8.

LOGICAL AND NATURAL CONNECTIVES

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1. One of the points where logical and natural languages seem
to diverge is in their respective connectives. The set of
logical connectives, interdefinable with negation (as a
so-called 'one-place connective'), such as conjunction (A),
disjunction (v) and material conditional (z), seem only in
part related with their natural language counterparts and,
or, if...then. Moreover, this latter set of grammatical
'conjunctions' contains other members such as but, although,
for, because, whereas adverbs such as so, yet, neverthe-
less should also be taken as natural conneCtIves, both
groups without corresponding connectives in classical
logics. Connectives of classical systems, it should be
recalled, are truth functional: given the truth values
(truth or falsity) of component propositions (or sentences)
they determine the over-all truth value of the compound
proposition (or sentence). Axiomatically, they have proper-
ties of commutativity, associativity, distributivity (con-
junction, disjunction) or they are transitive (conditionals).

2 The first problema arise as soon as connectives are used
in non-truth-functional contexts, e.g. with modalities.
The connectívity of two propositions a and 0 is not
normally restricted by the 'content' of a or 0; only their
truth values count, not the fact whether they are somehow
semantícally related in another way. As soon as we prefix
the box (O)--denoting 'necessity' (truth in all possible
accessible worlds)--to the compound formula, *e.g.* as
follows:0(uo $), which may also be written as a-30, where
' denotes a so-called 'strict' conditional or implica-
tion, the question arises in which respect propositions
or their values can be said to be 'necessarily' connected.
If we say, for example, that a necessarily or logically
implies $, we might want to require that this makes sense
only if W and 0 have some inherent relation, to be inter-
preted as a corresponding relation between truth values
or facts. Since there is a systematic relation between
conditional connectives and the relation of deductiva in-
ference (I--) by the deduction theorem (af-0 ml-a=0),
similar problems arise in the conditions of appropriate
deduction. If, for instance, a conclusion is logically
implied by the premisas, we may also desire to put some
constraints on the nature of the premises, e.g. that they
have at least a proposition in common with the conclusion.
The conflict with the validity of formulas such as ED(a=2),
-2=(2Da), (EA—)=5, aD(2v-2), 2D (Eva) and
((2vg)A-p)7.5, then becomes apparent, because they enable

to derive statements about the truth value of E or q (or of a relation between them), without knowing the truth value of one of them. These and other intuitive arguments have led to call these theorems the <u>paradores of material implication,</u> which seem still more paradoxical in their strict implicational versions.
In order to avoid these and related counter-intuitive properties of certain logical connectives (and deduction), several types of so-called <u>relevance logics</u> (or connective/connexive logics) have been developed, with which are associated the flanes of, among others, Ackermann, Anderson, Dunn, Belnap, Church, Gabbay, (David) Lewis, McCall, Meyer, Routley, Stalnaker, Urquhart. The main idea behind these, often rather diverse, approaches is to design axiomatic systems and/or formal semantics for relevant connectives, especially <u>relevant conditionals</u> ('normal' and strict). Intuitively, then, the antecedent of such a conditional must 'have something to do' with the consequent, for example due to a meaning relation. Similarly, of course, for deductive inference, i.e. between premises and conclusions.

Thus, we may require that a formula with a relevant conditional, E > a, corresponding to our natural language intuitions for a conditional such as <u>if...then,</u> would take truth values only if E is true (and/or "asserted").

3. The debate about logical connectives and their required relevance especially focuses on the properties of <u>entailment</u>, taken as a (semantic) relation between propositions 717: íf a II- 8, then if a is true, 8 is also (necessarily) true. In such a case, it is assume⌐, a necessary semantic dependency of the propositions must involve conceptual relations between the propositions. If this is so, we can hardly take the normal strict implication (-4) or deductive inference (1-), as the formal syntactic counterparts of entailment, because there, classically, no conceptual (intensional) constraints exist on connectivity or deduction. Hence, it is argued, we should take relevant (strict) conditionals as the syntactic expression for semantic entailment; especially if we would like to say that, in inferences, conclusions are 'entailed' by their premises, and not only 'follow logically from' their premises. Since we here talk 'about' conditions on deduction, the notion of relevance, as expressed in specific connectives, is also often relegated to the logical metalanguage. Much of the current work on (relevant) connectives is devoted to the construction of various entailment logics.

A crucial issue, of course, is to develop a serious formal
semantics for the various relevant or intensional con-
nect ves. The basic idea behind the different semantic ac-
counts is that the modela contain elements which enable
interpretation of propositions (sentences) <u>relative to</u>
each other--instead of freely assigning them independent
values as in classical systems. Thus, we may require that
the respective possible worlds in which the propositions
are interpretad are somehow 'connected', e.g. with respect
to a third possible world, a (communicative) context, or
a set of propositions (information).

Similarly, if a proposition 8 should be interpreted
relative to (the interpretation of) a, we may let some
function, determined by a, select the possible worlds
where 8 may have truth values. One of the many open
   problems, both axiomatical and semantic, is a unified
treatment of the various relevant or in general intensional
connectives, including conjunction and disjunction, and a
fundamental semantic device for 'relative interpretations'.
Perhaps recent developments in intensional logic may lead
to a solution for these problems.

4. Since, in natural language and theories about it, we are
not only interested in truth conditions or other extensions,
but also in the meaning structure of propositions and in
their intensional inter-relations, <u>natural connectives</u>
as those mentioned aboye, essentially seem to require a
formal reconstruction in terne of 'relevant' connectives.
This holds for all connectives, including conjunction and
disjunction, even if, occasionally and under specific con-
straints, we may connect two propositions which are neither
conceptually nor referentially related. More in general,
it should be required that <u>conditions of connection</u> are
satisfied by each compound sentence (and connected sequences
of sentences in a discourse, for that matter). Although
meaning relations may be involved in the coherente of com-
pound sentences and discourse, the connection conditions
rather depend on the relations between the values of the
propositions in some possible world(s), i.e. on the
relations between the 'facts'. These facts, in general,
should actualize the sane conceptual range in semantic
space--i.e. the fact-concepts, or propositions, must belong
to the same <u>range.</u> Relative to a given possible world,
point of view or topic of discourse the facts must be
<u>compatible</u> in related (similar, identical, successive)
worlds. Whereas the weakest forro, then, of natural con-
ditionals satisfying these conditions is 'possibility'
 (e.g. in co-occurrence or 'allow'-condition) as expressed
by conjunctions, the stronger connection is that of pro-

bability (likelihood) as in concessives such as but (where a
but S, implies if a then normally [in most possible worlds] —
:ḻr and finally necessity as in causals and implications such
as because, for, so, therefore etc., where the antecedent
logically, physically, biologically, psychologically or
socially 'neccessitates' the consequent in a certain possible
world (or in most, or all possible worlds). Necessitation,
in such a case, holds, we will say tentatively, in a world
w. where a is true, if $_s$ is true in all successive worlds w•
 which can be reached from w. (immediately, or sometimes
indirectly). If Peter falls from his chair, this may cause
that he breaks his neck, necessarily in that course of events
 (given the precise physical, and other circumstances), but of
course not in all possible worlds where Peter falls from his
chair, as would physically be the case for the connection
between 'rising temperature (aboye value x)' and 'melting of
butter'.
Among these referential and intensional conditions on the
connectivity of propositions, we have briefly mentioned that
of 'information' or 'topic'. This means that not only the
facts or the meanings must be related, but this must be so
relative to what is known (by the speech participants) in a
certain context and by the topic of discourse at issue, i.e.
one or more propositions defining the 'over-all' meaning of
compound sentences and discourse (macro-structure). Resides
the conceptual constraints on the topicality of propositions,
we have other conventional constraints related to the knowl-
edge of the participants about 'typical structures' of the
world (e.g. that we order food in restaurants, take an
umbrella when it rains, etc.--dependent on culture). Such
conventional knowledge structures are called frames.
In a formal semantic of natural connectives we should build
in these specific conditions and constraints on natural
connection. But at the moment little insight exists in the
possible forms such an extension of formal semantics should
take, let alone the account of the pragmatic connection con-
ditions.

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