grammatical mode, or tense and aspect. There is also an increased interest among cultural geographers in discourse analysis and social theory. Hence, these multimodal theorists now see political life as a complex process by which meaning is produced across many modes; and therefore, the analysis of the language of politics is beginning to incorporate methods, and theoretical tools from disciplines that only a few years ago were rarely referenced by linguists and discourse analysts.

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Multivalued Logics

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Logic is the formal discipline establishing *calculi of entailments*. A sentence, or set of sentences, A *entails* a sentence B just in case in all cases where A is true, B must also be true on account of the meanings of A and B (on analytical grounds). Since meanings are varied and manifold, it is, in general, not possible formally to *compute* entailments: most entailments are recognized intuitively. Aristotle discovered, however, that in some cases entailments can be computed with the help of specific words, the logical constants, whose semantic properties are precise enough to allow for formal computation. The logical constants usually recognized are *all* and *some* for quantification theory (predicate logic), and *not*, *and*, *or,* and *if* for both predicate and propositional logic. When an entailment is computable by virtue of one or more of the logical constants, it is a *logical* entailment.

Standard modern logic is firmly based on the Aristotelian *Principle of Bivalence*, also known as the *Principle of the Excluded Third* (PET), which says that (a) all propositions always have a truth value, and (b) there are exactly two truth values, 'true' (T) and 'false' (F), without any transitional values, and without any values outside T and F. Some logicians have queried the validity of PET with regard to natural language.

Strawson's attempt at infringing PET (Strawson, 1950, 1952) is most widely known among linguists and semanticists. His 'gapped bivalent logic' keeps the values T and F but introduces the possibility of a 'truth-value gap' for sentences without any truth value. Strawson thus violated subprinciple (a) of PET, in that he allowed for propositions (sentences) without a truth value. He never provided a formal account of this logic, but one surmises that it is identical to standard propositional calculus, except that a logically complex sentence lacks a truth value when at least one of the component propositions (sentences) does so: lack of truth value is 'infectious.' Lack of truth value, in Strawson's analysis, is the fate incurred by sentences that suffer from presupposition failure. The main empirical problem with this analysis (besides problems of a metalogical nature) is that such sentences are generally judged to be false, while their negations are judged to be true (*see* **Presupposition**).

Other logicians have developed nonbivalent logics that infringe subprinciple (b) of PET. The linguistic justification for such logics is the consideration that if the predicates 'true' and 'false' in natural language allow for degrees, or if there are different kinds of truth and/or falsity, then it should be possible to devise logical calculi reflecting the different degrees or kinds of truth and falsity. It has turned out that this is not only possible but also highly enlightening.

Apart from PPC_3, to be discussed in a moment, the main developments in formal multivalued logics occurred between the 1920s and the 1950s, as an outflow of the formalization of logic that had just occurred, with C. S. Peirce as an early precursor (Rescher, 1969: ch. 1). The multivalued logics developed in that period are all restricted to propositional calculus – that is, to truth tables for the logical constants (the so-called connectives) *not*, *and*, *or*, and *if*. Extensions to predicate logic, where the logic of the quantifiers *all* and *some* is defined, were not attempted. Moreover, all multivalued logics (apart from Strawson's gapped bivalent logic) developed during the period mentioned work with a value 'intermediate' or 'undefined.' They were devised to provide logical accounts for future contingency (J. Łukasiewicz), modalities (C. S. Peirce), intuitionism (A. Heyting), logical paradoxes (D. A. Bochvar), or undecidable mathematical statements (S. C. Kleene). There is a great deal of overlap among the logical machineries proposed by these authors.

The more interesting multivalued logics are extensions of standard bivalent logic, in the sense that there is, for each type of extension L^m, an algorithm that generates the precise form of L^m for any desired number of truth values in such a way that the theorems of standard logic, with the operators ¬, ∧, and ∨, are preserved. That is, they are closed under {¬, ∧, ∨}. One may repeat what Peirce wrote in a letter to William James in 1909 (Rescher, 1969: 5): "The recognition [of multivalued logics] does not involve any denial of existing logic, but it involves a great addition to it."

The best known, and most fruitful, system is Kleene's trivalent logic (Kleene, 1938, 1952), with the values 'true' (T), 'false' (F), and 'intermediate' (I). This logic thus violates subprinciple (b) of PET as defined earlier. Kleene's truth tables are as shown in Figure 1, with '∼' for Kleene's trivalent negation, '∧' for conjunction, and '∨' for disjunction (the implication is definable as '∼A ∨ B.' One sees that the negation '∼' turns T into F and vice versa, and leaves I unaffected; conjunction selects the lowest of the values of the component sentences A and B (T > I > F); disjunction selects the highest of the values of A and B. This accounts for the fanlike arrangement of the values T, I, and F in the tables for conjunction and disjunction. Kleene's calculus has no operator turning I into T. Such an operator can be added to the system by letting '?A' produce T for I, and F for both T and F. The standard bivalent negation operator '¬' also finds a place in this system, in that it turns T into F and all other values into T (it simply says that A is not true). One notes that ¬ is the disjunction (union) of ∼ and ?: ∼A ∨ ?A ≡ ¬ A.

The algorithm for generating Kleene logics with an unlimited number of values is simple. For an *n*-valued Kleene logic ($n \geq 2$), let the highest value be T, and the lowest F. All intermediate values I^i ($i \leq n-2$) are optional and are ranked between T and F. Then ∼ turns T into F and vice versa, and leaves all I^i unaffected; ∧ selects the lowest of the values of A and B; ∨ selects the highest of the values of A and B. $?^i$ turns the intermediate value I^i into T and all other values into F. An extension of the value I to an infinite number of intermediate values generates the multivalued 'fuzzy' logic of Zadeh (1975). Standard bivalent logic is merely the minimal variant of this Kleene family of logics, with $n = 2$ and without any intermediate values.

Although Kleene developed his logic with a mathematical purpose in mind (to account for undecidable mathematical statements), it is of specific linguistic interest in that it appears to account for cases of vagueness, in the sense of neither clearly true nor clearly false, as when one can say of a dimly lit room either that it is dark or light.

A different trivalent propositional calculus, likewise extendable to any number of truth values, was developed in Seuren (1985) for the specific purpose of capturing the logical properties of presupposition. This calculus, *trivalent presuppositional propositional calculus*, or PPC_3, distinguishes between two kinds of falsity. For logically atomic sentences, radical falsity (F2) ensues when there is presupposition failure; minimal falsity (F1) ensues when all presuppositions

A	~A	?A	¬A
T	F	F	F
I	I	T	T
F	T	F	T

∧		B: T	B: I	B: F
A	T	T	I	F
	I	I	I	F
	F	F	F	F

∨		B: T	B: I	B: F
A	T	T	T	T
	I	T	I	I
	F	T	I	F

Figure 1 Truth tables of Kleene's trivalent propositional calculus.

A	~A	≃A	¬A
T	F1	F1	F1
F1	T	F1	T
F2	F2	T	T

∧ (A \ B)	T	F1	F2
T	T	F1	F2
F1	F1	F1	F2
F2	F2	F2	F2

∨ (A \ B)	T	F1	F2
T	T	T	T
F1	T	F1	F1
F2	T	F1	F2

Figure 2 Truth tables of PPC_3.

are true but an update condition of the main predicate is not satisfied (*see* **Presupposition**; **Lexical Conditions**). Thus, a sentence like *The present queen of England is bald* is valued F1, because no presupposition is violated, but the person in question happens not to be bald. By contrast, a sentence like *The present king of France is bald* is valued F2 because the existential presupposition that there is such a person is not fulfilled.

The first proposal to this effect was made in Dummett (1973: 421), also on grounds of presuppositional phenomena, though more from a philosophical than from an observational point of view: Dummett does not provide an actual trivalent logical system incorporating the two kinds of falsity. He also considered the possibility of two kinds of truth – a suggestion that should be taken seriously but is not elaborated here. The logical system that corresponds to Dummett's suggestion is PPC_3. Yet it must be emphasized that PPC_3 does not *define* presupposition in natural language. Presupposition is defined by its purely linguistic and semantic characteristics (*see* **Presupposition**). PPC_3 is merely meant as a description of the epiphenomenal logical properties of presupposition.

In PPC_3 there are two negations, a *minimal negation* '$\sim$' turning T into F1, F1 into T, and leaving F2 unchanged, and a *radical negation* '$\simeq$' turning both T and F1 into F1 and F2 into T. The standard bivalent negation $\neg$ can be added for good measure: it turns T into F1 and all other values into T. Moreover, the conjunction $\wedge$ selects the lowest ($T > F1 > F2$), and the disjunction $\vee$ selects the highest of the component values. This gives the tables of Figure 2, again with the typical fanlike arrangement for conjunction and disjunction observed in Figure 1.

The algorithm for extension to n truth values with one value T and n–1 values F^i ($i \geq n-1$) is again simple. Define a specific negation '$\sim^i$' for each kind of falsity. $\sim^i$ turns F^i into T, all higher values ($T > F^1, \ldots > F^{n-1}$) into F^1 and leaves all lower values unaffected. $\wedge$ selects the lowest, and $\vee$ selects the highest of the component values. Again, standard bivalent logic is merely the minimal variant of this family of logics, with the values T and F^1 and the one specific negation $\sim^1$, which then equals standard $\neg$. Again, $\neg$ is the disjunction (union) of $\sim^1$ to $\sim^{n-1}$: $\sim^1 A \vee \sim^2 A \vee \ldots \vee \sim^{n-1} A \equiv \neg A$.

The two families – the Kleene family and the PPC_n family – can be combined into one large family with any number of intermediate values between any two values of the PPC_n system. Which selection of this wealth of possible logical options suits the facts of natural language best is an empirical question. The theory of language benefits substantially from this widening of the range of available options. Before multivalent logics were discovered, there was only one option for the logic of the propositional operators, the standard bivalent system, and there was, therefore, no empirical question because there was no choice. The extension of logical space in various directions has given rise to the empirical question of what the correct logic of language amounts to.

Research into the empirical question just formulated is relatively recent. What has been found so far suggests that a system like PPC_3 with an infinite set of Kleenean intermediate values between T and F1 appears to stand a reasonable chance of providing a suitable frame for an adequate analysis and description of the logical properties of the propositional connectives, including negation, in human language.

See also: Discourse Semantics; Lexical Conditions; Presupposition; Propositional and Predicate Logic: Linguistic Aspects; Vagueness: Philosophical Aspects.

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Munda Languages

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'Munda' is a group of languages belonging to the Austroasiatic language family spoken in eastern and central India, primarily in the states of Orissa, Jharkand, Bihar, and Madhya Pradesh and in adjacent areas of West Bengal, Maharashtra, and Andhra Pradesh. Some Munda speakers are found in expatriate or diaspora communities throughout India, Nepal, and western Bangladesh as well. In earlier literature, Munda is often referred to as Kol or Kolarian.

The Munda language family recognizes a major split between a North Munda and a South Munda subgroup. Within the North Munda subgroup, there is a binary opposition between Korku and a large group of Kherwarian languages, which is perhaps more properly described as a dialect continuum. Kherwarian includes both the largest of the Munda languages, Santali, with nearly 7 million speakers, as well as some of the smallest, such as Birhor, with under 1000. Other noteworthy North Munda languages include Mundari and Ho, each with approximately 1 million speakers, and smaller languages such as Agariya, Asuri, Bhumij (Mundari), Karmali Santali, Koraku, Korwa, Mahali, and Turi. Publications may be found in the larger of the Kherwarian languages (Mundari, Ho, Santali), including a range of Santali publications in a native orthography (the Ol' Cemet script). Short wave radio broadcasts are also available in Santali. The newly founded 'tribal' state of Jharkhand has a Munda-speaking majority and is lobbying to have some form of Kherwarian declared another state language of India.

The South Munda subgroup is older and more internally diversified than North Munda. At least the following languages belonging to this subgroup: Sora (Savara), Juray, Gorum (Parengi, Parenga), Gutob (Gadaba, Bodo), Remo (Bonda, Bondo), Gtaʔ (Gataʔ, Didey), Kharia, and Juang. In terms of further subgrouping, it is clear that Sora and Gorum form a branch of their own, as do the closely related Gutob and Remo. Gtaʔ, which is properly speaking two separate languages: the poorly known Hill Getaʔ and Plains/Riverside Getaʔ, has been traditionally linked at a slightly higher taxonomic level with Gutob-Remo (so-called Gutob-Remo-Gtaʔ), and Kharia and Juang have been linked together in a branch as well. These latter two classifications are tenuous and remain to be adequately demonstrated (Anderson, 2001). South Munda languages range in total number of speakers from 300 000 or more Sora speakers to between 150 000 and 200 000 Kharia speakers to Gutob with approximately 30 000–50 000 total speakers and Juang with around 15 000 speakers. The remaining South Munda languages have around 2000–4000 speakers each.

Typologically speaking, all Munda languages are moderately to extensively agglutinating, show SOV basic clause structure, and possess preglottalized or unreleased 'checked' consonants. This latter feature is quintessentially Munda, and readily distinguishes Munda languages from the surrounding languages of the subcontinent.

The shift to SOV word order from SVO to VSO may be attributed to influence from Indo–Aryan or Dravidian languages (Anderson, 2003), which varies from moderate to strong in individual Munda languages. Generally speaking, the southernmost South Munda languages show the greatest degree of structural influence from local tribal Dravidian and lexical influence from the local tribal Indo–Aryan (e.g., Desia/Kotia Oriya). In addition, Kharia has been heavily influenced by Kherwarian North Munda languages such as Mundari.

Kherwarian North Munda languages are characterized by a high degree of morphological complexity, standing out even within the morphologically rich languages of South Asia. Among the most noteworthy characteristic features of Kherwarian verb structure is