Plurality and the Atom-Set Distinction

Yoad Winter

Utrecht Institute of Linguistics

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Semantic puzzles of plurality

1. **Distributivity-Collectivity**:
   the boys smiled VS *the boys met/are numerous*

   Proposal: lexical semantic interface with concepts; not in formal semantics

2. **Two types of collectivity**:
   (*all*) *the boys met* VS (#*all*) *the boys are numerous*

   Proposal: reflects two formal types of predicates – over atoms vs. over sets – which give rise to atom-based vs. set-based collectivity

3. **Effects of morphological number**:
   (*all*) *the boys have met*   VS   #*each/the boy has met*
   (*all*) *the boys have been numerous*   #*each/the boy has been numerous*

   Proposal: number-inflection affects types of NPs – atoms vs. sets

The type-theoretical distinction between atoms and sets is a linguistic manifestation of a semantic number feature.

Plan

- Distributive predicates and collective predicates

- The formal concept of "semantic number"

- Champollion's proposal

- Discussion

Distributive predicates vs. collective predicates

Traditional contrast – (1) vs. (2):

(1)   The boys smiled   ~   "every boy smiled"
       Dan and Sue smiled   ~   "Dan smiled and Sue smiled"
       smile: a distributive predicate

(2)   The boys met $\not\sim$ #"every boy met"
       Dan and Sue met $\not\sim$ #"Dan met and Sue met"
       meet: a collective predicate

Traditional proposal

Distributivity/collectivity of predicates corresponds to a distinction in semantic number – ranging over singular/plural entities:

$smile(\mathbf{d} + \mathbf{s}) = smile(\mathbf{d}) \wedge smile(\mathbf{s})$

smile ranges over singular entities

through a distributivity mechanism – see Kruitwagen's talk

$meet(\mathbf{d} + \mathbf{s})$ cannot be simplified further

meet ranges over plural entities

Mixed predicates

Many predicates show a "mixed" behavior:

(3) Dan and Sue built a raft

~ "each of Dan and Sue built a raft, or Dan and Sue built a raft together"

Traditional proposal: such predicates are ambiguous/vague in terms of their semantic number.

A classificational problem

When considering different subjects, virtually all predicates show a "mixed" behavior:

(1) The committees met

~ each committee met, or the committees had a meeting together

• *meet* **can** distribute, e.g. over committees

(2) Arthur's lips smiled

~ Arthur's lips formed a smile together,
or (perhaps): each of Arthur's lips smiled

• *smile* **can** apply collectively, e.g. to lips

Revisiting the distributive-collective distinction

It is only **relative to certain entities** that a predicate can be meaningfully called *distributive*, *collective* or *mixed*.

• *meet* – collective for boys, but mixed for committees
• *smile* – distributive for boys, but collective (or mixed) for lips

Knowledge of concepts, and of the world, rather than a formal semantic distinction.

Roberts (1987, 124): "What does it mean to gather or to disperse? By virtue of the meaning of such a predicate, its subject must denote a group of individuals. [...] Viewed in this way, these verbs are no more special than a verb such as *grasp*, which, on one of its senses, can only be true of an individual with a certain type of movable thumb."

Winter (2002): Against traditional approaches, the distributive-collective distinction shows no evidence for a formal feature of "semantic number".

Whither semantic number?

Two types of collective predicates

Dowty (1987), Winter (2002) a.o.:

Type I: (all) the boys met
(all) the girls gathered
(all) the students built a raft together
(all) the critics admire each other

Type II: (#all) the boys are numerous
(#all) the girls are a good team

the students voted to accept the proposal
≠ **all** the students voted to accept the proposal

the trees get thinner in middle of the forest
≠ **all** the trees get thinner in middle of the forest

Type I: *all* has a collective reading
Type II: *all* does not have a collective reading

The atom-set distinction

Type I: *all* has a collective reading – unlike *every* and *each*

Type II: *all* does not have a collective reading – like *every* and *each*

General classification (Winter 2002):

Atom predicates: Predicates that behave the same with *all* and *every*.

Set predicates: Predicates that behave differently with *all* and *every*.

Atom: smile, (be) *numerous*, (be a) *good team*, *vote*, (be) *dense*
all the boys = every boy

Set: *meet, gather, **V** together, **V** each other*
all the boys ≠ every boy

On the atom-set classification

- More robust distinction than the collective-distributive distinction
all the committees met ≠ every committee met

- All classical distributive predicates qualify as atom predicates

- Some classical collective predicates (*meet*) are set predicates, others are atom predicates (*numerous*)

- A question on mixed predicates
all the boys built a raft $\overset{?}{=}$ every boy built a raft

- A plurality phenomenon, more general than the *every-all* test
no boy/no boys, many a boy/many boys

What are the theoretical implications?

Semantic number and the lexicon

- Atom predicates lexically range over *atoms* – singular entities.

- Set predicates lexically range over *sets* – plural entities.

- **Kruitwagen et al.**: an investigation into the conceptual semantics of reciprocal set predicates

- **Palmieri et al.**: a study of reciprocal marking in Italian – may Romance lexicons be more similar to lexicons of non-Romance languages?

Summary – towards a theory of semantic number

The theory is based on a binary semantic feature of lexical (uninflected) predicates:

$-set$ = the predicate denotation ranges over atoms
$+set$ = the predicate denotation ranges over sets (including singleton sets)

This feature is the semantic parallel to the morpho-syntactic feature $\pm plural$.

The interplay between these two features is used to account for a complex array of facts with:

- singular/plural NPs and VPs
- referential/quantificational NPs
- atom/set predicates

A two-way theory of collectivity

Set predication:

the boys met
meet(B)

all the boys met
all (and other plural quantifiers) quantifies over sets!

Set predication is possible whenever the quantifier ranges over sets. This only happens with plural quantifiers.

Impure atoms (Link 1984):

the boys are numerous
numerous$(\uparrow B)$

#all the boys are numerous
all (and other plural quantifiers) does not quantify over impure atoms

The impure atom strategy is a strategy of reference, not of quantification.

Champollion's analogy to mass-count and telicity distinctions

Proposal: the gather/numerous distinction is of the same type as other semantic distinctions.

Mass/Count:
much mud/*tables   many tables/*mud

Telicity:
sleep (*wake up) for an hour   wake up (*sleep) in an hour

Arbitrary semantic number?

Drawback: the atom/set feature assignment to lexical predicates is done in an ad hoc fashion. No insight into the relations between semantic number and "deeper meaning" of predicates.

No account for the reasons that the meaning of be numerous is associated with an atom predicate whereas the meaning of gather with a set predicate.

Can we do better than this?

The divisiveness intuition

Old intuition: the mass/count and telic/atelic distinctions corresponds to a distinction in divisiveness of reference.

- all (many) proper subparts of *mud* are mud

- a proper subpart of *table* is not necessarily a table

- all (many) proper subintervals of a *sleep* state are sleep states

- a proper subinterval of *wake up* event is not necessarily a wake-up event

Champollion (2010):

- all (many) proper subsets of a *gathering* set are gathering set

- a proper subset of a *numerous* set is not necessarily "numerous"

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Bounded divisiveness

Minimal-part problem:

water is mass, but parts of water molecules are not *water*

waltz ("for/*in an hour") is atelic, but parts of one waltz step are not *waltz*

singleton parts of a *gathering* group do not "gather"

Bounded divisiveness: if a predicate *P* holds of *x*, then *P* holds of sufficiently large parts of *x* (up to a certain size).

water is divisive up to the molecular level

waltz is divisive up to the level of triple steps

gather is divisive up to the level of doubletons

This idea is refined to a notion of **stratified reference** (Champollion 2015).

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The core distinction in the Winter/Champollion debate

Winter's proposal stipulates a type distinction (atom/set) on the basis of linguistic behavior.

Champollion's proposal aims to **define** whether a predicate shows a *gather*-like behavior or a *numerous*-like behavior based on its lexical meaning.

As such, Champollion's proposal is conceptually advantageous, similar to parallel approaches to mass terms and telicity (where the same kind of debate exists).

However, because of its reliance on lexical meanings, Champollion's proposal has to face more empirical problems.

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Problem 1 - divisibility of atom predicates

Be a group of less than ten shows perfect divisibility: any subgroup of a group of less than ten is also a group of less than ten.

However:

(#*all*) *the boys are a group of less than ten*: same behavior as of *numerous*!

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Problem 2 - non-divisibility of set predicates

Build a raft together does not show divisibility: taking any boy(s) out of a group of boys who built a raft together may lead to a group that did not build a raft together.

Similar problems with many predicates modified by *together*, even statives like *hold the piano up in the air together*.

However:

(*all*) *the boys built a raft together/held the piano up in the air together*: same behavior as of *gather!*

Similar problems with "cancel each other out" or "propped against each other" (Dalrymple et al. 1998).

Problem 3

Weak account of the causal relations between divisibility and quantification.

Overall

We see two trends in the literature:

1. Incorporate lexical meanings into the formal machinery.
2. Rely on formal features that are not explicated directly using lexical meanings.

The first approach is more ambitious, and, unsurprisingly, faces more empirical problems. The latter approach is technically straightforward, but must be accompanied by a better analysis of lexical meanings.

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