Composing Criteria of Individuation

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Plan for today

Copredication

The counting and individuation issue

Compositional Theory

Comparison with other accounts

Copredication

The apparent attribution of incompatible properties to a single object.

Some examples:

(1) Lunch was delicious but took forever. (Asher, 2011, p. 11)

(2) The bank was vandalised after calling in Bob's debt.

(3) London is so unhappy, ugly and polluted that it should be destroyed and rebuilt 100 miles away. (Chomsky, 2000, p. 37)

Issues

- ► Philosophical
- ► Compositional
- ► Pragmatic and discourse-based
- ► Counting and individuation

A question of individuation

*Suppose the library has two copies of Tolstoy's War and Peace,
Peter takes out one, and John the other. Did Peter and John
take out the same book, or different books? If we attend to the
material factor of the lexical item, they took out different books;
if we focus on its abstract component, they took out the same
book. We can attend to both material and abstract factors
simultaneously. . .*

(Chomsky, 2000, p. 16)

Examples

(4) Fred picked up three books.

(5) Fred mastered three books.

(6) Fred picked up and mastered three books.

(7) Fred mastered three heavy books.

volume 1

| Notes from Underground |
| The Gambler |
| The Double |

- ▶ Physically: 1 book. Informationally: 3 books.
- ▶ (5): True, (4),(6),(7): False

(4) Fred picked up three books. ×

(5) Fred mastered three books. ✓

(6) Fred picked up and mastered three books. ×

(7) Fred mastered three heavy books. ×
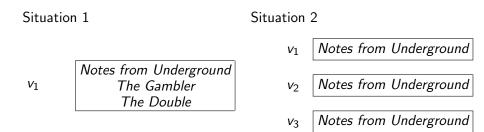
volume 1	*Notes from Underground*
volume 2	*Notes from Underground*
volume 3	*Notes from Underground*

- Physically: 3 books. Informationally: 1 books.
- (4): True, (5),(6),(7): False

(4) Fred picked up three books. ✓

(5) Fred mastered three books. ×

(6) Fred picked up and mastered three books. ×

(7) Fred mastered three heavy books. ×

The third criterion

Situation 1

v_1

| Notes from Underground
The Gambler
The Double |

Situation 2

v_1 | Notes from Underground |

v_2 | Notes from Underground |

v_3 | Notes from Underground |

(6) Fred picked up and mastered three books.

(7) Fred mastered three heavy books.

Key points

1. Nouns supporting copredication denote sets of complex objects—in the case of 'book', objects that have a part that is a physical volume and a part that is an informational (abstract) book.

2. Predicates encode criteria of individuation as part of their meaning.

3. Quantifiers access, compose and exploit criteria of individuation.

Complex objects

Suppose that we combine the books in situations 1 and 2 to make situation 3:

v_1

Notes from Underground The Gambler The Double

v_2 | Notes from Underground |

v_3 | Notes from Underground |

v_4 | Notes from Underground |

$[\![book]\!]^{s3} = \{v_1 + NfU, v_1 + TG, v_1 + TD, v_2 + NfU, v_3 + NfU, v_4 + NfU\}$

Problem: In this view, there are 6 books in situation 3.

Solution: This set of 6 is never used in plural quantification because of restrictions imposed by determiners.

Distinctness criteria

- Say that a group is 'physically compressible' iff there are two members of it that are physically equivalent.
- E.g. (8) is physically compressible, but (9) isn't.

(8) $v_1 + NfU \ \oplus \ v_1 + TG \ \oplus \ v_2 + NfU$

(9) $v_1 + TD \ \oplus \ v_2 + NfU \ \oplus \ v_3 + NfU$

- Both (8) and (9) are informationally compressible.

Composing distinctness criteria

- We can express 'x is physically compressible' as $(\text{PHYS})comp(x)$.
- Compressibilty statements can be complex, e.g.:

  $(\text{PHYS} \sqcup \text{INFO})comp(x)$—$x$ is (physically or informationally) compressible.
- E.g. $(\text{PHYS} \sqcup \text{INFO})comp(a)$, but $\neg(\text{PHYS} \sqcup \text{INFO})comp(b)$

$$(a) = v_1 + TG \ \oplus \ v_2 + NfU \ \oplus \ v_3 + NfU$$
$$(b) = v_1 + TG \ \oplus \ v_2 + NfU$$

Formally:

- PHYS is shorthand for $\lambda x_e.\lambda y_e.\text{phys-equiv}'(x, y)$—the two-place relation of physical equivalence.

- $(R)comp(x)$ is shorthand for $\exists y \exists z(y \neq z \land y \leq_a x \land z \leq_a x \land R(y, z))$—the statement that there are two singletons (y and z) that are part of the group x and which bear relation R to each other.

- $\sqcup$ is the generalized disjunction operator, familar from e.g. Partee and Rooth (1983).

- $\therefore (\text{PHYS} \sqcup \text{INFO})comp(x) \equiv$
  $\exists y \exists z(y \neq z \land y \leq_a x \land z \leq_a x \land (\text{phys-equiv}'(y, z) \lor \text{info-equiv}'(y, z)))$

Compositional theory

Novel lexical entries:

- $[\![book]\!] = \lambda x_e.\, \langle \text{book}'(x)\, ,\, \text{PHYS} \sqcap \text{INFO} \rangle$

- $[\![books]\!] = \lambda x_e.\, \langle {}^*\text{book}'(x)\, ,\, \text{PHYS} \sqcap \text{INFO} \rangle$

- $[\![be\ heavy]\!] = \lambda y_e.\, \langle \text{heavy}'(y)\, ,\, \text{PHYS} \rangle$

- $[\![be\ informative]\!] = \lambda z_e.\, \langle \text{informative}'(z)\, ,\, \text{INFO} \rangle$

Quantification

$$[\![three]\!] = \lambda P_{e\to\langle t\times\mathcal{R}\rangle}.\lambda Q_{e\to\langle t\times\mathcal{R}\rangle}.$$
$$\Big\langle \exists x\big(|x| \geq 3 \wedge \pi_1(Px) \wedge \pi_1(Qx) \wedge \neg(\pi_2(Px) \sqcup \pi_2(Qx))comp(x)\big),$$
$$\pi_2(Px) \sqcap \pi_2(Qx)\Big\rangle$$

$$\therefore [\![three\ books]\!] =$$
$$\lambda Q_{e\to\langle t\times\mathcal{R}\rangle}.$$
$$\Big\langle \exists x\big(|x| \geq 3 \wedge {}^*book'(x) \wedge \pi_1(Qx) \wedge \neg((\text{PHYS} \sqcap \text{INFO}) \sqcup \pi_2(Qx))comp(x)\big),$$
$$(\text{PHYS} \sqcap \text{INFO}) \sqcap \pi_2(Qx)\Big\rangle$$

Physical individuation

$[\![$ *three books are heavy* $]\!] =$

$\Big\langle \exists x \big(|x| \geq 3 \wedge {}^*\mathsf{book}'(x) \wedge {}^*\mathsf{heavy}'(x) \wedge \neg((\textsc{phys} \sqcap \textsc{info}) \sqcup \textsc{phys})comp(x) \big),$

$\quad (\textsc{phys} \sqcap \textsc{info}) \sqcap \textsc{phys} \Big\rangle$

$$(10) \quad = \Big\langle \exists x \big(|x| \geq 3 \wedge {}^*\mathsf{book}'(x) \wedge {}^*\mathsf{heavy}'(x) \wedge \neg(\textsc{phys})comp(x) \big),$$

$$\textsc{phys} \sqcap \textsc{info} \Big\rangle$$

More pieces of the puzzle

$$\llbracket \lambda_1 \, [\textit{Fred mastered } t_1] \rrbracket = \lambda x_e. \left\langle \mathsf{mastered}'(f', x) \, , \, \text{INFO} \right\rangle$$

$$\llbracket \textit{heavy} \rrbracket = \lambda P_{e \to (t \times \mathcal{R})}.\lambda y_e. \left\langle (\mathsf{heavy}'(y) \wedge \pi_1(Py)) \, , \, \pi_2(Py) \sqcup \text{PHYS} \right\rangle$$

$$\therefore \llbracket \textit{heavy books} \rrbracket = \lambda y_e. \left\langle {}^*\mathsf{heavy}'(y) \wedge {}^*\mathsf{book}'(y) \, , \, (\text{PHYS} \sqcap \text{INFO}) \sqcup \text{PHYS} \right\rangle$$
$$= \lambda y_e. \left\langle {}^*\mathsf{heavy}'(y) \wedge {}^*\mathsf{book}'(y) \, , \, \text{PHYS} \right\rangle$$

Copredication

$\therefore$ [[*three heavy books*]] $=$

$\lambda Q_{e \to \langle t \times \mathcal{R} \rangle} \cdot$
$\Big\langle \exists x \big(|x| \geq 3 \land {}^*\text{heavy}'(x) \land {}^*\text{book}'(x) \land \pi_1(Qx) \land \neg(\text{PHYS} \sqcup \pi_2(Qx))comp(x) \big),$

$\quad \text{PHYS} \sqcap \pi_2(Qx) \Big\rangle$

$\therefore$ [[*Fred mastered three heavy books*]] $=$

$\Big\langle \exists x \big(|x| \geq 3 \land {}^*\text{heavy}'(x) \land {}^*\text{book}'(x) \land \text{mastered}'(f', x) \land \neg(\text{PHYS} \sqcup \text{INFO})comp(x) \big),$

$\quad \text{PHYS} \sqcap \text{INFO} \Big\rangle$

Asher's Type Composition Logic

Objects and aspects

> *Predication typically involves the attribution of a property to an object considered under a certain conceptualization; this is what an aspect is. [. . .]*
>
> *A lunch object is wholly an event (under one aspect) and wholly food (under another aspect). When we speak or think of lunches as food, there's no "other part" of the lunch itself that's left out and that is an event. [. . .]*
>
> *I will codify the relation between aspects and the objects of which they are aspects with the relation o-elab, which stands for Object Elaboration. When I write o-elab(x, y), I mean x is an aspect of y, or x "elaborates" on the sort of object y is.*

Asher, 2011, pp. 149–50

Asher's Type Composition Logic

Key features

- Appeals to interactions between the process of predication and lexical semantics.
- Nouns supporting copredication are assigned a lexical entry of 'dot type', $\alpha \bullet \beta$. α and β are the types of the individual aspects under which the object can be considered.
- Type conflicts involving dot types induce the introduction of material into metalanguage formulae such that those type conflicts are resolved.

Interpretation of (1):

$$\lambda\pi\exists x(\text{lunch}(x, \pi) \wedge ((\exists y(\text{was delicious}(y, \pi) \wedge \text{o-elab}(y, x, \pi)))$$
$$\wedge \exists z(\text{took forever}(z, \pi) \wedge \text{o-elab}(z, x, \pi)))))$$

$x : \text{FOOD} \bullet \text{EVENT}, y : \text{FOOD}$ and $z : \text{EVENT}$

(4) Fred picked up three books.

$\lambda\pi.\exists v(v = \mathsf{Fred}'(\pi) \wedge \exists_3 x(\exists z(\mathsf{book}'(z, \pi) \wedge \mathsf{pick\text{-}up}'(v, x, \pi) \wedge \mathsf{o\text{-}elab}(x, z, \pi))))$

$\quad \pi: \ x : \mathrm{PHYS}, z : \mathrm{PHYS} \bullet \mathrm{INFO}$

(7) Fred mastered three heavy books.

$$\lambda\pi.\exists v(v = f'(\pi) \wedge \exists_3 x(\mathsf{master}'(v, x, \pi)$$
$$\wedge \exists z(\mathsf{book}'(z, \pi) \wedge \mathsf{o\text{-}elab}(x, z, \pi)$$
$$\wedge \exists y(\mathsf{heavy}'(y, \pi) \wedge \mathsf{o\text{-}elab}(y, z, \pi)))))$$

$\quad \pi: \ x : \mathrm{I}, \ y : \mathrm{P}, \ z : \mathrm{P} \bullet \mathrm{I}$

This says that there are three informational aspects of some book, i.e. three books-individuated-informationally, such that Fred mastered them and they have a physical aspect that is heavy. It is compatible with Fred mastering the contents of a (heavy) trilogy. But (7) would *not* be true in that situation.

Type Theory with Records
(Cooper, 2011)

$$(11) \quad [\![book]\!] = \lambda r : [\text{x} : Ind] \left(\left[\begin{array}{lll} \text{p} & : & PhysObj \\ \text{i} & : & InfObj \\ \text{c}_{\text{book}} & : & \text{book\_phys\_inf}(r.\text{x, p, i}) \end{array} \right] \right)$$

More than one way to convert (11) to a set for the purposes of quantification, e.g.

- $\{a | \exists r(r : [\text{x} : Ind] \wedge r.\underline{\text{p}} = a) \wedge \{b | b : [\![book]\!](r)\} \neq \emptyset\}$

  gets you the set of things a such that a is the physical aspects of some book, i.e. the set of books individuated physically.

- $\{a | \exists r(r : [\text{x} : Ind] \wedge r.\underline{\text{i}} = a) \wedge \{b | b : [\![book]\!](r)\} \neq \emptyset\}$

  gets you the set of things a such that a is the informational aspects of some book, i.e. the set of books individuated informationally.

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