The interplay of fact and theory in separating syntax from meaning

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Chomsky (1975):

> . . . at every point in the stream of discourse
> the speaker must choose a particular single word,
> and it makes sense to ask to what extent
> his choice of a particular word was governed by
> the grammatical structure of the language,
> and to what extent it was governed by other factors.

Thus

Language = Syntax + (Other factors)

The naive mathematician infers:

Language = Syntax + (Other factors)
so
(Other factors) = Language − Syntax.

The naive philosopher of language then infers:

Meanings = Language − Syntax.

In fact we know that these equations don't work.

Mathematically, the structures involved don't allow an operation of subtraction.
So what are these structures, properly described?

Philosophically, meaning is largely a theoretical construct.
Maybe the notion of meaning is useful
in very concrete situations (e.g. in this workshop),
but at a more fundamental level it simply vanishes—
like the notion of 'cause' in physics.

1. The right mathematical picture

Sentences break down into *constituents*.

We can separate out

(a) a constituent C of a sentence S,

(b) the rest of S when C is removed.

The rest of the sentence is a *frame*,
i.e. an expression with a variable, that becomes a sentence when the variable is replaced by a suitable expression.

(NB This is not the Atkins-Fillmore notion of 'frame'.)

Definition. By a *constituent structure* we mean an ordered pair of sets $(\mathbb{E}, \mathbb{F})$, where the elements of $\mathbb{E}$ are called the *expressions* and the elements of $\mathbb{F}$ are called the *frames*, such that the four conditions below hold.

(e, f etc. are expressions. F, $G(\xi)$ etc. are frames.)

1. $\mathbb{F}$ is a set of nonempty partial functions on $\mathbb{E}$.

('Nonempty' means their domains are not empty.)

2. (Nonempty Composition) If $F(\xi_1, \ldots, \xi_n)$ and $G(\eta_1, \ldots, \eta_m)$ are frames, $1 \leqslant i \leqslant n$ and there is an expression

$$F(e_1, \ldots, e_{i-1}, G(f_1, \ldots, f_m), e_{i+1}, \ldots, e_n),$$

then

$$F(\xi_1, \ldots, \xi_{i-1}, G(\eta_1, \ldots, \eta_m), \xi_{i+1}, \ldots, \xi_n)$$

is a frame.

Note: If $H(\xi)$ is $F(G(\xi))$ then the existence of an expression $H(f)$ implies the existence of an expression $G(f)$.

3. (Nonempty Substitution) If $F(e_1, \ldots, e_n)$ is an expression, $n > 1$ and $1 \leqslant i \leqslant n$, then

$$F(\xi_1, \ldots, \xi_{i-1}, e_i, \xi_{i+1}, \ldots, \xi_n)$$

is a frame.

4. (Identity) There is a frame $1(\xi)$ such that for each expression e, $1(e) = e$.

We say e is a *constituent* of f if
f is $G(e)$ for some frame G.

$F(e_1, f, e_3)$ is *the result of replacing the occurrence of* e_2 *in second place in* $F(e_1, e_2, e_3)$ *by* f.
(This notion depends on F, of course.)

Every bare grammar in the sense of
Keenan and Stabler, *Bare Grammar*, CSLI 2003,
has a constituent structure in an obvious way.
(Actually two obvious ways,
depending on whether we incorporate
the Keenan-Stabler 'categories' into words.)

Keenan and Stabler include grammars for
non-configurational languages, e.g. free-order Korean.
So in principle these are not a problem for us either.

2. The lifting lemma

Let X be a set of expressions (for example the sentences) and $\mu : X \to Y$ any function (for example 'meanings' of sentences).

We will define a relation $\equiv_\mu$ so that

$$e \equiv_\mu f$$

says that expressions e and f make the same contribution to μ-values of expressions in X.

The fact that $\equiv_\mu$ must be an equivalence relation
more or less forces us to the following definition.

Definition We write $e \equiv_\mu f$ if for every 1-ary frame $G(\xi)$,

- $G(e)$ is in X if and only $G(f)$ is in X;
- if $G(e)$ is in X then $\mu(G(e)) = \mu(G(f))$.

We say e, f have *the same* $\equiv_\mu$*-value*, or for short
the same fregean value, if $e \equiv_\mu f$.
We write $|e|_\mu$ for this fregean value
(determined only up to $\equiv_\mu$).

LEMMA. Suppose $F(e_1, \ldots, e_n)$ is a constituent of some expression in X, and for each i, $e_i \equiv_\mu f_i$. Then:

(a) $F(f_1, \ldots, f_n)$ is an expression.

(b) $F(e_1, \ldots, e_n) \equiv_\mu F(f_1, \ldots, f_n)$.

For the **proof**, by Nonempty Substitution we can make the replacements one expression at a time.
So it suffices to prove the lemma when $n = 1$.

Assume $F(e)$ is an expression, $H(F(e))$ is in X and $e \equiv_\mu f$.

Proof that $F(f)$ is an expression.
By Nonempty Composition $H(F(\xi))$ is a frame $G(\xi)$.
Since $e \equiv_\mu f$ and $G(e)$ is in X, $G(f)$ is in X.
But $G(f)$ is $H(F(f))$, so $F(f)$ is an expression.

Proof that $F(e) \equiv_\mu F(f)$.
Let $G(\xi)$ be any 1-ary frame such that $G(F(e))$ is an expression in X.
By Nonempty Composition $G(F(\xi))$ is a frame $J(\xi)$.
Since $e \equiv_\mu f$ and $J(e)$ is in X,
$J(f)$ is in X and $\mu(J(e)) = \mu(J(f))$.
So $\mu(G(F(e)) = \mu(G(F(f))$ as required. $\square$

We say that X is *cofinal* if every expression is a constituent of an expression in X.

Basic example:

- L is a language,
- $(\mathbb{E}, \mathbb{F})$ is the constituent structure of L,
- X is the set of sentences of L,
- for each sentence e, $\mu(e)$ is the class of contexts in which e is true.

Assume X is cofinal. Then by (b) of the Lemma,
if $e_i \sim_\mu f_i$ for each i then $F(e_1, \ldots , e_n) \sim_\mu F(f_1, \ldots , f_n)$
provided these expressions exist.
So F and the fregean values of the e_i
determine the fregean value of $F(e_1, \ldots , e_n)$.

Hence there is, for each n-ary frame F, an n-ary map
$h_F : V^n \to V$, where V is the class of $\sim_\mu$-values,
such that whenever $F(e_1, \ldots , e_n)$ is an expression,

$$|F(e_1, \ldots , e_n)|_\mu = h_F(|e_1|_\mu, \ldots , |e_n|_\mu).$$

$$|F(e_1, \ldots , e_n)|_\mu = h_F(|e_1|_\mu, \ldots , |e_n|_\mu).$$

We call h_F the *Hayyan function* of F.

Using the Hayyan functions,
the values $|e|_\mu$ are definable by recursion on the syntax,
starting from $|f|_\mu$ for the smallest constituents f.

Abu Ḥayyān al-Andalusī (Egypt, 14th c.)

> Just as one can't use newly-invented single words,
> so one can't use [newly-invented] constructions.
> Hence all these matters are subject to convention
> (*waḍ*^{c}), and matters of convention require one to
> follow the practice of the speakers of the relevant
> language. . . . syntax studies universal [rules],
> whereas lexicography studies items one at a time.

Definition Let ϕ be a function defined on expressions.
A definition of ϕ is called *compositional* if
for each expression $F(e_1, \ldots , e_n)$,

$$\phi(F(e_1, \ldots , e_n))$$

is determined by F and the values $\phi(e_i)$.

So fregean values are compositional.

One can construct counterexamples to the converse implication:
there are compositional semantics that don't yield fregean values,
because they carry up redundant information.

E.g. Cooper storage for quantifiers whose semantic scope is broader than their syntactic scope.

Everybody read one book. [i.e. the same book]

|one book|(|everybody|(|read|))

|everybody| (|read|,one book)

|read| one book

Though $e \equiv_\mu f$ always implies $\mu(e) = \mu(f)$,
the converse can fail,
if e and f make different contributions
to the meanings of sentences containing them.

The relation $\equiv_\mu$ is canonical.
This equivalence relation is really out there.
Its compositionality is a *theorem*, not an assumption.

In a sense the relation $\equiv_\mu$ is *prior to* meanings,
since it is part of the raw data for extracting meanings.

Nevertheless it is sensitive to a number of choices
that we can make:

1. to choose a constituent structure,
2. to choose what are the atomic expressions (words? morphemes?),
3. to choose a particular fragment of a language,
4. to choose any semantic function μ with any degree of precision.

3. Discrepancies between fregean values and meanings

Under any reasonable choice of μ etc.,
two expressions with the same fregean value
intuitively have the same meaning.

The converse often fails,
when we can chase meaning down only to
compound expressions or frames, not to atomic expressions.

Example 1:

in spite of ξ.
ξ notwithstanding.

Example 2:

ξ_1 pleases ξ_2.
ξ_2 likes ξ_1.

(Dorr 1993: 'Thematic divergence')

Definition Two frames $F(\xi)$ and $G(\xi)$ are μ-*equivalent*
if for every expression e,

(a) $F(e)$ is an expression if and only if $G(e)$ is an expression;

(b) if $F(e)$ is an expression then $F(e) \equiv_\mu G(e)$.

This is an equivalence relation on frames $F(\xi)$.
Similarly with $F(\xi_1, \xi_2)$ etc.

Both Examples 1 and 2 illustrate

Discrepancy type A: Frames $F(f, \xi)$ and $G(g, \xi)$ are μ-equivalent,
though f and g have different fregean values.

In Example 1 we are inclined to say the difference between 'in spite of' and 'notwithstanding' is purely syntactic.
How is Example 2 different?

Example 3:

ξ cleans easily.
ξ is easy to clean.
It's easy to clean ξ.
Cleaning ξ is easy.

(Dorr 1993: 'Demotional divergence')

Example 4:

ξ appears to be ill.
ξ is apparently ill.
It appears that ξ is ill.

(Dorr 1993: 'Promotional divergence')

Discrepancy type B:
Frames $F(f_1, f_2, \xi)$ and $G(g_1, g_2, \xi)$ are μ-equivalent,
though neither of f_1, f_2 have same fregean values as g_1, g_2.

In Example 3 one can intuitively match

- 'cleans' and 'to clean',
- 'easily' and 'is easy'.

This isn't always so.
Examples are easier to find if we allow ourselves to cross languages.

On(ξ) shël cherez gorod

He(ξ) went across the town on foot

Il(ξ) traversa la ville à pied

Some semantic theories explain such examples by
a set of atomic meanings not necessarily attached to words.

Different expressions (or different languages)
combine these atomic meanings in different ways.

(Dorr 1993: ‘Conflational divergence’)

Example 5:

He was angry. / / He was furious.
He was very angry. / / $\star$ He was very furious.

(Apresjan notes a similar Russian example.)

Example 6:

A win is likely. / / A win is probable.
He is likely to score. / / $\star$ He is probable to score.

Divergence type C:
When $F(f)$ and $F(g)$ are both expressions,
they have the same fregean value;
but there are a small number of frames which allow only
one of f and g.

Divergences of this kind seem to be widespread,
and not easy to handle in terms of any unitary notion of
‘meaning’.

Example 7:

- I liked / enjoyed playing tennis.
- I liked / enjoyed the chocolate cakes.
- I liked / enjoyed the Beatles song.
- I liked / enjoyed the aluminium.
- I liked / enjoyed Mary.

(Pustejovsky has further examples.)

4. A remark on translation

Quine famously claimed that
translation from one language to another is
necessarily indeterminate.

A central part of his argument is that
even when meanings of sentences have been matched,
the meanings of words in each language depend on
‘analytical hypotheses’
about how the sentences decompose into meaningful parts.

From our point of view,
Quine puts the problem in exactly the wrong place.
We have any number of ways of finding and justifying
syntactic analyses within one language.
Then fregean values are determinate *within one language*.

The problem is to compare two languages,
since in general expressions of one language
are not substitutable for expressions of the other.

Marcus Werning has a paper in press
arguing that the lifting lemma shows
there is much less indeterminacy in translation
than Quine claims.

Hannes Leitgeb has written a reply.

5. References

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