cavities are almost equal in length and are at right angles.[4]

The functional aspects of the sounds of human speech that the human vocal tract make possible are discussed in Lieberman et al. (1972) and Lieberman (1973). The general question of the evolution of language in relation to the functional aspects of human speech and the details of fossil reconstruction are discussed in Lieberman (1975).

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## Karttunen on Possibility

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Within the intriguing two-dimensional theory of truth developed by Hans Herzberger (1973), it is possible to explain the fact observed by Lauri Karttunen (1971, 1973) that the argument from "Possible *A*" to *B* is valid, if *A* presupposes *B*. As explained below, the inference is just like that from *A* to *B* when *A* presupposes *B*, and it can be generalized to other modal contexts. The considerations of context and conventional implicature suggested by Thomason (1973) are unnecessary. Further, by stepping up to four values and two dimensions we may preserve both the

[4] However, the larynx would be positioned too far back because of the error in the angulation of the styloid process that follows from Morris's estimate. Morris's comments also ignore the long distance between the vertebral column and the palate of the fossil skull that is an osteological consequence of the larynx positioned almost in line with the oral cavity with the pharynx positioned *behind* the larynx. The total skeletal complex has to be considered!

inference and the cumulative hypothesis for presuppositional projection, a combination doubted by Karttunen.

The basic ideas in Herzberger's semantics are two. First, to say of a sentence that it is true is to say both that it corresponds to the world and that all its presuppositions are themselves true: truth equals correspondence plus presuppositional satisfaction. Second, a valid argument preserves correspondence, not truth. Formally, sentences are assigned both correspondence and presuppositional satisfaction values. Correspondence values do not depend on semantic deviance and conform to the classical matrix. Presupposition values, however, depend on truth and hence on correspondence values.

Within this context we explain the above inference as follows. We give $\Diamond A$[1] the usual interpretation but limit it to correspondence: $\Diamond A$ corresponds in a world if and only if (iff) $A$ corresponds at some world or other. In addition, we incorporate Karttunen's observation that $A$ and $\Diamond A$ have the same presuppositions by requiring that $A$ is presuppositionally satisfied iff $\Diamond A$ is. It follows that $\Diamond A$ implies $B$ if $A$ presupposes $B$. For let $\Diamond A$ be true. Then the presuppositions of $\Diamond A$ are all true. But $B$ is among these, so $B$ is true.

Let the set of formulas be inductively defined over a denumerable set of atomic formulas such that $\neg A$, $\Diamond A$, and $A\&B$ are formulas if $A$ and $B$ are. Let $\mathscr{W}$ be the set of all $w$ such that for some $v$ and $v$,

(1) for any atomic formula $A$, $v(A)$, $v(A) \in \{0, 1\}$;
(2) $v(\neg A) = 1$ if $v(A) = 0$; $v(\neg A) = 0$ otherwise;
$v(A\&B) = 1$ if $v(A) = v(B) = 1$; $v(A\&B) = 0$ otherwise;
$v(\Diamond A) = 1$ if $\exists v'$, $v'(A) = 1$; $v(A) = 0$ otherwise;
(3) $v(\neg A) = 1$ if $v(A) = 1$; $v(\neg A) = 0$ otherwise;
$v(A\&B) = 1$ if $v(A) = v(B) = 1$; $v(A\&B) = 0$ otherwise;
$v(\Diamond A) = 1$ if $v(A) = 1$; $v(\Diamond A) = 0$ otherwise.
(4) $w(A) = \langle v(A), v(A)\rangle$.

[1] Symbols:

| | |
|---|---|
| $\neg$ | is for negation, read "not" |
| $\Diamond$ | is for possibility, read "possibly" |
| $\mathscr{W}$ | stands for all possible four-valued valuations or possible worlds |
| $v$ | stands for a presuppositional two-valued valuation |
| $v$ | stands for a two-valued correspondence valuation |
| $\forall$ | is the universal quantifier, read "for all" |
| $\exists$ | is the existential quantifier, read "for some" |
| $\langle\,\rangle$ | are ordered pair corners from set theory |
| $\Vdash$ | is the logical or semantic entailment relation read "implies" |
| $\models$ | is a special entailment relation defined in Herzberger's system also read "implies". |

Abbreviate $\langle 1, 1\rangle$ by $T$, $\langle 0, 1\rangle$ by $F$, $\langle 1, 0\rangle$ by $t$, and $\langle 0, 0\rangle$ by $f$. The values on the first dimension of members of $\mathscr{W}$, those on the second, and the compound values of $\mathscr{W}$ conform to tables I, II, and I × II respectively:

I

| | | & | 01 |
|---|---|---|---|
| 0 | 1 | | 00 |
| 1 | 0 | | 01 |

II

| | | & | 01 |
|---|---|---|---|
| 0 | 0 | | 00 |
| 1 | 1 | | 01 |

I × II

| | | & | T | F | t | f |
|---|---|---|---|---|---|---|
| $T$ | $F$ | | $T$ | $F$ | $t$ | $f$ |
| $F$ | $T$ | | $F$ | $F$ | $f$ | $f$ |
| $t$ | $f$ | | $t$ | $f$ | $t$ | $f$ |
| $f$ | $t$ | | $f$ | $f$ | $f$ | $f$ |

The result of identifying $t$ and $f$ in I × II yields the weak connectives of Kleene (1938). Let $D = \{T, t\}$ be the set of designated values, and let $A$ semantically entail $B$, briefly $A \Vdash B$, iff $\forall w \in \mathscr{W}$, if $w(A) \in D$, then $w(B) \in D$. Observe that $\Vdash$ is perfectly classical because the second dimension does not affect designation and the first obeys the classical tables. Let us say $A$ presupposes $B$ iff $\forall w$, $w(A) \in \{T, F\}$ only if $w(B) = T$. We define now a second entailment relation based on the notion of truth: $A \vDash B$ iff $\forall w$, $w(A) = T$ only if $w(B) = T$.

*Theorem:* If $A$ presupposes $B$, then $\Diamond A \vDash B$. *Proof:* Let $w(\Diamond A) = T$. Then for some $v$, $v(\Diamond A) = 1$. Hence $v(A) = 1$ and $w(A) \in \{T,F\}$. Hence $w(B) = T$.

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