

David Lewis and formal semantics today

Angelika Kratzer

David Lewis Conference

Manchester

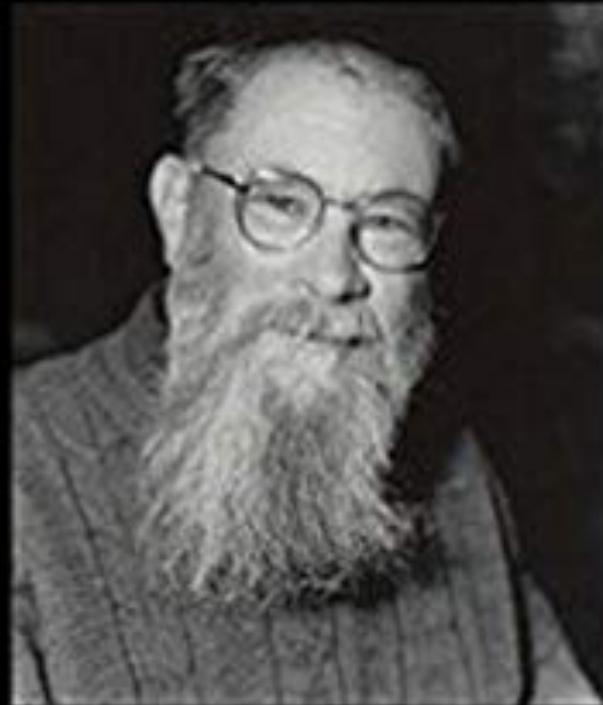
June 17, 2019

Ernie Lepore and
Matthew Stone.
David Lewis on
Convention

Barbara H. Partee
Asking What a
Meaning Does:
David Lewis's
Contributions to
Semantics.

Craig Roberts
Accommodation in a
Language Game.

A COMPANION TO DAVID LEWIS



Edited by

BARRY LOEWER AND
JONATHAN SCHAFFER

Questions for today

What were the available logical tools that a philosopher interested in natural language semantics could rely on in the late 60s?

What was David Lewis's relationship to the emerging field of generative grammar? What was his vision for a theory of grammar?

What is David Lewis to Semantics today?

A new semantics with an old toolkit

From the 40s & 50s to the late 60s
and early 70s

Formal and natural languages

A Tarski-style semantics

Who is talking about whom and when?

“Finally, the author gives a system of syntactical and semantical rules for a certain small segment of the English language, as an illustration of his general thesis that there is no difference in principle between a formalized and a natural language.”

Bar-Hillel 1952 on Church 1951

Yehoshua Bar-Hillel. 1952. Review of Alonzo Church: The need for abstract entities in semantic analysis. *The Journal of Symbolic Logic* 17(2), 137.

Alonzo Church. 1951. The need for abstract entities in semantic analysis. *Proceedings of the American Academy of Arts and Sciences*. 80(1), 100-112.

Church in 1951

“Although all the foregoing account has been concerned with the case of a formalized language, I would go on to say that in my opinion there is no difference in principle between this case and that of one of the natural languages.”

Church 1951, 106.

Montague in 1970

“There is in my opinion no important theoretical difference between natural languages and the artificial languages of logicians; indeed, I consider it possible to comprehend the syntax and semantics of both kinds of languages within a single natural and mathematically precise theory.”

Theoria, 373.

A typed λ -calculus.
Quantifiers as higher order
properties.

Church

The extensional portion of the system is built upon the following function constants: $C_{o \rightarrow o \rightarrow o}$ for material implication, $\sim_{o \rightarrow o}$ for negation, $\Pi_{(\alpha \rightarrow o) \rightarrow o}$ for the universal quantifiers, and $\iota_{(\alpha \rightarrow o) \rightarrow \alpha}$ for description functions. (The description functions take a function into truth-values as argument and yield the sole argument for which that function yields the True as value if there is such an argument, or yield a chosen member of the appropriate type if not.) More usual notation for quantification, $\lceil (\forall x_\alpha) M_o \rceil$, is defined as $\lceil \Pi_{(\alpha \rightarrow o) \rightarrow o} (\lambda x_\alpha M_o) \rceil$. The notation $\lceil A_o \supset B_o \rceil$ is used to abbreviate $\lceil C_{o \rightarrow o \rightarrow o} A_o B_o \rceil$. In some formulations, Church did not take negation as primitive, but defined $\lceil \sim A_o \rceil$ as $\lceil A_o \supset (\forall p_o) p_o \rceil$; little turns on this, however, and for the remainder of the paper, negation is taken as primitive solely for the sake of ease of comparison with other systems. Other logical operators ($\&$, \vee , \equiv , \exists) are defined as usual from negation, material implication and universal quantification. The notation $\lceil A_\alpha = B_\alpha \rceil$ is used to abbreviate $\lceil (\forall f_{\alpha \rightarrow o}) (f_{\alpha \rightarrow o} A_\alpha \supset f_{\alpha \rightarrow o} B_\alpha) \rceil$, where $f_{\alpha \rightarrow o}$ is the first variable of the appropriate type that does not occur in either A_α or B_α . In addition to standard inference rules (*modus ponens*, etc.), we also have three rules for λ -conversion:

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Kevin C. Klement. The senses of functions in the Logic of Sense and Denotation. The Bulletin of Symbolic Logic 16(2). 2010, 156.

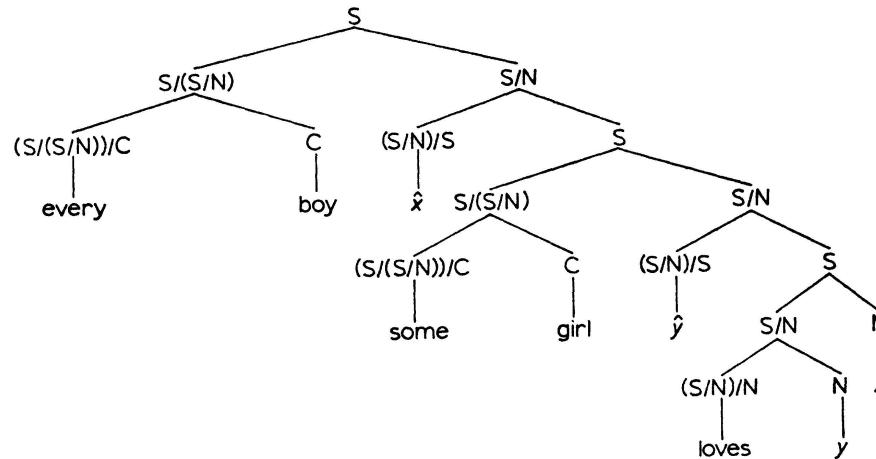
ALONZO CHURCH. *A formulation of the logic of sense and denotation.*

The distinction of *Sinn und Bedeutung* (see abstract of a paper by the author in this JOURNAL, vol. 7, p. 47) is incorporated into a logistic system. Types: ι_0 , names of individuals; ι_{i+1} , names of senses of names of type ι_i ; σ_0 , names of truth-values; σ_{i+1} , names of senses of names of type σ_i ; for any types α, β , a type $(\alpha\beta)$ of names of functions, such that if $F_{(\alpha\beta)}$ and A_β are names of types indicated by the subscripts, then $(F_{(\alpha\beta)}A_\beta)$ is a name of type α . Subscripts upon constants and variables of the system, and upon syntactical variables (bold letters) indicate the type. To represent variable or undetermined type symbols are used Greek letters, α, β , etc.; and subscript i is used upon such Greek letters to indicate the result of increasing all subscripts in the type symbol by i . As an abbreviation, parentheses are omitted under the convention of association to the left. Primitive symbols: constants $f_{\sigma_i}, C_{\sigma_i\sigma_i\sigma_i}, \Pi_{\sigma_i(\sigma_i\alpha_i)}, \iota_{\alpha_i(\sigma_i\alpha_i)}, \Delta_{\sigma_i\iota_j+i+1\iota_j+i}, \Delta_{\sigma_i\sigma_j+i+1\sigma_j+i}$; an infinite list of variables of each type; the abstraction operator λ ; parentheses. Definitions: $[A_{\sigma_0} \supset B_{\sigma_0}] \rightarrow C_{\sigma_0\sigma_0\sigma_0}B_{\sigma_0}A_{\sigma_0}$, $[(x_{\alpha_i})A_{\sigma_i}] \rightarrow \Pi_{\sigma_i(\sigma_i\alpha_i)}(\lambda x_\alpha A_{\sigma_i})$, $Q_{\sigma_i\alpha\alpha} \rightarrow \lambda x_\alpha \lambda y_\alpha (f_{\sigma_i\alpha}. f_{\sigma_i\alpha}y_\alpha \supset f_{\sigma_i\alpha}x_\alpha)$, $[A_\alpha = B_\alpha] \rightarrow Q_{\sigma_0\alpha\alpha}B_\alpha A_\alpha$, $\Delta_{\sigma_i(\alpha_i+\beta_i+1)(\alpha_i\beta_i)} \rightarrow \lambda f_{\alpha_i\beta_i} \lambda f_{\alpha_i+\beta_i+1}(x_{\beta_i})(x_{\beta_i+1}) \cdot \Delta_{\sigma_i\beta_i+\beta_i x_{\beta_i} x_{\beta_i+1}} \supset \Delta_{\sigma_i\alpha_i+\alpha_i}(f_{\alpha_i\beta_i}x_{\beta_i})(f_{\alpha_i+\beta_i+1}x_{\beta_i+1})$. Conventions for omission of brackets and punctuation by dots

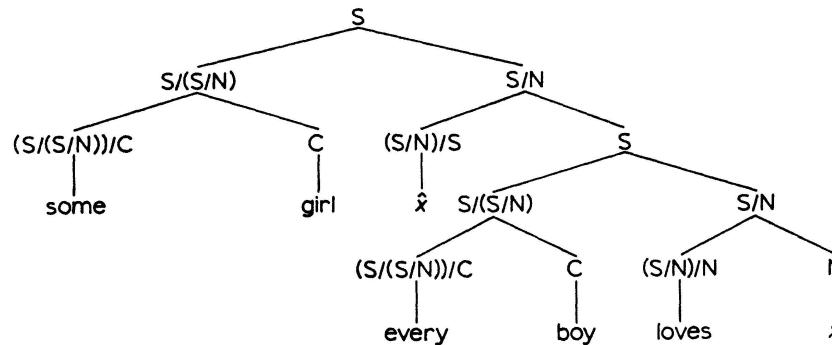
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Alonzo Church. The Journal of Symbolic Logic.
Volume 11(1). 1946, 31. A formulation of the
logic of sense and denotation.

Quantifier phrases & λ -abstraction



for the weak sense, and



General
Semantics,
47.

Possible worlds & intensions

Carnap 1947

Possible worlds in 1947

“A class of sentences in S_1 which contains for every atomic sentence either this sentence or its negation, but not both, and no other sentences, is called a state-description in S_1 ... Thus the state-descriptions represent Leibniz' possible worlds or Wittgenstein's possible states of affairs.”

Carnap. Meaning and Necessity, 9.

Intensions in 1947

Propositions

Classes of state descriptions.

Individual concepts

Functions from state
descriptions to
individuals.

Properties

Functions from
individuals to propositions.

Buried in Meaning & Necessity, § 40, 181-182.

Intensions in *Convention*

“A truth condition specifies truth values for a sentence; but in all possible worlds, not just in whichever world happens to be actual. We can interpret a constituent of any category on the same principle, by giving it an extension (appropriate to its category) in every possible world. The idea is Carnap’s; it has recently been applied to the semantics of formalized languages with intensional operators, in work by several philosophers in the tradition of Tarski and Carnap.” *Convention*, 170.

Categorial Grammars

Ajdukiewicz 1935, Bar-Hillel 1964

General Semantics

$\langle a$	$(S/(S/N))/C \rangle$	$\langle \text{pig} \quad C \rangle$
$\langle \text{believes}$	$(S/N)/S \rangle$	$\langle \text{piggishly} \quad (S/N)/(S/N) \rangle$
$\langle \text{every} \quad$	$(S/(S/N))/C \rangle$	$\langle \text{Porky} \quad N \rangle$
$\langle \text{grunts} \quad$	$S/N \rangle$	$\langle \text{something} \quad S/(S/N) \rangle$
$\langle \text{is} \quad$	$(S/N)/N \rangle$	$\langle \text{the} \quad (S/(S/N))/C \rangle$
$\langle \text{loves} \quad$	$(S/N)/N \rangle$	$\langle \text{which} \quad (C/C)/(S/N) \rangle$
$\langle \text{Petunia} \quad N \rangle$		$\langle \text{yellow} \quad C/C \rangle$

General Semantics, 21.

Modeling compositionality

If the denotations of linguistic expressions are functions that directly correspond to syntactic categories in a categorial grammar, all semantic composition amounts to functional application. No semantic projection rules are needed.

Framework neutrality

“I claim that whatever familiar sort of base component you may favor on syntactic grounds, you can find a categorial base (i.e. a suitable part of the system of meanings, generated by a suitable chosen lexicon) that resembles the base you favor closely enough to share its attractive properties.” General Semantics 39.

A transformation free grammar

“A transformation-free categorial grammar is a special case of a categorially based transformational grammar. It has a transformational component with no transformations or global constraints, so that the derivations therein are all and only those sequences $\langle p_1 \rangle$ consisting of a single phrase marker.” General Semantics, 37.

Assessment

By the time David Lewis began working on natural language semantics there was already a strong sense that natural languages could be given a Tarskian-style semantics, and all the essential tools used in formal semantics today were in place. This provided the shared background and starting point for subsequent work by Lewis, Montague, Parsons, and Cresswell in the late sixties and early seventies.

A vision for grammar in *Convention* 1969

Syntax

The linguist's job

The job of linguists is to cut down the range of possible grammars to those that are realistic models of the human faculty for language.

“A good deal of recent effort in linguistic theory has been devoted to finding a suitable normal form for grammars.” ... “See, for instance, Noam Chomsky, *Aspects of a Theory of Syntax* ...”

p. 165.

Division of labor

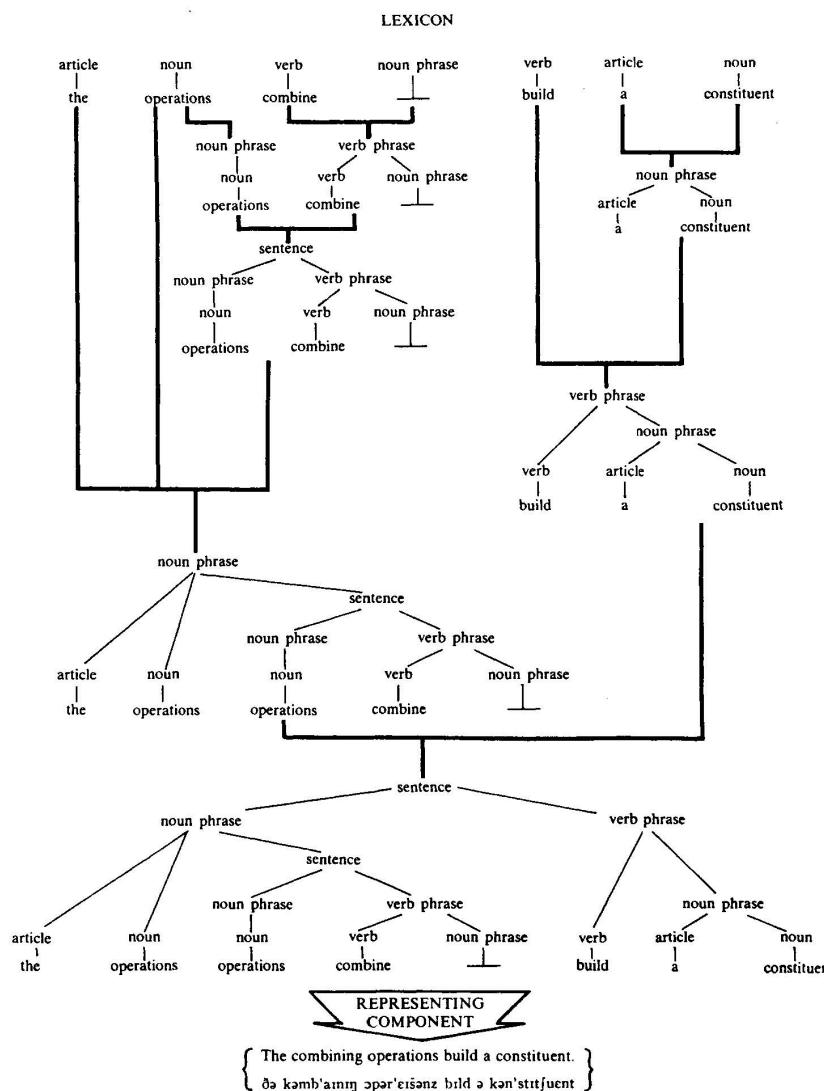
“It will do us no harm to have many extra entities counting as possible languages as well as the ones we really want ... But we must bear in mind that languages without grammars – or without grammars of whatever turns out to be the appropriate normal form – are called possible languages only because we have been too lazy to rule them out.” Convention. Page 165.

Blueprint for possible grammars

“Let me nevertheless try to say how one sort of grammar for a possible language \mathcal{L} might work. I distinguish three parts of the grammar, called the lexicon, the generative component, and the representing component.” Convention. Page 165

The components of a grammar

- The lexicon, elementary constituents indicating their category.
- A generative component: a finite set of combining operations operating over constituents of given categories.
- A representing component: Spells out the output of the generative component, may or may not move, delete, add material.



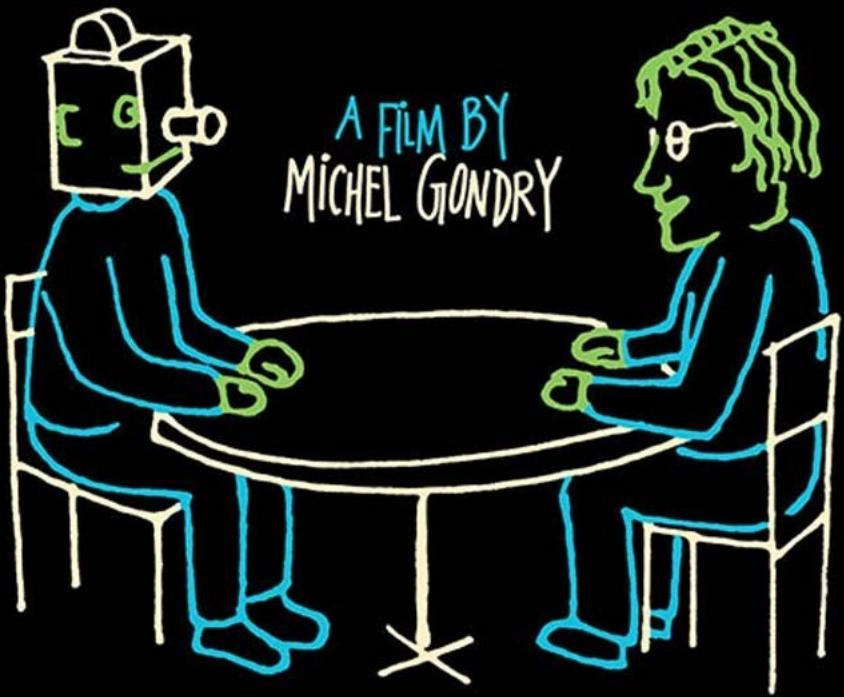
Constituent structure matters

Lewis presupposes, as any syntactician would, that a representation of constituent structure is crucial for any grammar for a natural language. Montague's syntax, curiously, has no systematic representation of constituent structure.

IS THE MAN WHO IS TALL HAPPY?

AN ANIMATED CONVERSATION WITH
NOAM CHOMSKY

FROM THE DIRECTOR OF
“ETERNAL SUNSHINE OF THE SPOTLESS MIND”



A FILM BY
MICHEL GONDRY

Structure dependence

- (1) a. The man is happy.
- b. Is the man happy?

Rule for question formation: Move the 1st instance of the finite verb to the beginning of the sentence.

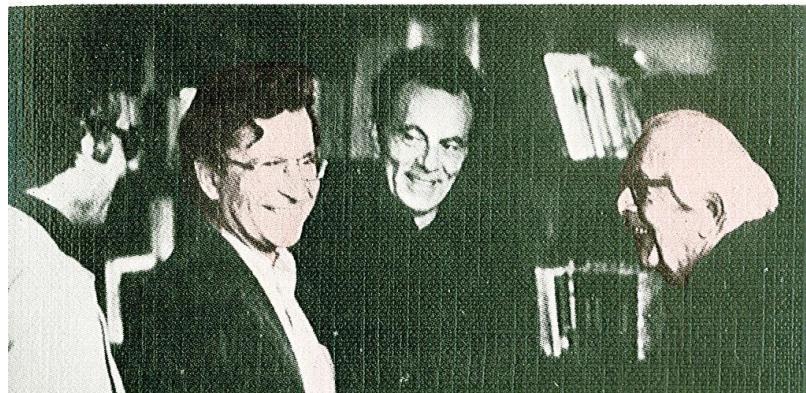
Structure dependence

- (2) a. The man who is tall is happy.
b. * Is the man who tall is happy?

Wrong rule for question formation: Move the 1st instance of the finite verb to the beginning of the sentence. You need to move the highest finite verb. But that requires a notion of phrase structure.

Centre Royaumont pour une science de l'homme

TEORIAS DA LINGUAGEM TEORIAS DA APRENDIZAGEM



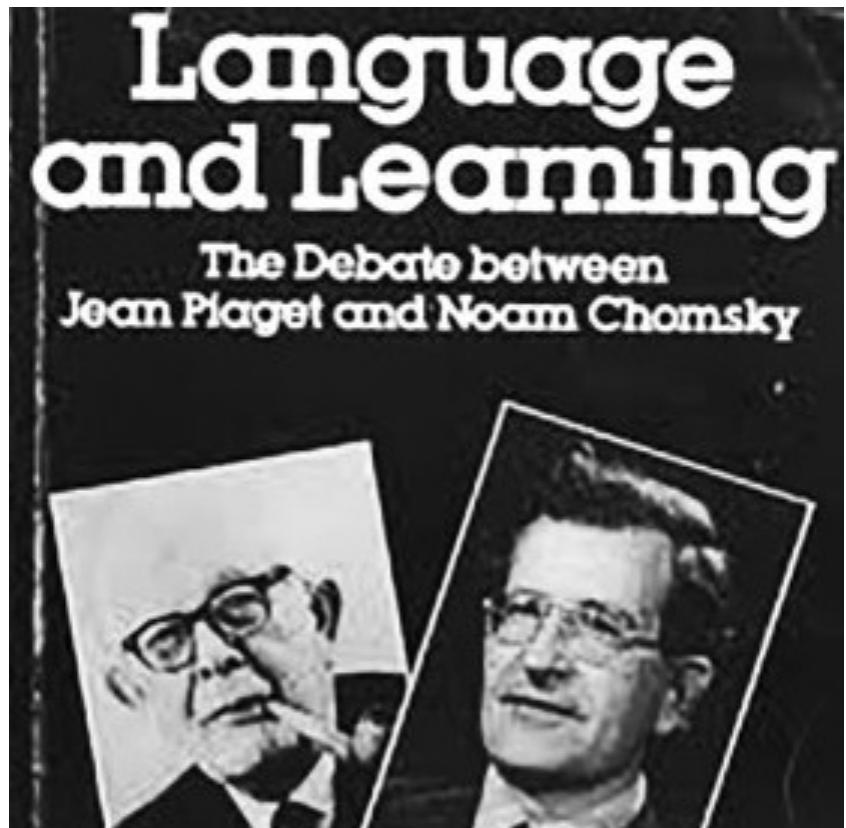
O debate entre Jean Piaget & Noam Chomsky

com a participação de

*Scott Atran Jacques Monod
Gregory Bateson Seymour Papert
Norbert Bischof Jean Petitot
Guy Cellérier Massimo Piattelli-Palmarini
Jean-Pierre Changeux David Premack
Antoine Danchin Hilary Putnam
Dieter Düttling Dan Sperber
Jerry Fodor René Thom
Maurice Godelier Stephen Toulmin
Bärbel Inhelder Anthony Wilden
François Jacob Thomas de Zengotita
Jacques Mehler*



Editora Cultrix
Editora da Universidade de São Paulo



No representation of phrase structure

every man loves a woman such that she loves him, 10, 0

every man, 0

man

he₀ loves a woman such that she loves him₀, 4

he₀

love a woman such that she loves him₀, 5

love

a woman such that she loves him₀, 2

woman such that she loves him₀, 3, 1

woman

he₁ loves him₀, 4

he₁

love him₀, 5

love

he₀

From PTQ. No representation of constituent structure.

Partee 1973

Partee proposed a crucial addition to Montague's syntax: To assign to each generated expression a labeled bracketing, thereby representing not just the derivational history of a sentence, but also its constituent structure. Journal of Philosophical Logic 2, 521.

A vision for grammar in *Convention* 1969

Semantics

Semantic component

- Assignment of intensions to lexical items.
- A mechanism that pairs each combining operation that builds a new constituent ξ out of $\xi_1 \dots \xi_k$ with a projection operation deriving an interpretation for ξ .

Compositional interpretation

“As the combining operations build up infinitely many larger and larger constituents, starting with the lexical elements, the corresponding projection operations work in parallel to derive interpretations for those constituents, starting with interpretations of the lexical elements.”
Convention, page 269.

Agreeing with Katz 1966

“I have subscribed to Katz’s account of the way in which a grammar derives interpretations for a sentence by starting with interpretations for lexical elements, using projection operations to derive interpretations for larger and larger constituents, and finally handing over interpretations from sentential constituents to the sentences representing them.” Convention, page 171-72.

Disagreeing with Katz

“But I have not endorsed Katz’s account of the nature of these interpretations; that is a separate question. Katz takes them to be expressions built out of symbols called “semantic markers” which represent “conceptual elements in the structure of a sense.” I find this account unsatisfactory, since it leads to a semantic theory that leaves out such central notions as truth and reference.”

Convention, page 171.

Adding indexicality

“Montague and Scott propose a unified treatment of intension and indexicality in which extensions are assigned relative to points of reference: combinations of a possible world and several relevant features of context – a time, place, speaker, audience, etc. “ Convention, page 172.

Assessment

The young David Lewis proposed a blueprint for a model of grammar that reconciled the essence of a generative approach to syntax with the essence of a compositional, truthconditional, semantics. All of that was done in just a few pages of a philosophical book on social conventions.

Formal semantics for natural languages today

David Lewis vs. Montague



Founding fathers

Founding fathers & founding stories

Disciplines, like nations and cities, are said to have founding fathers and founding stories.

Considered founding father (or mother)

Biology [edit]		
Field	Person/s considered "father" or "mother"	Rationale
Bacteriology	Robert Koch / Ferdinand Cohn ^[4] / Louis Pasteur	First to produce precise, correct descriptions of bacteria.
	Antonie van Leeuwenhoek ^[5]	
Biogeography	Alfred Russel Wallace	"...Often described as the Father of Biogeography, Wallace shows the impact of human activity on the natural world." ^[6]
Biology ^[note 1]	Aristotle	
Botany	Theophrastus	
Cheloniology	Archie Carr	^{[7][8][9][10][11]}
Ecology	Carl Linnaeus / Ernst Haeckel / Eugenius Warming ^[12]	Linnaeus founded an early branch of ecology that he called <i>The Economy of Nature</i> (1772), Haeckel coined the term "ecology" (German: Oekologie, Ökologie) (1866), Warming authored the first book on plant ecology. <i>Plantesamfund</i> (1895).
Entomology	Jan Swammerdam	^[13]
	Johan Christian Fabricius ^[14]	Fabricius described and published information on over 10,000 insects and refined Linnaeus's system of classification.
	William Kirby	^[15]
Ethology	Nikolaas Tinbergen Karl von Frisch Konrad Lorenz	The modern discipline of ethology is generally considered to have begun during the 1930s with the work of Nikolaas Tinbergen , Konrad Lorenz and Karl von Frisch , joint awardees of the 1973 Nobel Prize in Physiology or Medicine. ^[16]
Evolution · Natural selection	Charles Darwin ^{[17][18][19]}	<i>On the Origin of Species</i> (1859).
Genetics	Gregor Mendel	For his study of the inheritance of traits in pea plants, which forms the basis for Mendelian inheritance. ^[20]

History or founding myth?

“A New era had begun. But how does one progress from the notion of revolution to that of foundation, or from historic talk to mythical narrative?”

Bernadette Bensaude-Vincent: A founder myth in the history of sciences? The Lavoisier case.
1983.

Founding fathers & founding stories

Formal semantics is said to have a founding father, too, but the title hasn't been conferred on David Lewis.

A founding story?

“In the afternoon of 15 October 1968, Richard Montague gave a talk ... that would later be published as the first of his three classic papers on natural language semantics. ... though the broad linguistic community did not become aware of it until its popularisation in Partee (1975), the foundations of modern compositional semantics had been laid with the appearance of *English as a Formal Language.*” T. E. Zimmermann, 2019, 41.

Fathering a field of study?

“ ... a brilliant philosopher and logician, who, among other achievements, fathered formal semantics just a few years before he was murdered.” Ivano Caponigro on Richard Montague.

Fathering a field of study?

“It is clear, however, that no adequate and comprehensive semantical theory has yet been constructed, and arguable that no comprehensive and semantically significant syntactical theory yet exists. Or even a reasonable semantics for a reasonably comprehensive fragment of any natural language, with the single exception of the treatment in Montague [4] of a fragment of English.” Montague. Universal Grammar. 1970, 373.

On transformational grammar

“In particular, I believe the transformational grammarians should be expected to produce a rigorous definition, complete in all details, of the set of declarative sentences of some reasonably rich fragment of English - at least as rich as the fragments treated below or in Montague [4]- before their work can be seriously evaluated.”

Montague 1970. Universal Grammar, 374.

Defending transformational grammar

“Where will I find a precise definition of a transformational grammar? ... Montague’s been reading Aspects and Jacobs & Rosenbaum, and claims he still hasn’t the foggiest idea what a transformation is; I’d like to try to shut him up, though it’s probably not a worthwhile thing for me to try to do. ... Having read a little transformational grammar, he plans to lambaste it more than ever.”
David Lewis, letter to Partee, November 1969.
Companion to David Lewis, 329-30.

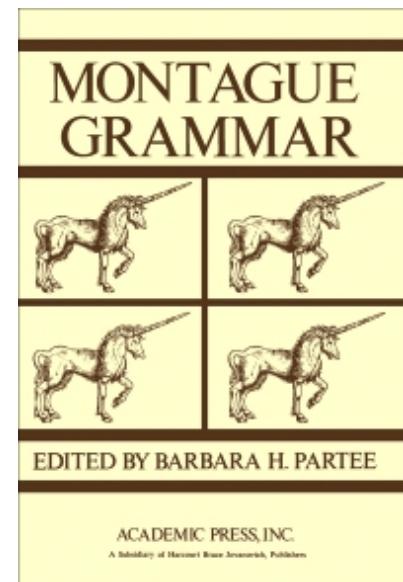
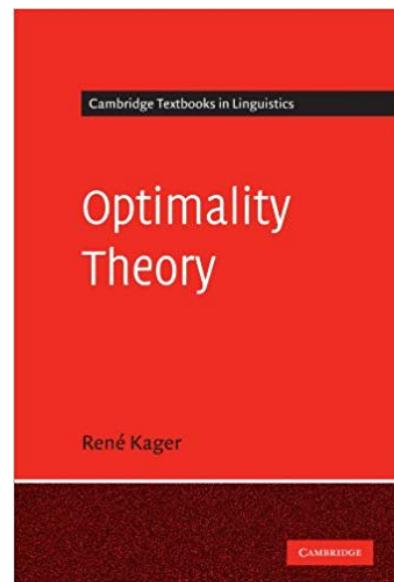
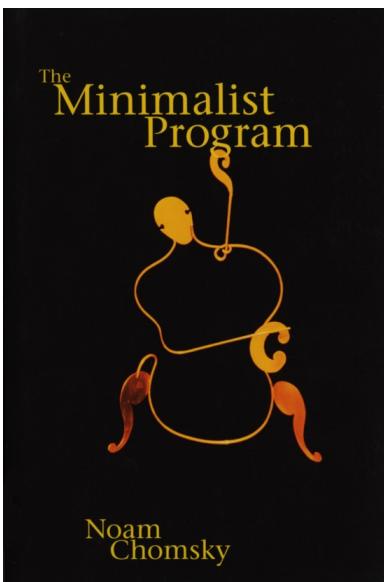
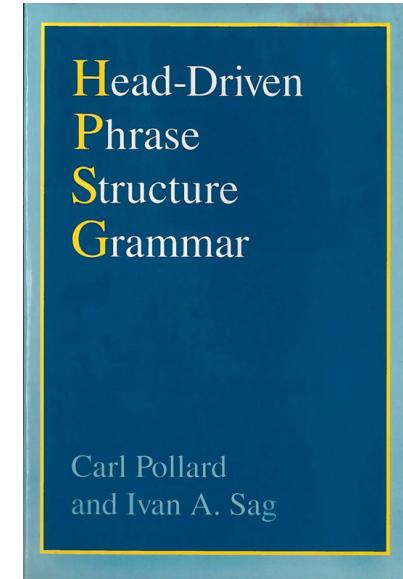
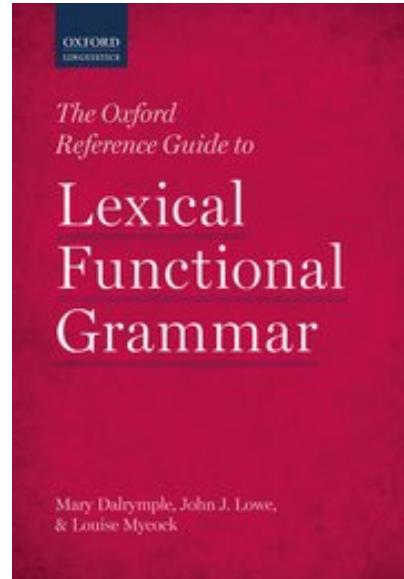
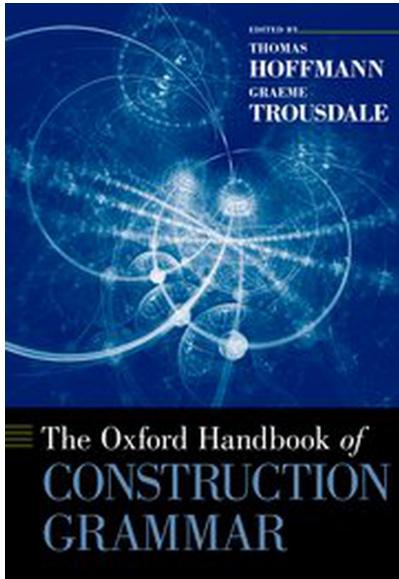
No thoughts of others?

In a letter from 1972 Lewis refers to
“Montague’s efforts to isolate his approach from
others’ thought about the same problems.”

Reported in Partee’s chapter in the Companion
to David Lewis, page 330.

New models proliferate

New models of grammar were put forward in the 70s and later, most of them targeting syntax, most of them representing some kind of opposition to the current Chomskyan model. Montague's outspoken hostility towards Chomsky fit into this picture.



How does Lewis fit in?

From his earliest work in formal semantics, David Lewis linked a truthconditional semantics to syntax in a way that is not only easily accessible to newcomers in semantics, but is also neutral with respect to the various instantiations of generative grammar that have been proposed over the years.

His unifying vision for the relation between syntax and semantics helped formal semantics to become the unified discipline it is today.

