Type Shifting of Entities in Discourse

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Abstract for the International Workshop "Where Semantics Meets Pragmatics"
Michigan State University, July, 11-13, 2003

Overview. Clauses denoting propositions, facts, and reasons share a suite of semantic properties. These implicate a higher semantic type for clausally-introduced propositions, facts, and reasons, than for their counterparts introduced by nominals, which are of type e. Clausally introduced events are also of type e. The present talk does two things: (1.) It extends these results to properties; and, (2.) it shows that the semantic type of a clausally introduced proposition, fact, reason, or property shifts to type e upon subsequent mention, with observable effects on the entire suite of properties indicating higher type. The semantic type of an entity depends on the linguistic expression used to refer to it, and can vary during discourse with successive referential acts.

When propositions, facts, and reasons (including purposes) are introduced into a discourse by a clause, they are more readily accessible to immediate subsequent reference with demonstrative pronouns and demonstrative noun phrases, than they are to reference with personal pronouns such as *it*; see Webber (1988), Webber (1991), Gundel, Hedberg and Zacharski (1993), Borthen, Fretheim and Gundel (1997), Gundel, Borthen and Fretheim (1999), and Hegarty, Gundel and Borthen (2002), among others. In (1), the proposition that the cognitive mechanisms responsible for mathematical concepts are also responsible for ordinary ideas can be felicitously referred to by the demonstrative pronoun, but not the personal pronoun. In (2) (from Hegarty, Gundel and Borthen 2002), the demonstrative, but not the personal pronoun, can felicitously refer to the fact that the court does not believe Ms. Lewinsky. Likewise for reasons (3a), and purposes (3b). But events (4) introduced by clauses are immediately accessible to reference with *it*.

(1) For more sophisticated [mathematical] ideas, it is necessary to study the cognitive mechanisms that characterize mathematical concepts. Lakoff and Nuñez argue that these are the same ones that characterize ordinary ideas. **This** leads to the authors' main thesis—that mathematics develops by means of metaphors. (Auslander, Joseph. 2001. *American Scientist* 89:366.)
versus: # **It** leads to the authors' main thesis….

(2) "We believe her, the court does not, and **that/#it** resolves the matter," Mr. Montanarelli said today of Ms. Lewinsky's testimony that she had an independent recollection of the date. (*New York Times*, May 24, 2000)

(3) a. Jill fired Fred because he had made inappropriate remarks to his co-workers. **That/#it** is the reason listed on the personnel forms.
b. The company hired Susan to create web pages. **That/#it** is the purpose they specified in the job announcement.

(4) John broke a priceless vase. **That/it** happened at noon.

Furthermore, propositions, facts, and reasons introduced by a nominal expression are rendered immediately accessible to reference with a personal pronoun. Contrast (5)-(7) below with (1)-(3) above.

(5) Alex then introduced a new proposition. But **it** was immediately pooh-poohed.
(6) At that moment, another fact struck Maria. **It** sent shivers down her spine.
(7) Jill fired Fred for a valid reason. **It** was that he made inappropriate remarks to his co-workers.

These observations can be framed in terms of the cognitive statuses defined within the Givenness Hierarchy of Gundel, Hedberg and Zacharski (1993). They propose that a determiner or pronominal form signals that the referent of the associated nominal is assumed by the speaker or writer to have a particular cognitive status (memory and attention state) for the addressee. Of relevance here are the statuses labeled 'activated' and 'in focus'. An entity is activated for a participant in a discourse if that person has a representation of it in short term (or working) memory; and an entity is in focus for a participant if it is activated and, moreover, at the center of that person's attention. The personal pronoun *it* is used by a speaker or writer only when the referent can be assumed to be in focus for the addressee prior to processing of the referring form. Demonstratives *that* and *this* are used when the referent can be assumed to be at least activated (while it may or may not be in focus) prior to processing of the referring form.

If we suppose that clausally introduced entities are rendered activated, but not in focus, upon their introduction, then delineation of these different cognitive statuses provides a preliminary explanation of the data in (1)-(7). An entity will be in focus only if it has been mentioned by a nominal expression in a prominent syntactic argument position earlier in the utterance or in the previous utterance. This accounts for (1)-(3) and (5)-(7). (4) indicates that events are immediately rendered in focus upon their introduction into a discourse, even when they are introduced by a clause.

Recent literature (Hegarty 2003) shows that the possibility of immediate reference with a personal pronoun, described above, varies inversely with the possibility of coordination as a singular sum. A coordination of clauses introducing propositions, facts, and reasons can be interpreted as denoting a single, more complex, proposition, fact, or reason, supporting subsequent reference with a singular demonstrative pronoun or NP. (Similar facts, regarding singular agreement upon coordination of *that*-clauses, were noted by McCloskey 1991 and Moltmann 1997.) But a coordination of nominal expressions denoting propositions, facts or reasons can only be interpreted as a plural. To illustrate with reason clauses (8) versus nominals (9):

(8) Susan fired Bill because she needed to trim the budget and (because) he had the largest salary on the staff. This was a legitimate reason.
(9) To justify firing Bill, Susan cited the need to trim the budget and the excessive size of Bill's salary. #This was a legitimate reason. / These were legitimate reasons.

In contrast to (8), a coordination of clauses introducing independent events (not components of a single, larger event) behaves strictly as a plural.

A parallel to the coordination pattern is obtained in possibilities for quantification by a quantity adverb. To illustrate, the adverb *mostly* in (10) below can quantify over a discourse-appropriate propositional content.

(10) A: What does Jill think about the incident at the nuclear plant?
B: Mostly, Jill believes that the plant was on the brink of a meltdown.

Putting aside the extraneous interpretation in which *mostly* modifies the degree of Jill's belief, and identifying part-whole structure in line with the semantics of amount quantifiers (see Lahiri 2000, 2002), the whole at issue in (10) is the propositional content of the body of Jill's beliefs pertaining to an incident at the nuclear plant, while the part at issue is the propositional content of the subordinate clause. This yields a quantity adverb interpretation of (10) as asserting that the greater part of Jill's beliefs pertaining to the incident can be summed up in the proposition that the plant was on the brink of a meltdown. In a parallel example with a nominal complement of the verb, as in (11), *mostly* can quantify over degrees of Jill's belief, but (11B) does not assert that the propositional content of Jill's beliefs about the incident consists mostly of the proposition denoted by the direct object.

(11) A: What does Jill think about the incident at the nuclear plant?
B: Mostly, Jill believes the proposition Sam believes.

It can be shown that the semantic type s, t for clausally introduced propositions, facts, and reasons yields unsatisfactory explanations both for their coordination as a singular sum, and for quantification over their domains by quantity adverbs. However, satisfactory accounts of these facts are obtained (Hegarty 2003) if these entities are type raised to type s, t , t when they are introduced by a clause. Let = *P*, , , ¬ be the standard Boolean algebra on propositions, defined in terms of the connectives of propositional logic, and define a partial linear ordering ≤ on *P* in terms of entailment. Given a clause α, and the proposition *p* recovered directly from the predicate-argument and quantificational structure of α, let the denotation of α be the principal ultrafilter F_p generated by *p* under the partial order, ≤.

(12) [| α |] = F_p = {*r*: *p* ≤ *r*}.

It follows that, for any propositions *p*, *q* *P*, $F_p \cap F_q = F_{p \vee q}$. As Winter (2001) notes in a similar context, this permits a strictly Boolean interpretation of coordination, but one with the effects of proposals for non-Boolean coordination as a singular sum. Furthermore, it can be shown that (12) yields a realistic account of the quantity adverb interpretation of (10B).

Propositions, facts and reasons introduced by a nominal expression do not follow suit since they are of type e. Furthermore, events are of type e even when introduced by a clause due to Davidsonian interpretive procedures which automatically introduce a first-order variable for the event or state described by a clause, as discussed by Higginbotham (1985, 1989, 2000).

The present work extends these results in two directions: by bringing properties into the fold, and by examining what happens to the semantic types of entities upon further mention in a discourse.

We can observe that properties are only activated upon their introduction. Upon further mention, they are rendered in focus.

(13) The electrical poles are perfectly spherical.
That/#it is how the calculation requires them to be.
(14) Max is taller than the linemen.
That/#it is what we want in a quarterback.
(15) A: Susan is as smart as Einstein.
B: That's smarter than anybody else in the program. It's even smarter than Max.

Furthermore, they coordinate as a singular sum (16)-(17), and are subject to quantity adverb quantification over their domain (18), where *mostly* can quantify over the bulk or extent of Max's relevant properties in the context at hand.

(16) Max is tall and strong. That is what we want in a player.
(17) Susan is taller than a typical guard, and as strong as most forwards. That is rare.
(18) Mostly, Max is attentive to details.

By any account, properties are of higher type, mininally, $\langle e, t \rangle$. To account for the above facts, properties introduced by APs (rather than nominals) are type-raised to type $\langle\langle e, t \rangle, t \rangle$, by defining them as principal ultrafilters under the partial linear order defined by entailment, $(\lambda x)[Px \rightarrow Qx]$. Properties denoted by nominals are of type e. Of course, this recapitulates, in different terms, Frege's (1892) observation that the nominal *the predicate 'red'* is not coreferential with the predicate term *red*, and likewise (with only apparent paradox), that the concept 'horse' is not a concept.

Type change of entities in discourse. This is exhibited in (15) above, and in (19) below.

(19) A: Alex believes that Bill stole the artifact.
B: **That** is implausible. **It** would entail that Maria was in on the scam,
and we know that she wasn't.

What does this tell us about in-focus, as opposed to activated, entities?

Hypothesis 1. In focus requires spatio-temporal delimitation.

This is shown to be wrong: propositions introduced by a nominal are in focus, as are propositions after a second mention in a discourse, yet they do not have spatiotemporal bounds, any more than propositions introduced by a clause.

Hypothesis 2. In focus requires full comprehension.

The idea is the following: The interpretation of a clause as a principal ultrafilter must be wielded in a psychologically plausible way. If *John believes* β, where β is interpreted as F_p, then some of the entailments in F_p will be cognitively accessible to John, and some will not be. From *John believes* β, it certainly doesn't follow that John automatically believes all entailments of *p* in C; it can only mean that he believes the generating proposition and those entailments which are cognitively accessible to him. As a result, there is a grading off in ramifications: if John believes that Bill stole the artifact in a context C, it follows that he believes the artifact was stolen, but he may not realize that Bill could not have stolen the artifact without Mary's help, even if this necessarily follows within C.

But Hypothesis 2 is also shown to be wrong. A shadowy individual, about whom the participants in a discourse know little, can be in focus, and referred to with a personal pronoun. Furthermore, the principal ultrafilter F_p of a proposition, fact, or reason does not become more

fully comprehensible or psychologically accessible upon further mention with a nominal expression, yet such further mention renders the referent in focus, as in (19).

Hypothesis 3. Only entities of type e can be in focus.

That is, only elements of type e are admitted into the center of attention. Higher typed entities, even if introduced in prominent syntactic positions, are not admitted to the center of attention. In (19), use of *that* effects a type update: the type of the proposition, $\langle s, t \rangle$, changes to type e upon use of *that* to refer to the proposition. Since the proposition is in short-term memory and at the center of attention, it is rendered in focus upon type change to type e.

How does type-shifting work? It won't do to take the generating member of the ultrafilter as the shifted type since the generator is already of higher type than e, specifically, of type $\langle s, t \rangle$ for propositions, and $\langle e, t \rangle$ for properties. Note that for propositions, type-shifting can't even be construed as type-lowering since the higher type doesn't contain e. A new elementary individual of the discourse is created, of type e.

If type-shifting is correct, it should be revealed by the diagnostics used above. It has already been observed that further mention permits reference with a personal pronoun. Check for coordination as a singular sum, versus only as a plural:

(20) Jill believes that Max embezzled from his division. Alex believes that Susan used insider knowledge to purchase stocks. The first claim and the second claim have been reported to the president and to the SEC.
   a. They are likely to be true.
   b. # It is likely to be true. [it = that Max embezzled and that Susan did insider trading]

In (20), following the introduction of the two propositions, subsequent coordination of nominals denoting these propositions, *the first claim* and *the second claim*, does not set up reference to a singular sum. Check quantification by a quantity adverb:

(21) A: What does Jill think about the incident at the nuclear plant?
   B: Mostly, Jill believes that the plant was on the brink of a meltdown.
   A: I believe that myself. Mostly, Sam believes it too. / Sam mostly believes it too.

In B's response, *mostly* can quantify over the body of Jill's beliefs about the incident; this yields an interpretation of (21B) as asserting that the greater part of Jill's beliefs pertaining to the incident can be summed up in the proposition that the plant was on the brink of a meltdown, and its ramifications. But in A's rejoinder, *mostly* can only modify Sam's intensity, certainty, or degree of belief. It can't assert that the greater part of Sam's beliefs about the incident are summed up in the proposition referred to by *it*.

Summary. Clausally introduced propositions, facts, reasons, and properties have a higher type than the ones standardly associated with these entities. But upon being entered into a discourse, these entities do not retain their higher types; with subsequent nominal mention, the type of such an entity reverts to type e, the type of an ordinary individual. Effectively, the entity becomes a peg, in the sense of Landman (1986), no matter how exotic or complex its original type in the discourse.

Selected Recent References

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