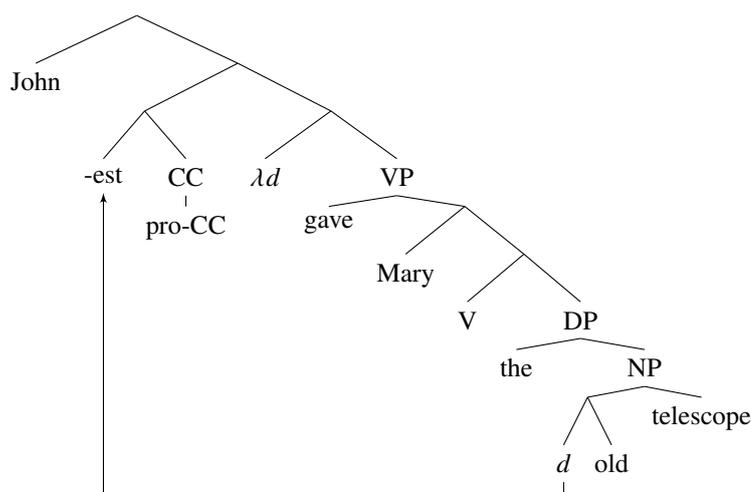
Since  $\bigcup \llbracket \lambda x \text{ John}_F \text{ gave Mary } x \rrbracket^f = \llbracket \text{to be given to Mary} \rrbracket$ , pro-CC can denote this, deriving the comparative reading we are after. Other comparative readings can be derived in similar ways. This explains the focus sensitivity, another property shared by ordinals and superlatives.

Turning now to the temporal properties, according to the above semantics, *-est* existentially quantifies over the temporal parameter in determining *A*, just like *-th*. This accounts for the fact that different alternatives in *A* may satisfy the XP at different times. For example, for *the earliest train to arrive*, different trains arrive at different times. We also observe that the alternatives can satisfy the NP at different times, e.g. for *the tallest president of the US*, different individuals are US presidents at different times. However, each alternative needs to satisfy the NP and CC at the same time, which is forced by the semantics in (62). This is a good result in light of the discussion in Sect. 4.2. That is, recall that the following is infelicitous, as it is associated with the inference that the person in question was attending the elementary school as a professor.

(34) #I met the oldest professor to attend this elementary school.

So far, everything is the same between ordinals and superlatives. However, there is one crucial difference between ordinals and superlatives: superlatives are allowed to covertly move out of the local DP. Such a covert movement would also yield comparative readings. For instance, the following LF yields the same comparative reading (4b).

(66)



In this case the set *A* of alternatives will be the set of people who gave a telescope to Mary, and John is asserted to be the one who gave the oldest telescope.

However, notice that in this case, CC cannot be overtly realised as a non-modal subject infinitival clause. Concretely, the following sentence cannot mean that among the people who like Mary and gave her a telescope, John gave the oldest telescope.

(67) #John gave Mary the oldest telescope to like Mary.

We stipulate here that *-est* can move out of the local DP only with pro-CC, and not with an overt non-modal subject infinitival clause. This could be given a syntactic explanation, but we leave this for future research.

If the movement of *-est* crosses an intensional predicate like *want*, as depicted in (17), an upstairs *de dicto* reading is derived. Notice that in this case too, an overt non-modal subject infinitival blocks the movement out of the local DP. That is, the following sentence does not have an upstairs *de dicto* reading, where *to be at this station now* would restrict the set *A* of alternatives to which John belongs.

(68) #John wants to take the earliest train to be here now.

Let us take stock. The common properties of superlatives and ordinals are due to the syntax and semantics of their comparison classes. They have absolute and comparative readings, because of the flexibility of pro-CC. Their focus sensitivity boils down to the semantics of pro-CC as well. Furthermore, both ordinals and superlatives license non-modal subject infinitival clauses, because they license the CC slot.

As for the difference between them, namely, superlatives can undergo movement out of the local DP, while ordinals cannot, we have little to say. However, we have uncovered a curious constraint on this movement: An overt non-modal subject infinitival clause blocks the movement out of the local DP. This ultimately needs to be explained but we leave it for another occasion.

Lastly, it is worth remarking that the analysis of superlatives that emerged from the above discussion looks ‘eclectic’ in the sense that there are two mechanisms responsible for comparative readings, but we think it is justifiably so, namely it is motivated by the consideration about the similarities with ordinals. The bulk of the theoretical controversy surrounding superlatives concerns the existence of covert movement out of the local DP. As we explained in Sect. 3, we think it is well motivated given the existence of upstairs *de dicto* readings. That said, it is completely understandable that others have sought alternative explanations of upstairs *de dicto* readings in an attempt to dispense with the covert movement. We think this is a very healthy skepticism, but such attempts have so far been not very successful (see the discussion in fn.6). Putting upstairs *de dicto* readings aside, the general tendency in the literature is to assume that one and the only one mechanism is responsible for comparative readings. That is, those who postulate movement blame movement for comparative readings, while those who think absolute-comparative ambiguities should be accounted for solely by the difference in the comparison class do not postulate movement. This is of course completely natural given the considerations of theoretical parsimony. Our view that emerged from the above discussion is different, however. We need to recognise both mechanisms that generate comparative readings. Specifically, the availability of upstairs *de dicto* readings for superlatives but not for ordinals led us to postulate covert movement only for superlatives. But at the same time, since absolute-comparative ambiguities are observed with both of these items, we need an *in situ* account of comparative readings for ordinals. Consequently, superlatives are equipped with two different mechanisms that generate comparative readings under this view. Theoretically cluttered though this might look, we think our

analysis has achieved an unprecedented level of empirical adequacy for both ordinals and superlatives.

## 7 Conclusions and Further Issues

In the present paper, we have proposed an *in situ* semantics for ordinals. In particular, the ordinal forming morpheme *-th* is assigned the semantics in (37). This is motivated by the novel observation that ordinals do not give rise to upstairs *de dicto* readings, unlike superlatives. We provided explanations for the similarities between these two classes of items based on the syntax and semantics of comparison classes, which are expressed overtly as non-modal subject infinitival clauses, or covertly as pro-CC.

Incidentally, this analysis of ordinals can be extended straightforwardly to related expressions such as *last* and *next*. *Last* has a number of uses, which we take to be a lexical accident in English, as analogous items in other languages are not always ambiguous. In the sense of ‘final’, it can be given the following meaning.

- (69)  $\llbracket [\text{last CC}] \text{NP} \rrbracket^t(x)$
- a. is defined only if  $A = \{y \in D_e \mid \exists!t' \llbracket [\text{NP}] \rrbracket^{t'}(y) = \llbracket [\text{CC}] \rrbracket^{t'}(y) = \top\}$  is such that  $x \in A$ .
  - b. whenever defined, denotes  $\top$  iff for the temporal ranking function  $R$  induced by NP and CC,  $R(x) = |A|$ .

Unlike *-th*, *last* does not refer to a natural number. Rather, it says  $x$  is the temporally the last one to satisfy the NP and CC. Another use of *last* in the sense of ‘one before’ is analysed as referring to a contextually determined number  $\zeta$  in the following manner.

- (70)  $\llbracket [[\zeta \text{ last}] \text{CC}] \text{NP} \rrbracket^t(x)$
- a. is defined only if  $A = \{y \in D_e \mid \exists!t' \llbracket [\text{NP}] \rrbracket^{t'}(y) = \llbracket [\text{CC}] \rrbracket^{t'}(y) = \top\}$  is such that:
    - (i)  $\zeta - 1 \leq |A|$ ; and
    - (ii)  $x \in A$ .
  - b. whenever defined, denotes  $\top$  iff for the temporal ranking function  $R$  induced by NP and CC,  $R(x) = \zeta + 1$ .

The meaning of *next* is a variant of this, where ‘+1’ is substituted for ‘-1’.

While we succeeded in explaining many central properties of ordinals, our analysis leaves open a number of further questions and puzzles, some of which were mentioned along the way. We discuss five additional further issues in what follows.

### 7.1 Nominal *only*

Bhatt (2006) discusses another construction that licenses non-modal subject infinitival clauses, namely nominal *only* exemplified by (71).

(71) I met the only person to receive a Nobel Prize in two different sciences.

Naturally, we expect our account of comparison classes to extend to this construction. In fact, we observe the same temporal simultaneity restriction to be active here.

(72) #I met the only professor to attend this elementary school.

Given our proposal about comparison classes, the following semantics for *only* suggests itself.

- (73)  $\llbracket [\text{only CC}] \text{XP} \rrbracket^t(x)$
- is defined only if  $A = \{y \in D_e \mid \exists t' \exists d [\llbracket \text{XP} \rrbracket^{t'}(d)(y) = \llbracket \text{CC} \rrbracket^{t'}(y) = \top]\}$  is such that  $x \in A$ .
  - whenever defined, denotes  $\top$  iff  $|A| = 1$ .

We leave appraisal of this analysis for future research, but nonetheless it is interesting to notice that *only* also does not give rise to upstairs *de dicto* readings, just like ordinals, and unlike superlatives. Specifically the following sentence is judged as *false* in our context with three travellers, John, Bill and Fred, given in (15).

(74) John wants to take the only train between 3 pm and 4 pm.

If *only* could take scope in the manner *-est* can, it could make sentence true with the meaning being ‘John is the only person who want to take a train between 3 pm and 4 pm’. This interpretation is clearly unavailable.

## 7.2 Adverbial Uses of Ordinals

Ordinals can not only modify NPs but also VPs, as in (75).<sup>27</sup>

(75) John swam first.

As previously observed by Bhatt (2006:55,63), ordinals as VP-adverbs also exhibit focus sensitivity. For (75), if the subject *John* is in focus, it is naturally read as meaning that John swam before anybody else, while if the predicate *swam* is in focus, it means that John swam before he did anything else, or that John swam before other relevant things took place.

It is of course desirable if our analysis of nominal ordinals straightforwardly extends to account for adverbial ordinals, but there are some non-trivial obstacles. In order to appreciate this, let us minimally modify our semantics of the nominal *-th*, using event semantics (Parons 1990, Landman 2000, among others), as follows.

(76)  $\llbracket \llbracket \text{VP} \llbracket [n\text{-th}] \text{CC} \rrbracket^t \rrbracket^t(e_v)$

<sup>27</sup>Ordinals also have speech act uses, as illustrated by (i).

(i) First, we’ll discuss the syntax, and second, we’ll discuss the semantics.

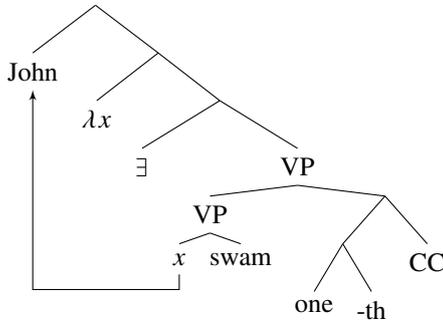
Although this use is perhaps amenable to a similar treatment, we will ignore it here. For related discussion, see Parons (1990:Ch.12), Potts (2005:§4.7), Morzycki (2014:§5.5), for example.

- a. is defined only if  $A = \{e' \in D_v \mid \exists! t' [\llbracket \text{VP} \rrbracket^{t'}(e_v) = \llbracket \text{CC} \rrbracket^{t'}(e') = \top]\}$  is such that:
- (i)  $n \leq |A|$ ; and
  - (ii)  $e \in A$ .
- b. whenever defined, denotes  $\top$  iff for the temporal ranking function  $R$  induced by VP and CC,  $R(e) = n$ .

There are several differences from (37). One is the word order. Also, the last argument is an event  $e$  (of type  $v$ ), rather than an individual  $x$ , and the predicate denoted by the VP is of type  $\langle v, t \rangle$ , rather than type  $\langle e, t \rangle$ . Correspondingly, the set  $A$  of alternatives is a set of events, rather than a set of individuals, and the ranking function  $R$  is accordingly a function of type  $\langle v, n \rangle$ .

It is easy to see why this does not work. According to (76), (75) is analysed as follows. We assume the following LF, where the subject *John* has undergone Subject Raising, and  $\exists$  is the Existential Closure operator that existentially closes off the event argument. For the sake of simplicity, we ignore tense.

(77)



In event semantics, VPs denote predicates of events. The VP  $x$  *swam*, for example, denotes the following function of type  $\langle v, t \rangle$ .

$$(78) \quad \llbracket x \text{ swam} \rrbracket^t = \lambda e \in D_v. \mathbf{swim}(e) \wedge \mathbf{agent}(e, x)$$

The problem is that the set of alternatives is now going to be a set of swimming events. This is only adequate for one of the comparative readings, i.e. one where *John* is focused.

We suggest two possible solutions to this puzzle. Firstly, we could remove reference to the VP from the above semantics, as follows.

$$(79) \quad \llbracket [n \text{ -th}] \text{ CC} \rrbracket^t(e_v)$$

- a. is defined only if  $A = \{e' \in D_v \mid \exists! t' [\llbracket \text{CC} \rrbracket^{t'}(e') = \top]\}$  is such that:
- (i)  $n \leq |A|$ ; and
  - (ii)  $e \in A$ .
- b. whenever defined, denotes  $\top$  iff for the temporal ranking function  $R$  induced by CC,  $R(e) = n$ .

This is a predicate of type  $\langle v, t \rangle$  and can combine with a VP via (Generalised) Predicate Modification.<sup>28</sup>

Another possibility is that ordinals themselves only have nominal uses but together with silent adverbial structures that embed a nominal, they can be used to modify VPs. For instance, under this analysis (75) is assigned underlying structures akin to the following.

- (80) a. John swam as the first person.  
b. John swam as the first activity.

We do not try to decide between these two options here, but it is also worth pointing out that in adverbial uses, non-modal subject infinitival clauses cannot appear, which might be related to the point made earlier that when *-est* covertly moved out of the local DP, it cannot have an overt non-modal subject infinitival.

### 7.3 Plural ordinals

Another issue that we leave for future research is the use of plural ordinals such as *the first people to discuss ordinals*. We will mention here some problems that plural ordinals give rise to.

When the plural NP receives a collective interpretation, as in (81), the plural ordinal essentially behaves the same as singular ordinals.

- (81) a. John bundled up the first magazines.  
b. John and Mary are the 100th Americans to get married here.

An interesting problem arises with plural NPs with distributive interpretations, as in (82).

- (82) John and Mary were the first people to fall asleep.

Although it is not impossible to describe by (82) a situation where John and Mary fell asleep at the exact moment, it is also possible to describe situations where there is a non-negligible lapse between the times at which they fell asleep, provided that the other people fell asleep considerably later. Consider the following situation.

- (83) a. John fell asleep at 9:00 pm.  
b. Mary fell asleep at 9:15 pm.  
c. Bill fell asleep at 10:30 pm.  
d. The rest of the people fell asleep after 11:00 pm.

Intuitively, the sentence (82) is true in this situation. One theoretical problem this observation poses is the fact that *first* fails to distributive over *people*. Thus, John and Mary are not both the first to fall asleep. This leads to another problem that in this context the sentences in (84) are intuitively not true.

<sup>28</sup>*Generalised Predicate Modification*: If A is a branching node with two daughters B and C of type  $\langle \sigma, t \rangle$  for any type  $\sigma$ ,  $\llbracket A \rrbracket^t = \lambda x_\sigma. \llbracket B \rrbracket^t(x) = \llbracket C \rrbracket^t(x) = 1$ .

- (84) a. John, Mary and Bill are the first people to fall asleep.  
 b. John and Bill are the first people to fall asleep.

Thus, having the first person to fall asleep (i.e. John) in the plurality is not sufficient to make the sentence true.

Another thing to note here is that only extreme ordinals, i.e. *first* and *last*, are compatible with distributive plural NPs. Thus the following sentences are infelicitous, regardless of what actually happened (unless, potentially, the two events have happened at the exact same moment).

- (85) a. #John and Mary were the second people to fall asleep.  
 b. #John and Mary were the ninth people to die from the new disease.

Instead of giving an analysis, we would like to hint at a possible connection with the analysis of plural superlatives due to Fitzgibbons, Sharvit & Gajewski (2009). They observe similar problems for superlatives combined with distributive NPs, e.g. (86).

- (86) John and Bill are the tallest students.

As they point out, this sentence is true in a situation where John and Bill differ in height, provided that their heights considerably exceed the heights of the other students, e.g.:

- (87) a. John is 190 cm tall.  
 b. Bill is 185 cm tall.  
 c. Fred is 172 cm tall.  
 d. The rest of the students are below 170 cm.

The problems are similar to the case of ordinals. In this situation, John is the tallest and Bill is not, so the superlative does not distribute over students. Furthermore, the following sentences do not sound true.

- (88) a. John, Bill and Fred are the tallest students.  
 b. John and Fred are the tallest students.

Fitzgibbons, Sharvit & Gajewski (2009) propose the following semantics for plural superlatives. To simplify the discussion and also to remain faithful to their exposition, we assume that the set of alternatives  $A$  is contextually determined.

- (89)  $\llbracket \text{-est}_A \rrbracket (R_{\langle d, et \rangle})(X_e)$   
 a. is defined only if  
 (i)  $X \in A$ ;  
 (ii) for each  $Y \in A$  such that  $X \neq Y$ ,  $X$  and  $Y$  do not overlap;  
 (iii) for each  $Y \in A$  there is a singular or plural degree  $D$  such that  $R(D)(Y) = \top$ .  
 b. whenever defined, denotes  $\top$  iff  $R(\text{Cut-off}_c)(X) = \top$  and for each  $Y \in A$  such that  $X \neq Y$ ,  $R(\text{Cut-off}_c)(Y) = \perp$ .

Here  $\text{Cut-off}_c$  denotes a contextually determined cut-off degree in  $c$ . In addition, they crucially assume the  $**$ -operator on *tall*, which relates plural degrees and plural individuals in the following manner (Beck & Sauerland 2000; see Beck 2014 for an application of plural degrees to the issue of quantifiers in comparatives).

- (90) For any plural degree  $D$  and any plural individual  $X$ ,  
 $\llbracket **\text{tall} \rrbracket(D)(X) = \top$  iff  
 a. for each  $d \sqsubseteq D$ , there is  $x \sqsubseteq X$  such that  $\llbracket \text{tall} \rrbracket(d)(x) = \top$ ; and  
 b. for each  $x \sqsubseteq X$ , there is  $d \sqsubseteq D$  such that  $\llbracket \text{tall} \rrbracket(d)(x) = \top$ .

Now, putting these ingredients together, we have:

- (91)  $\llbracket -\text{est}_A \rrbracket(\llbracket \lambda D \llbracket D **\text{tall} \rrbracket \text{students} \rrbracket \rrbracket)$   
 $= \llbracket -\text{est}_A \rrbracket(\lambda D_d . \lambda X_e . \llbracket **\text{tall} \rrbracket(D)(X) = \llbracket \text{students} \rrbracket(X) = \top)$

Whenever the presuppositions of *-est* are satisfied, (91) will be true of a plural individual  $X$  iff  $\llbracket **\text{tall} \rrbracket(\text{Cut-off}_c)(X) = \top$  and  $X$  is a plurality consisting of students and for each alternative  $Y \in A$  that does not overlap with  $X$ ,  $\llbracket **\text{tall} \rrbracket(\text{Cut-off}_c)(Y) = \perp$  (or  $Y$  is not a plurality consisting of students).

It is not trivial, if not impossible, to extend this analysis to plural ordinals for two reasons. Firstly, in ordinals, we cannot apply the  $**$ -operator to *first* or *-th*. Secondly, if we are correct about the syntax and semantics of comparison classes, the alternative set  $A$  should not be just contextually determined. We leave this task for future research.

#### 7.4 Ordinal superlatives

One might have noticed that although we have discussed superlatives and ordinals, we never touched on ordinal superlatives like the following.

- (92) John is the second tallest in his class.

Our analysis, unfortunately, does not straightforwardly cover this construction. Furthermore, there are several curious facts concerning this construction. Firstly, *first*, *last* and *next* cannot appear in this construction. Secondly, languages like Russian do not have this construction altogether. A proper analysis of this construction needs to be able to explain these additional observations, a task we leave for future research.

#### 7.5 NPI Licensing

Lastly, we observe that so-called weak Negative Polarity Items (NPIs) like *ever* are licensed by certain ordinals.

- (93) John is the first/last person who ever read this book.

Interestingly, the judgments seem to mildly degrade with *second* and *third*, and significantly with higher numbers.

- (94) a. ?John is the second/third person who ever read this book.  
 b. \*John is the 26th person who ever read this book.

Recent work by Edwin Howard (Howard 2014) on NPIs in superlatives is highly relevant to this observation. He pursues an analysis according to which tensed relative clauses containing NPIs express comparison classes for superlatives, and develops an account of NPI licensing based on the idea of von Stechow (1999).

Unfortunately, we cannot simply apply Howard's analysis to ordinals, because we cannot maintain the idea that tensed relative clauses are comparison classes, due to the difference with non-modal subject infinitival clauses that we observed in Sect. 4.1. Recall that the observation is that non-modal subject infinitival clauses, but not tensed relative clauses, determine the ordering by the linguistic content. Notice that this consideration does not arise for superlatives, as the ordering for a superlative is already determined by the adjective, so to speak. Again, this is left for future research.

### Appendix: Putative Temporal Boundedness Effects

Bhatt (2006), Bhatt & Pancheva (2012) and Sharvit (2010) claim that in DPs containing ordinals, the temporal interpretations of NP and the non-modal subject infinitival are controlled by the matrix tense. In short, according to them, the temporal interpretation of the infinitival clause is bounded by the matrix tense, i.e. the former cannot follow the latter, though it need not be simultaneous with it. In (95) are some examples illustrating due to Bhatt that are purposed to illustrate this with his original judgments.

- (95) a. The first American to walk on the moon/#Mars visited my school yesterday.  
 b. The first American to walk on the moon/#Mars is walking in my garden.  
 c. The first American to walk on the moon/Mars will be canonized in 3000A.D.  
 (Bhatt 2006:(181))

Bhatt's interpretation of the data is as follows. The infelicity of the versions of (95a) and (95b) with *Mars* is attributed to the temporal requirement of the construction that is in conflict with the world knowledge that no human beings, let alone Americans, have been to Mars yet. More specifically, the matrix clauses of (95a) and (95b) are temporally prior and simultaneous with the current time, and it is required that the American have walked on Mars at or before these times, which cannot be met given that no one has been to Mars. On the other hand, if the matrix clause refers to a future time as in (95c), the sentence becomes felicitous, because there can be some time at which an American walked on Mars before or during that future time. The versions of the sentences with *the moon* are all acceptable, given the fact that the first American walked on the moon in the past, namely in 1969 (and assuming that the current utterance time is, say, 2014). This is temporally prior to the events in the matrix clause in all of the examples.<sup>29</sup>

<sup>29</sup>Interestingly, Bhatt (2006:92) reports based on the following examples that in Spanish, unlike in English, the infinitival clause need to be true at the matrix time. The judgments here are as reported by Bhatt.

- (i) a. ???NA es el primer en andar por la luna.  
 NA is the first 'in' walk.inf on the moon  
 'Neil Armstrong is the first man to walk on the moon.'  
 b. NA fue el primer en andar por la luna.  
 NA was the first 'in' walk.inf on the moon  
 'Neil Armstrong was the first man to walk on the moon.'  
 c. NA es el primer en haber andado por la luna.  
 NA was the first 'in' have.inf walked on the moon  
 'Neil Armstrong was the first man to have walked on the moon.'  
 (Bhatt 2006:178)

However, we are not certain if the generalisation is empirically observable as clearly as Bhatt seems to assume. The main reason is that under the modal interpretation, the versions of the sentences with *Mars* are not infelicitous, and furthermore, for the examples at hand, we cannot use the temporal trick to exclude modal interpretations, which we mentioned in passing in Sect. 2.3 and Sect. 4.1. In order for this to be possible, the matrix time crucially needs to temporally follow the time of the infinitival clause. However, the crucial examples that could show the validity of the generalisation necessarily involve a matrix time that temporally precedes the time of the infinitival clause.

Since we have no way of excluding modal interpretations of the subject infinitival clauses, we could not replicate the data reported in Bhatt (2006) and Sharvit (2010). Nor could we construct data that did not involve the confound. Thus, we have no empirically solid evidence for their generalisation at this point, although we also have nothing that disproves it. We would like to remain neutral to this issue in the present paper and leave it undiscussed.

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Bhatt remarks that (ia) is infelicitous because entails that Neil Armstrong is walking on the moon right now.

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