Scope and predicational structure in summative existentials

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Modalized existentials

- Modalized existentials are generally interpreted as embeding the existential under the modal.

(1) There might be someone here.
$\Diamond$(there be someone here)

(2) There must be two people here.
$\Box$(there be two people here)

- This exemplifies the familiar generalization that pivots take low scope relative to all operators (e.g. Heim 1987)
- Straightforward to model in existing approaches to the semantics of existentials.

The problematic data: summative existentials

(3) There can be three winners in this race.

- This sentence has two readings.
  - (i.) # It is possible that three people will win the race.
  - (ii.) **For three people x, there is a possible world in which x is the winner in the race**.

(4) There can be three outcomes to this election.

(i.) # It is possible that this election will have three outcomes.

(ii.) **For three situations/states x, it is possible that x will be the outcome of the election**.

Summative readings

- I call these **summative existentials** since they seem to have what Gendler Szabo (2010) calls *summative readings*.
- Summative readings involve counting individuals who meet a condition across worlds or times.

(5) John believes three witches live upstairs.
NOT: Three witches are such that... (*de re*)
NOT: John believes: three witches live upstairs (*de dicto*)
Three people x: John believes: witch(x) and lives-upstairs(x)

(6) France had twenty seven kings.
NOT: 27 kings are such that ...
NOT: $\exists t$: France had 27 kings at t
27 people x: $\exists t$: king-of-France(x) at t

- The examples are reminiscent of cases of "split scope", in that an operator intervenes between the numeral and it's surface restriction.

Summative readings of existentials across languages

- Italian

(7) Ci possono essere tre vincitori in questa gara.
ci can.pl be.inf three winners in this race
There can be three winners in this race.

- Hebrew

(8) ba-taxarut ha-zot yexolim liyot shlosha menatsxim.
in.the-race the-this.f can.m.pl be.inf three.m winners
In this race there can be three winners.

- Hindi (Aswhini Deo, p.c.)

(9) is samasyā-ke tin hal ho sakte hañ
this.obl problem-gen three solutions.nom be can.m.pl be.pres.3.pl
There can be three solutions to this problem.

- Basque (Karlos Arregi, p.c.)

(10) asterketa honetan, hiru irabazle egon daiteke
race this.in three winner be can
There can be three winners in this race

Observation:

Summative readings only arise with relational/functional nouns, never with sortal nouns:

(11) There can be three books on the table.

Goals of the talk:

- Show that summative readings of existentials raise puzzles that standard analyses cannot solve.
- They challenge existing assumptions about:
  - The denotation of pivot NPs
  - The quantificational and predicational structure of existentials
- Show that analyses in terms of "split scope" also fail to capture the data.
- Propose an analysis that does not involve split scope, but which instead involves quantification over the values of an individual concept.

Plan

- Go over three major approaches to the semantics of existentials in the literature and:
  - Discuss how they might approach relational pivots.
  - Show that however relational nouns are modeled, these analyses can't capture summative readings.
- Show that standard approaches to split scope also can't capture the relevant readings.
- Propose an analysis.

What analyses vary on:

(A) The meaning of pivots.

(B) The relation between pivots and codas.

Analysis I: Barwise and Cooper (1981)

- Pivots are quantifiers.
- There are no codas, only NP-internal modifiers.
- $[\![\text{there be NP}]\!] = [\![\text{NP}]\!](D)$

  $[\![\text{There are three chairs in the room }]\!] =$
  THREE(CHAIRS IN THE ROOM)(EXIST)

Analysis II: Keenan (1987)

- Pivots are quantifiers.
- There are codas, which form the scope of quantification for pivots.
- $[\![\text{there be NP PP}]\!] = [\![\text{NP}]\!](PP)$

  There are three chairs in the room =
  THREE(CHAIRS)(IN THE ROOM)
- Francez (2009) provides a truth-conditionally equivalent analysis

Analysis III: McNally (1992)

- Pivots denote properties.
- There are codas, which specify when and where the pivot property is instantiated.
- $[\![\text{there be NP PP}]\!] = \text{INSTANTIATED}_{\text{PP}}([\![\text{NP}]\!])$

  There are three chairs in the room =
  $\text{INSTANTIATED}_{\text{in-the-room}}(\lambda x.\text{three chairs}(x))$

Modeling relational pivots

- Even before considering modalized existentials, all of these analyses must say something about relational noun pivots.

  (12) There is a winner in this race.

- Analysis I can handle this case if we assume that the PP is an internal modifier.

  (13) A(WINNER-IN-THIS-RACE)(EXIST)

- But the PP does not behave like an internal modifier even in English.

  - SCOPE:
    There is a winner in every race. ≠ A winner in every race exists.
  - FREE CHOICE *any*:
    There is a winner in any race.
    *I met a [winner in any race].

Modeling relational pivots

- Analysis II yields the LF in (14):

  (14) A(WINNER)(IN-THIS-RACE)

- If *winner* denotes the set of winners, $\lambda x.\exists y[\text{win}(x,y)]$, then quantification is over people who won something, instead of people who win the race.
- Alternatively, *winner* is a relation: $\lambda x \lambda y.\text{win}(x,y)$, and quantification is over pairs (cases of someone winning something).
- Then, *in the race* can be interpreted as the set of pairs in which the right element is the race:
  $[\![\text{in-the-race}]\!] = \lambda x \lambda y.y = \text{the race} \;\&\; x \in D$
- (14) is then true iff there is a pair $\langle a,b\rangle$ such that $b =$ the race and $\langle a,b\rangle \in [\![\text{winner}]\!]$
- This solves the problem of relational nouns, but doesn't help with summative readings.

Modeling relational pivots

- Analysis III can also not be applied straightforwardly if the PP is a coda

(15) $\text{INSTANTIATED}_{\text{the-race}}(\lambda x.\text{winner}(x))$

- Taking the race to be the spatio-temporal index of instantiation does not ensure that the instantiating individual actually wins the race.
- For sentences like (16) the treatment is even less clear:

(16) There is a solution to this problem.

Back to modalized existentials

Even if some of these analyses can be extended so as to model existentials with relational nouns, they all still fail to account for summative existentials.

Analysis I

- Suppose analysis I is right, and the pivot is *three winners in the race*, with *winners in the race* interpreted as:

$$\{x : \text{won}(x, \text{the race})\}$$

- Then we get two options, both wrong:
  (i) CAN(THREE(WINNERS-IN-THE-RACE)(E))
  It is possible that three winners-in-the-race exist.
  (ii) THREE(WINNERS-IN-THE-RACE)(λx.CAN($x \in E$))
  Three winners in the race are such that it is possible that they exist
- Both options require that the domain (of at least one possible world) contain three individuals that win the race, but this is not required by the summative reading.

Analysis II

- Counting winners will give the same wrong truth conditions as in analysis I:
  (i) CAN (THREE(WINNERS)(IN-THE-RACE))
  In some world, three winners are such … .
  (ii) THREE(WINNERS)(λx.CAN(IN-THE-RACE(x)))
  Three winners are such that in some world…
- Counting pairs doesn't help.
  (i) CAN (THREE(WINNERS)(IN-THE-RACE))
  In some world, the number of pairs $\langle a, b\rangle$ such that b is the race and a wins b is three
  (ii) THREE(WINNERS)(CAN(IN-THE-RACE))
  For three pairs $\langle a, b\rangle$ such that a won b, in some possible world, b is the race
  - (ii) is always false, assuming that it is never possible for things not to be self-identical. A pair $\langle a, b\rangle$ is the same pair in any possible world.

Analysis III

- If the pivot denotes a property, we get wrong results regardless of how we analyze the PP.
- If the pivot is *three winners*, interpreted as $\lambda x : \text{three-winners}(x)$, we get wide scope for the modal:

(17) $\text{CAN}(\text{INSTANTIATE}_{\text{race}}(\lambda x : \text{three-winners}(x)))$
In some world, the property of being three winners is instantiated (in the race).

- If the pivot is *three winners in the race*, the analysis is equivalent to analysis I, and we get the same problem.

Summary: the sources of the problem

Intuitively, the problems for existing accounts seem to stem from the interaction of three things:

(1) The difference between relational and sortal nouns.

(2) The scopal interaction between the modal and the determiner in the pivot.

(3) The role of the common noun.

(1) Relational vs. sortal nouns

- Existing analyses are tailored to deal with pivots that express properties or sets, and relational nouns do not seem to.
- Relational nouns are sensitive to modality in a way that sortal nouns are not and which must be captured by any analysis of summative readings.

(2) Scopal interaction and predicational structure

The truth conditions of our running example are the following:

(18) Three people x: $\Diamond$[win-the-race(x)]

- Existing analyses do not afford the right status to the predicate win-the-race(x).
- On the instantiation analysis, this predicate is not part of the truth conditions. Instead, they involve the property λx.three winners(x) and the modifier *in the race*.
- GQ analyses:
  - do not involve this predicate at all (analysis II)
  - or else it is part of the restriction of *three* (analysis I).
- But in (18) it is clearly part of the scope of *three*

Furthermore:

These analyses cannot give the modal the scope it needs relative to the determiner and the predicate win-the-race(x).

- GQ analyses must scope the modal above or below the quantifier *three winners* or *three winners in the race*.
- The scoping we intuitively want is below a quantifier *three* and above the predicate win-the-race(x).

  (19) THREE > CAN > win the race

- The instantiation analysis cannot accommodate any scopal interaction between the modal and the determiner.

The puzzle we are faced with:

How to get in a natural way from the syntax of:

There [**can**] be [**three** winners] [in the race]

To the truth conditions of:

[**Three** people] [**can**] [win the race].

Can split-scope do the job?

It is well known that certain NPs that look like constituents on the surface behave as if they are semantically decomposed

(20) Du muss keine Krawatte anziehen.
you must no tie wear
You don't need to wear a tie.
NOT > MUST > A TIE

- This is known as "split scope", and occurs only with non-increasing quantifiers (DeSwart 2001, Penka 2011, Abels and Marti 2010)

More examples

(21) You need wear no tie.

(22) You can pick at most two cards.
NOT > CAN > MORE THAN TWO CARDS
(Split reading: The maximal number of cards you can pick is 2)

No it can't

- What is common to all split scope examples is that they involve decreasing quantifiers (DeSwart 2000), which are decomposable into sentential negation and an upward-increasing quantifier.

(23) no tie(P) $\equiv$ $\neg$a tie(P)

- This is not the case in our examples, where a determiner is split from what looks like it's restriction, but is still interpreted as a determiner, and the restriction moves to the scope.

(24) CAN THREE[winners][...] $\Rightarrow$ THREE[...][can win]

- Existing analyses of the familiar split scope data cannot achieve what we need.
- I exemplify using the analysis of Abels and Marti (2010).

Example: Ables and Marti

- Their basic intuition is that determiners quantify over choice functions.
- Details aside, the truth conditions they assign to (25) are in (26).

(25) Du muss keine Krawatte anziehen
you must no tie wear
You don't need to wear a tie.

(26) $\neg\exists f : ch(f)\ \&\ \forall w R_{@} : \text{wear}(\text{you}, f(\text{tie}_w))$ in w

- (26) says that there is no way of picking a tie in each relevant world such that you wear that tie. This entails that there are worlds in which you don't wear any tie.

Can this analysis be applied to existentials?

- Using Abels and Marti's system, and allowing *winner in the race* to be a constituent, we can at best generate the LF in (27):

(27) THREE(λf: CAN(there be f(winner in the race))

- This then gives rise to the following truth conditions:

(28) There are three choice functions
$f : \exists w R_{@}[f(\text{winner-in-race}_w) \text{ exists}]$

- But when the race has a unique winner, (28) is false, since there is only one choice function that meets the condition: the one that chooses the unique winner in each world.

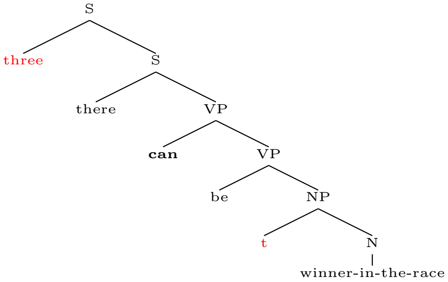
Can this analysis be applied to existentials?

- Within this framework, what we would want to generate is closer to:

(29) There are three choice functions f:
$[f(\lambda x.\exists w R_{@} : \text{winner-in-race}_w(x))$ exists$]$

- But there is no way in this system to allow *can* to be interpreted below the trace of *three*.

(30)



The analysis intuitively

- Existential sentences are "about" the coda (Francez 2007, 2009). They attribute some property of an individual or a set mentioned in the coda. (31) says something about the race:

(31) There can be three winners in the race.

- (31) says about the race **r** that:

for three people x,

the set of propositions true in some possible world (*can*)

contains the proposition that x wins **r**.

The analysis hangs on three assumptions:

(1) Relational nouns like *winner* can denote (relational) individual concepts, i.e. functions from worlds and individuals to individuals.

(2) Codas like *in the race* determine the value of one of the arguments of the relational noun.

(3) Cardinal determiners like *three* have denotations that take individual concepts and sets of propositions and return a property of individuals.

- The expression *there can be three winners* is therefore interpreted as a property of entities:

$$\lambda x.\text{three winners-of-}x(\text{can})$$

  – it maps an entity x to true iff there are three things that, in some possible world, win x.

- This property is predicated of the race.

The analysis formally

- I propose the logical form in (32), with the truth conditions in (32-a)

(32) THIS RACE r: [THREE(WINNERS-IN-r)] (CAN)

a. This race r is such that:
for $3x : \exists w \in R_{@} : \text{the-winner}(r)(w) = x$

- The components:

(33) $[\![\text{winner}]\!] = \lambda u \lambda w.\text{the winner of } u \text{ in } w$

(34) $[\![\text{three}]\!] = \lambda \mathcal{I}_{e,st} \lambda \mathcal{M}_{st,t} \lambda y.\exists 3x : \mathcal{M}(\lambda w.\mathcal{I}(y)(w) = x)$

(35) $[\![\text{can}]\!] = \lambda p.\exists w \in R_{@} : p(w)$

- Composing *three winners* by function application:

(36) $[\![\text{three winners}]\!] =$
$\lambda\mathcal{M}_{st,t}\lambda y.\exists 3x : \mathcal{M}(\lambda w.\text{the winner of } y \text{ in } w = x)$

- Thus, *three winners* takes a modal and returns true iff there are three values for *the winner of y* across the worlds quantified over by the modal.
- Composing *there can be three winners* by function application:

(37) $[\![\text{there can be three winners}]\!] = [\![\text{three winners}]\!]([\![\text{can}]\!]) =$
$\lambda y.\exists 3x : [\![\text{can}]\!](\lambda w.\text{the winner of } y \text{ in } w = x) =$
$\lambda y.\exists 3x : \exists w \in R_{@} : \text{the winner of } y \text{ in } w = x$

- Applying (37) to *in the race*, assuming the preposition is vacuous, gives the right truth conditions:

(38) $\exists 3x : \exists w \in R_{@} : \text{the winner of the race in } w = x$

Some further questions

- Is there any other context in grammar where we need this meaning for *three*?
  - Yes. If we assume numerals have this meaning, we get (39) for free:

    (39) Three winners are possible in this race.

- Why can't we get a universal modal?

(40) There must be three winners in the race.

  - (40) does not have a distinct summative reading – it says that it is necessary that three people win the race.
  - It might seem that my analysis predicts exactly this! (40) gets the meaning in (41).

    (41) $\exists 3x : \forall w \in R_{@}$: the winner of the race in $w = x$

  - (41) entails the wide scope reading for the modal. If there are three people who win the race in every world, then in every world, there are three people who win the race.

Summary and conclusion

- There are summative readings of existentials, in which a modal seems to scope between the determiner and the common noun in the pivot.
- In such cases, both the common noun and the modal are interpreted as part of a **predicate** in the **scope** of the determiner, rather than it's restriction.
- Standard analyses of existentials are based on GQs or properties, and so cannot separate the numeral from the common noun.
- Split scope is not enough either, because it cannot let the modal form part of a predicate with the common noun.
- I proposed an analysis which:
  - Maintains a standard syntax for existentials.
  - Captures summative readings.
- My analysis involves non-standard denotations for numerals, but these are, arguably, required anyway to model certain uses of predicative modal adjectives like *possible*.