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Other and *Else*: Restrictions on Quantifier Domains in Game-Theoretical Semantics

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Introduction It is common in ordinary language that quantifiers do not range over the entireties of the sets which are said to constitute their domains. I do not refer here to the fact that quantification in ordinary language is many-sorted, but rather to the fact that quantifiers often do not even range over all of the relevant (restricted) domains.

(1) Everyone enjoyed the departmental party last night.

(1), for instance, does not entail that every person attended the departmental party last night. The domain of the quantifier is just the set of those who did attend. There is nothing about the structure of (1) which forces this restriction on the domain; rather the restriction is determined through the consideration of (1) as (part of) a discourse taking place at a certain time among certain individuals. Sometimes, though, there are features of a sentence which explicitly effect restriction of the domain.

(2) John wore a lampshade for a hat, and someone else climbed the flagpole.

Here, the individual whose ascent is reported is not John, for the occurrence of *else* signals the exclusion of John from the domain of *someone*. Similarly, in (3):

(3) If any other showoff eats a raw egg, Hank and Frank will, too,

Hank and Frank are not possible values of the quantifier *any*, due to the presence of *other*.

Due to its dynamic character, game-theoretical semantics (GTS)[1] provides a particularly easy means of capturing such explicit quantificational restrictions in the analysis of natural language quantifiers.

A brief sketch of game-theoretical semantics is in order. Assuming given an assignment of truth-values to atomic sentences, nonatomic sentences are interpreted as follows: Each such sentence S is associated with a zero-sum two-person

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game $G(S)$. Each play of $G(S)$ consists of the sequential application of game rules to "input" sentences to produce "output" sentences. For the first application of a game rule in $G(S)$, S is the input sentence. Otherwise, the output of a given application of a rule in $G(S)$ is the input for the next application of a rule. In general, applications of game rules take input sentences to less logically complicated outputs. By this means, an atomic sentence is eventually the output of a game rule. Here $G(S)$ ends; if the atomic sentence is true, then the player we will call Myself has won this play of $G(S)$; otherwise, the player we will call Nature has won. S is *true* just in case Myself has a winning strategy for $G(S)$; *false*, If Nature does. Here are some rules.

(G. every) If the game has reached a sentence of the form

$$X - \text{every } Y \text{ who } Z - W$$

then Nature selects an individual, say d, from the appropriate domain, and the game continues with respect to

$$X - d - W, \text{ if } d \text{ is a } Y \text{ who } Z.$$

(G. some) If the game has reached a sentence of the form

$$X - \text{some } Y \text{ who } Z - W$$

then Myself selects an individual, say b, from the appropriate domain, and the game continues with respect to

$$X - b - W, \text{ and } b \text{ is a } Y \text{ who } Z.$$

(G. or) If the game has reached a sentence of the form

$$X - S_1 \text{ or } S_2 - W$$

then Myself selects S_i ($i = 1, 2$) and the game continues with respect to S_i.

(G. any) and (G. each) are like (G. every), with appropriate changes in the input. (G. an) is likewise like (G. some). (G. and) is like (G. or), with the appropriate input, but nature makes the selection of output sentence.

1 Effects of **other** *and* **else** We let the domain (before restrictions) of a given occurrence of a quantifier be denoted by D. By I we denote the restricted domain of the occurrence of the quantifier.[2] In the case of (1), then, D is the set of human beings, since the quantifier word *everyone* normally ranges over people. I is the set of people who attended the departmental party.

The words *other* and *else* normally serve to exclude previously mentioned individuals from the domain of quantification, and so will be treated as signaling that the set-theoretical operation of relative complementation must be performed to provide the domain. In the presence of either of these words, the domain of the associated quantifier will be the relative complement in D of the set of previously mentioned individuals. This latter set can reasonably be said to constitute I, since in the absence of *other* and *else* (and other complementation-signaling expressions), it is the previous mention of a member of D which requires that the member also be in I; witness (4):

(4) Bartholomew and his friends bought a soft-porn movie, but everyone was disappointed at the end.

(4) serves also to show that an individual need not be singly mentioned in order to belong to I.

Although the constituency of I may change during the course of a semantical game, at any particular application of a rule during the game I is determined and hence may be referred to in the statement of the rule being applied. Thus game rules for *other* and *else* occurring within quantifier phrases may be presented as follows.

($G.Q$ other) If the game has reached a sentence of the form

$$X - Q \text{ other } Y \text{ who } Z - W$$

where Q is a singular quantifier word, then the game proceeds with respect to

$$X - QY \text{ who } Z - W$$

and the choice performed for the application of the rule for Q is from $D - I$.

In the case that there is an unstated restriction on the quantifier's domain, as with (1), the set which serves as D in the statement of this rule must accordingly be restricted, but I am not concerned here with *implicit* restrictions, only with the semantical effects of complementation-signaling expressions, so I will not discuss this.

Whereas *other* may occur in such constructions as *some other Y*, *every other Y*, and *any other Y*, *else* may not do so; rather, *else* occurs in such constructions as *someone else*, *everywhere else*, and generally as a part of quantifier phrases lacking a common noun Y. In these constructions, the quantificational domain D is determined not by a Y but rather by the "amplification" of the quantifier word. *Someone* ranges over people, *everywhere* ranges over places, and so on. We will use *Qamp* as the metavariable ranging over these amplified quantifier words. Now the game rule for *else* may be formulated.

($G.Q$ else) If the game has reached a sentence of the form

$$X - Qamp \text{ else who } Z - W$$

then the game continues with respect to

$$X - Qamp \text{ who } Z - W$$

and the choice performed for the application of the rule for *Qamp* is from $D - I$.

The game rules ($G.Q$ other) and ($G.Q$ else) are unlike the usual game rules such as ($G.$ every) and ($G.$ or): they require action on the part of neither player, but impose constraints on what players may do later in the game.

2 An alternative formulation Because the effect of *other* and *else* is not to require a move by either player, but only to restrict the set of available individuals among which the players choose when the game rules for the quantifiers associated with occurrences of *other* and *else* are applied, there is an alternative method for treating *other* and *else*. Rules can be formulated for occurrences of what may be called other-phrases, which treat as single semantical units constructions such as *some other Y*. On this alternative treatment, we formulate game rules for the following other-phrases:

some other
another
every other
any other
each other
someone else (somewhere else, etc.)
anyone else (anywhere else, etc.)
everyone else (everywhere else, etc.)

(G. some other) If the game has reached a sentence of the form

$$X - \text{some other } Y \text{ who } Z - W$$

Myself selects an individual from $D - I$, say b. The game continues with respect to

$$X - b - W, \text{ and } b \text{ is a } Y \text{ who } Z.$$

(G. another) is formulated in analogy with (G. some other).

(G. every other) If the game has reached a sentence of the form

$$X - \text{every other } Y \text{ who } Z - W$$

then Nature selects an individual from $D - I$, say d. The game continues with respect to

$$X - b - W, \text{ if } b \text{ is a } Y \text{ who } Z.$$

(G. any other) and (G. each other) are formulated in analogy with (G. every other).

(G. someone else) If the game has reached a sentence of the form

$$X - \text{someone else who } Z - W$$

Myself selects an individual from $D - I$, say b. The game continues with respect to

$$X - b - W, \text{ and } b\, Z.$$

(G. everyone else) If the game has reached a sentence of the form

$$X - \text{everyone else who } Z - W$$

Nature selects an individual from $D - I$, say d. The game continues with respect to

$$X - d - W, \text{ if } d\, Z.$$

Not unexpectedly, (G. anyone else) is formulated in analogy with (G. everyone else).

Rules for else-phrases containing other amplified quantifiers are just like (*G.* someone else) and (*G.* everyone else), where D is assumed to reflect the restrictions on choices imposed by the amplification present.

Let us consider some of the rules presented here at work in a game.

(5) Reagan will not attend tonight's debate, but every other presidential candidate will be there.

Assuming *but* is properly treated as a variant of *and* in this case, let Nature choose the second conjunct.

(6) Every other candidate will be there.

Now I contains only Reagan. Applying (*G.* other) produces

(7) Every candidate will be there,

but Nature is now prevented from choosing Reagan as an instance of (7). If her choice is Jackson, then the game continues with respect to

(8) Jackson will be there, if Jackson is a presidential candidate.

Application of (*G.* every other) to (6) would of course have produced (8) immediately.

(9) Sally will bring the booze and someone else will bring the munchies.

Supposing that Nature selects the second conjunct of (9), Myself is now to choose, in accordance with (*G.* someone else), a person distinct from Sally, say Brenda, and the game will proceed with respect to

(10) Brenda will bring the chips.

3* Other *and* else *in discourse Consider the following speech:

(11) A group of Klansmen filled the street. One carried a rifle, another carried a handgun, and some other carried a list of Communists.

The first thing to notice about the other-phrases in (11) is that although they do not contain amplified quantifier-words, no Y is present. Thus in the application of corresponding game rules, the output sentences will lack Y-phrases as well as Z-phrases.

In the game associated with the second sentence of (11), I will vary in accordance with which conjunct is chosen. For instance, if the first conjunct is chosen, then in the application of the rule to eliminate *one*, I consists of all and only the Klansmen filling the street. Call this set I_1. If the second conjunct is chosen, then I_1 must play the role of D in the application of (*G.* another), and the choice is made by Myself from I_1-I_2, where I_2 is the unit set of the Klansman with a rifle chosen during the game for the first conjunct. If the third conjunct is chosen, then again Myself must make a selection, this time in accordance with (*G.* some other). Now I_1-I_2 plays the role of D in the application of the rule and the selection is from $(I_1 - I_2) - I_3$, where I_3 consists of the Klansman with a handgun.

In other words, the first sentence of (11) determines the set I which is to serve as the domain of the quantifiers. The rifle-carrying individual must therefore be a member of this group of Klansmen. When we come to *another*, it is the group of Klansmen which serves as the universe within which we take the complement of the unit set containing the previously mentioned individual. Thus this unit set must serve as the I occurring in the statement of (G. another), whereas the set of Klansmen now serves as D. When we come to the third conjunct, the allowed values of the quantifier *some other* must some from the complement, in the set of Klansmen, of the set whose members are the rifle-carrying individual and the handgun-carrying individual. This may become clear when it is noticed that $(I_1 - I_2) - I_3$ is just $I_1 - (I_2 \cup I_3)$. What is important here is that the constituency of D, as well as that of I, is determined by the context surrounding the other-phrase whose game rule is being applied.

The reason that D must be relativized in this manner is that our rule operates not by successively adding members to the set whose complement is taken in the original domain, but rather by successive complementations. That is to say, the original domain is not restricted once by the removal of all previously mentioned individuals, but rather is restricted once each time that an individual or group is mentioned. Either of these methods would work, but the latter allows a simpler formulation of game rules. This is why, in the discussion of (11), we denote the domain of *some other* as $(I_1 - I_2) - I_3$, instead of as $I_1 - (I_2 \cup I_3)$.

There are cases where individuals excluded by *other* or by *else* from the domain of the associated quantifier are not mentioned earlier in the discourse than the quantifier itself, but instead occur later in the discourse (or later in the same sentence). This is so for (3), as well as (12):

(12) If someone else enters the Haunted House, then I will.

In this case it is clear that the speaker is excluded from the domain of *someone*.

For this reason, it is not correct to say that *other* and *else* serve merely to exclude previously mentioned individuals, or equivalently to say that I is determined by previous mention of individuals. Rather, the membership of I relative to a given occurrence of an other-quantifier must be determined by the entirety of the local structure of the discourse. There are, in fact, phrases that occur in construction with other-quantifiers which serve only to exclude individuals mentioned in the same NP; specifically, *besides* and *than.* In fact, *besides* may occur in construction with quantifier phrases lacking *other* or *else* and nevertheless play this role.

(13) Some other student besides Albert will fail the next exam.
(14) Some student besides Albert will fail the next exam.
(15) I hope that someone other than Cindy brings the salad.
(16) Everyone else besides Jake will drink cheap beer if it's available.

In all of these examples occur phrases whose sole semantical function is to restrict the domain of the associated quantifier phrases, and their treatment is not difficult in GTS.

4 Reciprocal quantifiers There is another phenomenon of English involving *other* which, although similar to that discussed above, cannot be assimilated to it; namely, the quantifier *one another* and certain uses of *each other*. Call these two phrases *reciprocal quantifiers*.

The semantical analysis of reciprocal quantifiers is like that of other-quantifiers insofar as it requires a restricted domain of discourse I. However, the analysis of reciprocal quantifiers is somewhat more complicated.

Consider a simple example.

(17) John and Mary insulted each other.

The meaning of (17) is clear: John insulted Mary and Mary insulted John. A game rule for *each other* must result in the equivalence of (17) and (18):

(18) John insulted Mary and Mary insulted John.

There is no semantical difference between *each other* and *one another*: rather, the difference is a purely syntactic one, and concerns the cardinality of the group of individuals spoken of. When exactly two individuals constitute I, *each other* is allowed but *one another* is ungrammatical; when I contains more than two members, *one another* is in order, but not *each other*. Thus

*John and Mary insulted one another.
*Jean, Joan, and June are concerned about each other.
Jean, Joan, and June are concerned about one another.

This syntactic difference is safely ignored here.

To represent the general case, we consider (19):

(19) The I's R one another.

Assume that I is indexed by some subset of the natural numbers. (If I is of too great a cardinality for this, pick an index set which suffices.) Further let the various a_i's and a_j's denote the members of I. Then (19) is equivalent to the conjunction of all sentences of the form

a_i R's a_j

where $a_i \neq a_j$. When I is infinite, however, there is no such conjunction (at least in English!). This is unproblematic. Our game rule for reciprocal quantifiers will take (19) as input, require Nature to select an a and a b from I, and will output

a R's b.

(G. the/one another) If the game has reached a sentence of the form

X – [the Y]$_{NP}$ – V – Z one another – W

where Y is the grammatical subject of the verb V and *one another* its direct or indirect object or prepositional object, then Nature selects two distinct individuals a and b from I, and the game continues with respect to

X' – a – V' – Z' – b – W', if a and b are Y

where X', V', Z', W' are like X, V, Z, W, but with appropriate changes of number.

Similar rules for other quantifiers, and rules for *each other*, are easily formulated.

(*G*. the/one another), applied to (20)

(20) The family gave one another their Christmas presents on Christmas eve

outputs, according to Nature's selection of, say, Sally and Bubba,

(21) Sally gave Bubba his Christmas present on Christmas eve.

Sentences containing reciprocal quantifiers in the presence of negation display a scope ambiguity: two readings are available for the sentence which appears to be the negation of (19):

(22) The *I*'s do not *R* one another.

If (*G*. not) is applied first in the semantical game for (22), the corresponding reading is the semantical negation of (19); on this reading, if there is just one pair, *a* and *b*, of *I*'s which fail to *R* each other, then (22) is true.

The other reading is obtained by applying (*G*. one another) first in the semantical game. On the reading obtained now, there are no pairs *a* and *b* of *I*'s such that *a* and *b R* each other. If we represent (19) as

$$UxUy \neq x(Ix \,\&\, Iy \rightarrow Rxy),$$

then the readings of (22) correspond, respectively, to

$$\sim UxUy \neq x(Ix \,\&\, Iy \rightarrow Rxy)$$

and

$$UxUy \neq x(Ix \,\&\, Iy \rightarrow \sim Rxy).$$

NOTES

1. Much of the early work in GTS is collected in [3]. For a comprehensive bibliography of GTS and related literature, see [2].
2. The restricted quantifier domain *I* has been discussed by Hintikka and Kulas in [1]; "Definite Descriptions in Game-Theoretical Semantics," in [2]; and in Kulas's 1982 dissertation.

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