Ontological Issues in Discourse and the Theory of Predication

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Overview of Talk

- situating this work in a theory of communication
- complex types in predication and discourse
- models for complex types
- aspects and tropes

- dynamic semantics (intersentential anaphora)
- underspecified semantics (semantics doesn't determine all of what is conveyed)

  (1) John fell. Mary helped him up.

  (2) John fell. Mary pushed him.

  (3) John fell. He fell backwards.

- reasoning about preferred resolutions of underspecifications. This reasoning needs to be defeasible in light of:

  (4) John slipped on the wet grass. He fell. Then Mary pushed him, and he rolled over the edge of the cliff.

In general a variety of factors affect conveyed content. A theory like SDRT (Segmented Discourse Representation Theory) seeks to see how discourse structure affects conveyed content in:

- affecting anaphoric phenomena (individual and abstract entity anaphora, treatment of presuppositions, temporal structure)
- the choice of discourse function for the current discourse constituent. In general a discourse constituent may play several roles, instantiate several speech acts.

Discourse structure computed by looking at:

- the syntax semantics interface
- lexical choice.
- prosody
- gesture...

Complex types and copredication

(5) a. Mary picked up and mastered three books on mathematics. [*physical object* and *informational content*]

b. Most cities that vote democratic passed anti-smoking legislation last year. [*population* and *legislative entity*]

An object of $\bullet$-type $\alpha \bullet \beta$ has two aspects, the aspect of being α and the aspect of being β and that the predication of a property to an object may hold in virtue of that aspect.

In copredication we predicate on two distinct aspects of an object simultaneously.

(6) Could you pass the salt please?

Asher and Lascarides (2001) argue that *please* types its sentential argument as a request, while the syntax of (6) types the clause as a question, and this forces the discourse constituent introduced by (6) to have a complex type QUESTION • REQUEST. Asher and Reese (2004) (2005) extend this notion to biased questions which are both assertions and questions.

(7) Does John do a damn thing around the house?

We adduce a wide variety of tests to show that such examples also function as complex speech acts.

Some Choices for formalization

- one level: typed unification formalism with complex AVMs. Types and logical forms in one. Model (Blackburn 1992): types interpreted as propositions true at nodes. What are complex types unless propositional operators? $\bullet$ as $\sqcap$ (conjunctive type)
- two levels: type calculus and the effects of type adjustment rules on the logical form being constructed

Consider a model where • types are modelled as conjunctive types.

- **Conjunctive Types Axiom**:
  $x : \alpha \sqcap \beta$ iff $x : \alpha \wedge x : \beta$

This model of • adopts the following conjunctive types hypothesis (CTH). Let's assume for simplicity, as most work in lexical semantics does, that the type hierarchy forms a complete lattice in which greatest lower bounds are assured to exist. Then:

- **Conjunctive Types Hypothesis (CTH)**:
  $\alpha \sqcap \beta := \alpha \sqcap \beta = glb\{\alpha, \beta\}$

(8) The book is interesting but very heavy to lug around.

- Imagine that the coordinated adjectival phrases place a • type requirement on its argument–e.g., P • I.
- Types match; copredication succeeds.

Problem with CTH

For many cases of copredication, not the case that for $x : \alpha \bullet \beta$ that $x : \alpha$ and $x : \beta$, because $\alpha \sqcap \beta = \bot$. By CTH, $\alpha \bullet \beta = glb\{\alpha, \beta\} = \bot$

- complex speech acts of the form QUESTION • REQUEST, QUESTION $\sqcap$ REQUEST $= \bot$.
- LUNCH $\sqsubseteq$ EVENT • FOOD. EVENT $\sqcap$ FOOD $= \bot$ Events and physical objects have different, even incompatible properties. Objects, from our commonsense point of view, perdure through time while events have a duration; objects are wholly present at each moment in time while events have temporal parts. Linguistic tests: temporal modifiers

(9) a. The tree grew slowly.
b. The tree was slow.
c. The tree was slow in growing.

- AUSTIN $\sqsubseteq$ CITY $\sqsubseteq$ LOCATION • ADMINISTRATIVE BODY. But ADMINISTRATIVE BODY has 8 members. Locations don't have members (perhaps inhabitants, of which Austin has about 1 million.

- BOOK $\sqsubseteq$ PHYSICAL-OBJECT • INFORMATIONAL-OBJECT.
- informational objects and physical objects have incompatible individuation properties. Informational objects, abstract objects that contain information can have multiple concrete instantiations, if indeed they have any physical instantiations at all. Individual physical objects cannot have multiple concrete instantiations.

A Case Study about Books (Tim Fernando)

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a there are exactly two copies of War and Peace, two copies of Ulysses, and six copies of the Bible on the shelf

b Pat has read War and Peace and Ulysses, and no other book

c Sandy has read the Bible, and no other book.

Now, consider

- (Q1) How many books are there on the shelf?
- (Q2) How many books has Pat read?
- (Q3) How many books has Sandy read?
- (Q4) Who has read more books, Pat or Sandy?

TF's guess is that most people would answer:

- ten to (Q1)
- two to (Q2)
- one to (Q3)
- Pat to (Q4)

Problem Continued

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if $glb\{\alpha, \beta\} = \bot$ in virtue of incompatible properties of their inhabitants, $\mathrm{Inh}(\alpha \bullet \beta) = 0$

Since there are obviously books, then if we assume that books have a dual nature in some sense yet to be specified, CTH must be wrong.

Another Problem

---

(10) a. The apple is red.
     b. The apple is juicy (is delicious).

x : APPLE • SKIN $\longrightarrow$, according to CTH, x is the skin of the apple. So the intersection of the type SKIN and FOOD just give us the skin of the food, and that's *not* what tastes delicious or is juicy.

Another Hypothesis

Using Category Theory as an abstract model for types, we can say that $\alpha \bullet \beta := (\alpha, \beta)$, the product construction.

- **Pair Types Hypothesis (PTH)**:
  $\alpha \sqcap \beta := (\alpha, \beta)$

- Makes sense of different individuation conditions, say of books. Use one element or the other of the pair to give the appropriate counting principle (Geach, Gupta, Baker).

- Once again makes sense of copredication (same story as for intersective types, but replace products for the type restriction of the coordinated predicates)

(11) The book weighs five pounds

- λx*weighs five pounds*$(x) \longrightarrow x :: \text{P}$
- Assume projection operations π_1, π_2) on types such that $\pi_i(\tau) = i$th constituent of τ, if τ is $\bullet$, ow. undefined.
- ?? $\lambda P(\exists x(\text{book}(x) \wedge P(x)), \quad x : \text{P} \bullet \text{I} \Rightarrow x : \pi_1(\text{P} \bullet \text{I})$

(8b) John's Mom burned the book on magic before he could master it.

If we shift *the book on magic* to P so as to make the predication in the main clause of (8b) succeed, then the anaphoric pronoun will not have an antecedent of the appropriate type for the predication in the subordinate clause.

The crucial insight seems to be that the projections from complex types go with different terms not the original term.

Assume to function symbols f_1 and f_2 that give us new terms associated with t.

- **Separate Terms Axiom (STA)**:
  $t : \alpha \bullet \beta$ iff $f_1(t) : \alpha \wedge f_2(t) : \beta$

With the relevant details now omitted, the analysis of

(12) The book weighs five pounds and is an interesting story.

under PTH and STA would have the following logical form:

(12') $\exists! x(\text{book}(x) \wedge \text{ weighs five pounds}(f_1(x)) \wedge \text{ interesting story}(f_2(x)),$
$\langle x : \langle \textsc{info-obj}, \textsc{phys-obj} \rangle, f_1(x) : \pi_1(\langle \textsc{phys-obj}, \textsc{info-obj} \rangle),$
$f_2(x) : \pi_2(\langle \langle \textsc{phys-obj}, \textsc{info-obj} \rangle \rangle) \rangle)$

An incompleteness in PTH+STA

- Not always a functional relation between elements of a constituent type and elements of the complex type (books as $p \bullet i$ might be individuated via their information conditions and so have many physical instantiations).
- Some dependence between $f_i(t)$ and t where $t : \alpha_1 \bullet \alpha_2$ and $f_i(t) = \alpha_i$. But what is it?
- What does $t : (\alpha, \beta)$ tell us about semantic values of t?

- Inhabitants of • types are in fact collections or sums of parts of simple types.
- Lunch has an event part and a food part. Is lunch a singular noun referring to a plural collection of its parts?

  (13) a. The orchestra got ready. Then they started to play the Bach suite.

  b. The battalion was in trouble. They were receiving heavy fire from the enemy. They called in for tactical air support.

  c. I thought the lunch$_i$ for Chris Peacocke was very nice. They$_i$ pleased him too.

- Inhabitants of • types are not collections! Lunch is one thing not two!

A Metonymic Conception (Kleiber and Cooper)

- Inhabitants of $\bullet$ types have parts picked out by the simple constituent types.
- So, e.g., a lunch is a single item but composite a fusion, of an event and foodstuff. lunches are like apples with several parts.
- the parts of apples are named, but not so for lunches.
- The parthood relation holding between the parts of an apple and the apple as a whole is not the same as the parthood relation operative in lunches or books. Not a physical parthood relation for books.
- Allowed by unrestricted mereological composition. But is that a plausible theory of objecthood? Not substance dualism but substance "multi-ism"
- A Benaceraff type problem:

  (14) Part of the lunch is an event and part of the lunch is a meal.

- Inhabitants of • types are pairs with elements picked out by the simple constituent types.
- So, e.g., a lunch is a pair of objects, an event and foodstuff.
- Suppose there are three copies of the Bible on a shelf plus a volume with the collected works of Jane Austen (7 novels). (example due to Laure Vieu).
- How many books are on the shelf? Eight? Four? The pair hypothesis says there are 10 book (pair objects).

- Leave the objects simple, but complicate the notion of predication.
- Relative predication as a guide:

(15) John as a janitor makes only $20K but as a salesman on E Bay he makes $40K.

(16) That statue as a lump of stone is undistinguished but as a statue by Bernini it is one of the greatest works of art.

(17) This book as a paddle is useless.

(18) a. An isosceles triangle as a triangle has two equal sides.

b. An isosceles triangle as such (as an isoceles triangle) has two equal sides.

- Predication relative to a conceptualization of the object (an aspect or guise). Kratzer's and others' notion of a "thick object"
- Aspects are not constitutive of objects (not parts in the normal sense). They form a partial order, however, under entailment with the aspect True(a) the sup of all aspects of object a (Asher 2006).

Two sorts: Rules for type shifting and rules for transferring the effects of shift to logical form.

An example: *the book is heavy*

- $\lambda P \exists x(\text{book}(x) \wedge P[x])[\lambda u \text{heavy}(u)], \quad \langle P\colon (p \bullet i) \multimap \underline{t}, x\colon p \bullet i, u\colon p \rangle]$
- By •-Exploitation: $\lambda P \exists x(\text{book}(x) \wedge P[x])[\lambda u \text{heavy}(u)], \quad \langle P\colon (p \bullet i) \multimap \underline{t}, x\colon p \bullet i \Rightarrow (x\colon p, v\colon p \bullet i), u\colon p \rangle$
- By Transfer where c abbreviates the typing context in the previous step, $\lambda P \exists x(\exists v(\text{book}(v) \wedge \text{O-Elab}(x, v)) \wedge P[x])[\lambda u \text{heavy}(u)], \quad c$

(19) a. The student read every book in the library.
b. The student carried off every book in the library.

1. $[\![\text{the library}]\!] = \lambda P \exists x(\text{library}(x) \wedge P[x])$,
$\langle P\colon (p \bullet l) \multimap \underline{t},\ x\colon p \bullet l\rangle$

2. We assume that the preposition *in* types its first argument as physical and takes an argument of $p \bullet l$ as its second argument. However, because it will combine with a lexical head, we introduce an as yet undetermined variable y that will be typed by the head. So:
$[\![\text{in the library}]\!] = \lambda Q \lambda y \exists x(\text{library}(x) \wedge \lambda w \text{in}(w,x)[y] \wedge Q[y])$,
$\langle Q\colon e \multimap \underline{t},\ x\colon p \bullet l,\ y\colon e, w\colon p\rangle$

3. $[\![\text{book in the library}]\!] =$
$\lambda Q \lambda y \exists x(\text{library}(x) \wedge \lambda w \text{in}(w,x)[y] \wedge Q[y]), \langle Q\colon e \multimap \underline{t} \Rightarrow Q : (p \bullet i) \multimap \underline{t}), x\colon p \bullet l,\ y\colon e, w\colon p\rangle[\lambda v \text{book}(v)\ \langle v\colon p \bullet i\rangle$

4. We now merge typing contexts:
$[\![\text{book in the library}]\!] =$
$\{\lambda Q \lambda y \exists x(\text{library}(x) \wedge \lambda w \text{in}(w,x)[y] \wedge Q[y])[\lambda v \text{book}(v)], \langle (Q\colon e \multimap \underline{t} Rightarrow Q : (p \bullet i) \multimap \underline{t}), x\colon p \bullet l,\ y\colon e, w\colon p\rangle, v\colon p \bullet i\rangle$

5. We now adjust types on y to reflect the type of Q:
$[\![$book in the library$]\!] =$
$\{\lambda Q\lambda y\exists x(\text{library}(x)\wedge\lambda w\text{in}(w,x)[y]\wedge Q[y])[\lambda v\text{book}(v), \langle(Q{:}\, e-$
$\multimap \underline{t} Rightarrow Q : (p\bullet i)\multimap\underline{t}),\, x{:}\, p\bullet l,\ (y{:}\, e\Rightarrow$
$y{:}\, p\bullet i), w{:}\, p\rangle, v{:}\, p\bullet i\rangle$

6. Letting the whole type context above be abbreviated as c, we can now do Application, getting rid of Q:
$\lambda y\exists x(\text{library}(x)\wedge\lambda w\text{in}(w,x)[y]\wedge\text{book}(y)), c$

7. Now we can do $\bullet$ Exploitation on the type of y:
$\lambda y\exists x(\text{library}(x)\wedge\lambda w\text{in}(w,x)[y]\wedge\text{book}(y)), c+$
$(y{:}\, p\bullet i\Rightarrow v{:}\, p\bullet i, y{:}\, p)$

8. By transfer we get: $\lambda v\exists y\exists x(\text{library}(x)\wedge\lambda w\text{in}(w,x)[y]\wedge$ $\text{book}(v)\wedge\text{O-Elab}(y,v))), c+(y{:}\, p\bullet i\Rightarrow v{:}\, p\bullet$ $i, y{:}\, p)$ by Application:

$\lambda v\exists y\exists x(\text{library}(x)\wedge\lambda w\text{in}(y,x)\wedge\text{book}(v)\wedge\text{O-Elab}(y,v)), c+$
$(y{:}\, p\bullet i\Rightarrow v{:}\, p\bullet i, y{:}\, p)$

9. Now applying the determiner meaning we get:
$\lambda P\forall v(\exists y\exists x(\text{library}(x)\wedge\lambda w\text{in}(y,x)\wedge\text{book}(v)\wedge$ $\text{O-Elab}(y,v))\rightarrow P(v)),\ c+(y{:}\, p\bullet i\Rightarrow v{:}\, p\bullet$ $i, y{:}\, p)$

10. The second argument of *read* has type $p{\bullet}i$ matching the type of the DP:
    $[\![$read every book in the library$]\!] =$
    $\lambda u[\forall v(\exists y \exists x(\text{library}(x) \wedge \text{in} y, x) \wedge \text{book}(v) \wedge \text{O-Elab}(y, v)) \rightarrow$
    $\text{read}(u, v)),$
    $\langle u : a, v\colon p \bullet i,\ x\colon p \bullet l, y\colon p,\ \rangle$

After application we get the desired quantificational reading for the VP. That is, quantification is over $p{\bullet}i$ objects, not physical objects only.

We have a choice as to whether to quantify over the objects using a physical criterion of individuation or using an informational criterion. In this example the informational criterion is preferred.

Note: You can't count with **both** principles of counting. Inconsistent.

Contrast this with the sentence in (19b). By the Head Principle, the type on the verb must win, and *steal* types its object as physical. So we must retype and rewrite the λ-term for the DP.

(20) $\lambda\mathcal{P}\lambda w\mathcal{P}(\lambda u\text{carry-off}(w,u)), \langle w: a,\ \mathcal{P}: (p \multimap \underline{t}) \multimap \underline{t}, u: p\rangle$

(21) After bringing together the two terms and using merging contexts and letting c stand for the result, we have
$\lambda\mathcal{P}\lambda w\mathcal{P}(\lambda u\text{steal}(w,u))[\lambda P\forall v(\exists y\exists x(\text{library}(x)\wedge \lambda w\text{in}(y,x)\wedge\text{book}(v)\wedge\text{O-Elab}(y,v)) \rightarrow P(v)),\ c$

(22) By • E on v, we get:
$\lambda\mathcal{P}\lambda w\mathcal{P}(\lambda u\text{carry-off}(w,u))[\lambda P\forall v\exists y(\exists x(\text{library}(x)\wedge \text{in}(y,x)\wedge\text{book}(v)\wedge\text{O-Elab}(y,v)) \rightarrow P(v))], c+$
$(v\colon p \bullet i \Rightarrow z\colon p \bullet i, v\colon p$

(23) Now by Transfer and letting c' stand for the updated context:
$\lambda\mathcal{P}\lambda w\mathcal{P}(\lambda u\text{carry-off}(w,u))[\lambda P\forall v\exists z\exists y(\exists x(\text{library}(x)\wedge \text{in}(y,x)\wedge\text{book}(z)\wedge\text{O-Elab}(y,z)\wedge\text{O-Elab}(v,z)) \rightarrow P(v))], c'$

Now by application we get the following result with the desired quantificational reading, since the logical form that will result from reducing the lambda terms in (19b) will entail that all physical copies of all books that are in the library will be stolen.

(19b') $\lambda w \forall v(\exists x \exists y \exists z \exists v(\text{library}(x) \wedge \text{in}(y, x) \wedge \text{book}(z) \wedge \text{O-Elab}(y, z) \wedge \text{O-Elab}(v, z)) \rightarrow \text{steal}(w, v)),$
$\langle w : a,\ y{:}\, p, v{:}\, p, z{:}\, p \bullet i,\ x{:}\, p \bullet l\rangle$

Simplify by identifying the copies that are in the library with the physical aspects quantified over:

(19b") $\lambda w \forall v(\exists x \exists z(\text{library}(x) \wedge \text{in}(y, x) \wedge \text{book}(z) \wedge \text{O-Elab}(v, z)) \rightarrow \text{carry-off}(w, v)),$
$\langle w : a,\ y{:}\, p, v'{:}\, p \bullet i,\ x{:}\, p \bullet l\rangle$

Because I have introduced terms that refer to both thick individuals (aspects) and thin individuals (individuals of complex type), we must have both in the domain. In the quantificational puzzles, we saw that counting and quantification may be directed over physical aspects or informational aspects of books, or over books as objects of complex type, depending on the predicational restriction.

Postulate domains for each type.

Domains D_α for simple types α have their own individuation and counting criteria provided by α.

But what about the inhabitants of • types? Could they simply be identical to those that inhabit the simpler types?

- $x = y \rightarrow (x : \alpha \leftrightarrow y : \alpha)$

or, given that typing contexts are functions from terms to types:

- (ITID) $t_1 = t_2 \rightarrow \text{TYPE}_C(t_1) = \text{TYPE}_C(t_2)$, for any typing context C.

But it also seems reasonable to say that $\alpha \bullet \beta \neq \alpha$.

Now suppose that $D_{\alpha \bullet \beta}$ and D_α have a common inhabitant. I.e.

(24) $\exists x \exists y\ x = y,\ \langle x\colon \alpha, y\colon \alpha \bullet \beta \rangle$

We can now derive an immediate contradiction from ITID. So the inhabitants of $\alpha \bullet \beta$ must be disjoint from the inhabitants of the constituent types, unless we give up ITID.

A rich universe

This leaves us with a very rich universe of objects when we consider complex types. But there is yet another complication.

To count individuals we need a principle of counting given by a simple type. Viz for books:

- one way of counting: informational object with a physical realization
- another way of counting books: physical object with an informational content.

The Jane Austen example revisited

Consider the Jane Austen case again, where we have one physical volume containing Jane Austen's seven published novels together with three copies of the *Bible* on a shelf.

A principle of counting will determine the number of P • I inhabitants. If we graph the Jane Austen situation using lines for the O-elab relation, we have for the case where we individuate the P • I inhabitants, $b_1, b_2, \ldots$ via the P type:

```
   b1 b2      b3   b4
 /  /\  |  \      |   \ /  \
     p1  /   \                                     p2   \  |   / \
  i1 .... i7 i8      p3  p4
```

Whereas if we individuate with respect to the I type, we have:

```
b1   b2  b3  b4  b5  b6  b7 b8
       / \ |    |     |     |    |    /  |
/  |  \
     i1    \ i2  i3   i4   i5  i6  /   i7                    /
     \        /    / i8    \
              \                     /
                \            /                          p2
                  \             /
                      p1
```

Thus, the number of P • I inhabitants is either in 1-1 correspondence with the P inhabitants, the physical aspects of the P • I objects or with the I inhabitants, the informational aspects of the P • I objects. We have in effect two models with two different sets of P • I inhabitants, depending on which criterion of individuation is chosen.

We have multiplied entities and introduced an indeterminacy of cardinality in the models. We can't say exactly how many inhabitants of a complex type there are, unless the context determines for us the relevant criterion of individuation.

This is a form of underspecification. It's underspecified or even vague as to how many books there are in a model without a criterion specified.

Not all complex types introduce distinct or even incompatible individuation and counting criteria. For instance, consider the complex types introduced by *John as a janitor* and *John as a salesman on E-Bay*. John as a janitor and John as a salesman on E-Bay are not two different people.

Janitors and salesmen on E-Bay arguably have the same individuation and counting criteria as persons.

While we don't count aspects, however, conjoining them forms a plural collection demanding plural agreement with its predicate.

(25) John as a gay stripper and John as a banker are a weird combination.

There is one sort of example where we do seem to distinguish aspects but only in a metaphorical way:

(26) John as a gay stripper and John as a banker are two different people.

Over our domain, we impose a partial ordering $\leq$ to model the ordering of the thick individual with the bare or thin individuals at the top. I also introduce a sum operation over thick individuals $+$.

Each individual under this ordering generates a filter, and the filters of the thin individuals form a possibly overlapping tessilation of the domain. The filters generated by thick individuals are subfilters of a filter generated by a thin individual. Let $\mathcal{F}(a)$ be the filter associated with a.

1. $\{\mathcal{F}(a) : \text{Thin}(a)\}$ form a possibly overlapping tessilation of the domain.
2. $(b \leq c \wedge b \in \mathcal{F}(a)) \rightarrow c \in \mathcal{F}(a)$
3. $0 \notin \mathcal{F}(a)$
4. $a \in \mathcal{F}(a)$
5. For $a, b \in \mathcal{F}(c)$, $a + b =$ the trope defined by the conjunction of the properties defining the thick individuals a and b. When those properties are incompatible, we say $a + b = 0$.
6. $(b, c \in \mathcal{F}(a) \wedge b + c \neq \perp) \rightarrow b + c \in \mathcal{F}(a)$
7. $\text{Thin}(a) \wedge \text{Thin}(b) \rightarrow (a \neq b \rightarrow \mathcal{F}(a) \cap \mathcal{F}(b) = 0)$, unless a,b are inhabitants of a type $\alpha \bullet \beta$.
8. $b \in \mathcal{F}(a) \rightarrow \mathcal{F}(b) \subseteq \mathcal{F}(a)$

We can at least partially capture the nature of thick and thin individuals with this algebraic construction.

Conclusions

- • types are useful both in lexical semantics and discourse interpretation.
- We have surveyed several models for • types. Argued in favor of an aspect account.
- A formalism using both types and logical forms is essential to making clear how these models work..