Best wishes

Brian

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the state of the art

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6. Functionalist approaches to grammar

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In his history of linguistics, R. H. Robins (1968) traces the beginning of modern linguistic theory back to Ferdinand de Saussure's famous distinction between *langue*, "language," and *parole*, "speech." *Parole* refers to the speech behavior of individuals. *Langue* is an emergent system that exists *between* individuals. Although the linguist must use the data of speech to discover the properties of language, the language system itself need not exist in the behavior or the mind of any given individual. Indeed, the justification for a separate linguistic science is based upon this distinction. Because linguists are not interested in actual speech behavior (except as a means to an end), they need not concern themselves with states, motives, or underlying processes involved in the production and understanding of speech. Those factors, though interesting, are the domain of psychologists and philosophers of mind.

The development of the relatively new field of psycholinguistics represents a systematic erosion of Saussure's distinction. Psycholinguistics was built in large measure upon Noam Chomsky's (1957) distinction between *competence* and *performance*. *Performance*, as defined by Chomsky, is essentially the same thing as Saussure's *parole*: actual speech behavior by individuals. However, *competence* is different from Saussure's *langue* in one crucial respect: Whereas *langue* is an abstract system that comes to exist between individuals, *competence* is defined as the abstract knowledge about language that is contained in the mind of individual native speakers. Thus, as explicitly stated by Chomsky (1968, p. 1), linguistics once again becomes a part of cognitive science and philosophy of mind.

Given this merger, how can we now distinguish the respective goals of linguistics and psycholinguistics? One possibility is the following division: (1) Linguistics is devoted to the *description* of language as an integrated system (competence); whereas (2) psycholinguistics is devoted to the *explanation* of language in terms of the goals and processes involved in using that system (performance). This approach was implicit in much of the psycholinguistic research of the 1960s. Transformational grammarians handed down descriptions of English as a system; psycholinguists

sought to establish the psychological reality of that system within processing and acquisition models. This period in our brief history has been amply reviewed elsewhere. As many of the original proponents of the approach (e.g., J. A. Fodor, Bever, & Garrett, 1974) now readily admit, the abstract descriptions of a transformational grammar do not translate readily into real-time processes. For example, sentences that supposedly involve six rules do not necessarily take longer to produce or verify than sentences with four rules. And although there is a rough correlation between formal complexity in the grammar and order of acquisition by children (see, e.g., Brown & Hanlon, 1970), there are also many exceptions to the acquisition sequences predicted by a model based on addition and reorganization of rules.

In the 1970s, there has been a change in the way that many psycholinguists and students of child language have used linguistic theory. Instead of *accepting* linguistic descriptions and seeking their correlates in psychological processing, many researchers have tried to formulate their descriptions of language behavior directly in processing terms. This approach characterizes much of the recent work on the cognitive and social bases of language, sociolinguistics and discourse factors, prespeech in infant communication, and context effects on language processing in adults. A survey of such research might lead to the following distinction between linguistics and psycholinguistics: (1) Linguistics is devoted to the *description* of the *forms* that are taken by particular languages, and language as a general system; whereas (2) psycholinguistics is devoted to the *description* of the *functions* that are served by particular linguistic forms, and by language in general. Presumably, given this distribution of labor, the joint goal of linguistics and psychology is to describe the relationship between form and function and above all to explain how form and function constrain one another.

As long as linguists and psycholinguists are pursuing their separate descriptive goals, there is little room for controversy beyond minor disagreements concerning method and interpretation. At the level of explanation, however, the matter becomes far more difficult. In exploring how form and function constrain one another, we must also decide just how much the two *fields* can constrain one another. To what extent must the elements, categories, and processes described by psychologists fit the elements, categories, and relationships described by linguists? In describing the mapping between form and function, there is considerable room for disagreement concerning the causal force that each imposes on the other.

In our own research (e.g., MacWhinney & Bates, 1978), we have been interested in the functional system of topicalization or point making in discourse. We have examined the acquisition of that system by children, and its use by adults, in a variety of languages including English, Italian,

Table 6.1. *Grammatical devices associated with topic and comment*

Topicalization devices	Commenting devices
Assignment of sentence subject	Assignment of sentence predicate
Initialization in word order	Initialization in word order
Pronominalization	Specific lexicalization
Ellipsis	Lexicalization
Definite articles and modifiers	Indefinite articles and modifiers
Existential sentences (e.g., *There was this guy. He . . .*)	Connectors to previous discourse (e.g., *yet, now, still, too*)
	Contrastive stress

and Hungarian. More recently we have begun to investigate Serbo-Croatian, Navajo, and American Sign Language. So far, our results suggest that, although the basic communicative function is presumably universal, there is an enormous variation across languages in the particular surface devices or forms used to encode that function. These include variations in the use of word order, verb agreement, ellipsis and pronominalization, definite and indefinite articles, contrastive stress, adverbials, and relative clauses – indeed, almost all of the conceivable kinds of syntactic-morphological devices (see Table 6.1). However, there is a tendency for languages to make particularly frequent use of one subset of devices to encode the topic function. These are the devices typically associated with the hypothetical formal role of "sentence subject," in particular, word order and verb agreement (Li, 1976). We could simply stop with a description of the topic function and a description of associated surface forms. However, if we want to move beyond description to an explanatory account of just how and why particular forms and functions are related in history, used by adults, and acquired by children, then we must face a number of controversial issues. In this chapter, we want to outline those controversies as we see them, separating the possible kinds of functionalist claims and describing the kinds of data relevant to each.

We do not pretend to have resolved very much at this point. However, we do have a bias of sorts, which is best admitted from the outset. That is, we suspect that the point-making function plays a strong causal role in the way particular forms have evolved and in the way those forms are used by adults and acquired by children. Furthermore, we are attracted to linguistic models that offer formal descriptions of the subject system that can be interfaced easily with the functional process of topicalization. In other words, given a variety of possible grammars to describe the same set of surface conventions, we prefer a grammar that maps subject phenomena (e.g., word order and verb agreement) onto the category of "topic" with a minimal number of intervening steps, separate compo-

nents, and separate categories. This functionalist bias is based on our experience with the above-mentioned languages. It is not, however, a conclusion dictated by existing data. In fact, our goal in this state-of-the-art discussion is to examine the kinds of empirical tests that could decide between "formalist" and functionalist claims about the nature of language. The rest of the chapter is divided into the following sections: (1) a brief look at the history of the functionalist–formalist controversy and a description of four distinct kinds of functionalist claims and the data relevant to each; (2) a description of a "competition model" that is our own best guess about a realistic combination of these four claims; (3) application of the competition model to the internal structure of the topic system; (4) application of the competition model to the relationship between "topic" and "agent" as categories that govern subject phenomena; and (5) some ideas about the kind of grammar that could be written to describe the representational system that mediates between the surface forms of subject and the underlying categories of topic and agent.

6.1. The functionalist–formalist controversy

The issues that separate formalist and functionalist accounts of language can be traced back to the early Greek philosophers, to the classic debate between the Analogists and the Anomalists. As Esper (1973) and Robins (1968) describe this debate, the Greeks were divided on several issues concerning the origin of language – particularly the origin of sound–meaning relationships in lexical items. The Analogists, including Aristotle, proposed that true irregularity in language is rare, that language is governed by reason, and that the bond between sound and meaning is lawful even if it is not obvious. The Anomalists, including the Stoics and the Skeptics, argued instead that language is characterized by irregularity or anomaly, and must have emerged without great reliance on the rational faculties. In short, the Analogists stressed the regularity of patterns as well as their inherent rationality or functional base. The Anomalists stressed the irregularity of patterns, and their arbitrariness with respect to any rational, functional base.

Notice that two claims separate these schools: *regularity* of pattern and *rationality* of pattern. In the modern version of analogy versus anomaly, both functionalists and formalists agree that language is primarily lawful. Indeed, developmental research in the 1960s demonstrated that children not only recognize and seek regularity, but actually impose it in areas where none exists (e.g., turning *feet* to *foots*). The current debate in psycholinguistics centers on the second part of the analogy–anomaly issue: the inherent rationality of patterns, their basis in communicative functions and ongoing processing constraints. Modern-day anomalists, including many transformational grammarians, stress the relative autonomy or independence of form and function. Modern-day analogists, including functionalist grammarians and generative semanticians, stress the contribution of function (e.g., meaning, "perceivability," production constraints, etc.) to the creation and maintenance of linguistic forms.

For the Greeks, the analogy–anomaly debate was in practice related to a second controversy concerning the role of nature versus convention in establishing linguistic forms. The Stoics argued in favor of nature, that is, the "innate" or naturally given basis of language. This approach was compatible with the anomalist view: Arbitrary forms must be studied sui generis, taken as they are, precisely because they are given in nature as absolutes. Aristotle, by contrast, argued for the role of convention in the creation of language. This view was compatible with the analogist position: Language is rational precisely because it is the product of human reason, created by men. It is not *logically* necessary, however, for anomalists and analogists to side respectively with nature and nurture. Indeed, in the modern-day analogy–anomaly debate, we find all possible combinations with respect to the innateness issue. From the "nature" side, Noam Chomsky (1975) has argued that language should be viewed as a "mental organ" that is highly predetermined by genetic factors. Like the Stoics, then, he suggests that an otherwise impenetrable formal system *must* be given in nature; otherwise, it could not be acquired. However, Maratsos and Chalkley (1980; see also Maratsos, Chapter 8) have proposed that human children are extraordinarily good at learning anomalous forms and deriving abstract categories from linguistic input–without innate clues but also without particular functional motivation. In other words, children are excellent pattern analyzers; they learn to do what others do, to manipulate curious linguistic objects because that is how grownups do things.

Similarly, we can find both nativists and empiricists within the functionalist or analogist camp. The term *functionalism* is usually associated with general learning theories, including behaviorist approaches as simple as that proposed by Skinner (1957). However, it is also possible to view the functionalist approach as a particular type of genetic determinism, albeit via an indirect causal route. Let us take one simple example: In all human cultures that have been studied to date, human beings eat with their hands (with or without an intervening tool). It seems perfectly fair to conclude, then, that hand-feeding is an innate human characteristic. But it is also likely that it is innate in a very indirect way, that is, as the most efficient and probable solution to a particular problem. Given the nature of human foodstuffs, the fact that they must pass through the mouth, the availability of hands as excellent all-purpose object manipulators, and the location of the hand vis-à-vis the mouth, it is simply inevitable that human beings will hit upon the solution of hand-feeding even without social reinforcement, imitation, and so on. In the same

fashion, a functionalist may view certain universal aspects of grammar as indirectly innate, as inevitable solutions to certain universal constraints of the problem of mapping nonlinear meanings onto a linear speech channel (see Bates, 1979, chap. 1, for a more detailed discussion of functionalism as a nativist position).

In sum, the analogy–anomaly debate is logically independent of the nature–nurture issue. There are, however, several different kinds of claims that can be made within a functionalist or analogist position. We can discern at least four levels of functionalism, ranging from a relatively conservative historical view to some radical proposals about the nature of adult grammatical knowledge. Each level requires qualitatively different kinds of evidence, although the stronger levels presuppose the more conservative ones both logically and empirically. The four respective positions involve (1) claims about diachronic or historical correlations between form and function, (2) synchronic or ongoing correlations between form and function in real-time processing, (3) use of these form–function correlations in the acquisition of language by children, and finally (4) a functionalist approach to the grammar or system of representation that mediates the relationship between form and function.

Level 1: diachronic correlation. The claim of diachronic correlation is that linguistic forms are historically associated with one or more communicative functions, in a manner that suggests a causal relationship. This is the weakest version of the functionalist approach, a purely historical claim that certain forms evolved under pressure from one or more specific constraints. It is a kind of linguistic Darwinism, an argument that languages look the way they do for functional or adaptive reasons. These reasons include a variety of constraints from cognitive, social, perceptual, and production factors. Indeed, the interactions among these factors may be so complex that the relationship between form and function is often opaque.

The appropriate methodology for establishing such claims is of course historical research, demonstrating a series of intermediate forms leading up to the present, in which the constraints that are operating become transparent. For example, Sankoff and Brown (1976) have studied the emergence of relative clause markers during the evolution of a South Pacific pidgin code, Tok Pisin, into a complete creole language. In the creole form, relative clauses begin and end with an *-ia* particle that is now apparently meaningless, for example, "This man-ia he sell me pig-ia he come to my house." However, an examination of the history of this form suggests that it evolved from a tag question, "Hear?" that was used as a discourse marker for topicalizing a referent within two complete main clause sentences, for example, "This man, hear? He sell me pig, hear? He come to my house." Similarly, Givón (1976) has argued that subject–verb agreement is a device that evolved to meet a discourse constraint for double marking topics when the topic is fronted and the comment postponed to a point much later on in an utterance, for example, "This *guy* I told you about the other day, well *he came* over and . . ." The proform (in this case *he*) that double marks that topic near its predicate gradually erodes phonologically into the verb, to become an inflection marking that verb for person, number, gender, and so on. In a recent volume on the discourse bases of grammar, Givón (1979) gives an impressive list of examples like this in a chapter aptly titled "Where Does Crazy Syntax Come From?" Similar examples are discussed by Slobin (1977) as they relate to child grammar. In short, apparently arbitrary syntactic devices may have their origins in the structure of discourse, evolving in the service of universal communicative functions. Some of the research supporting this type of diachronic correlation is referenced in Table 6.2.

Table 6.2. *Level 1 evidence for a diachronic relation between syntax and topic–comment functions*

Device	Languages	References
Left dislocation	Several	Givón, 1976
	Italian	Duranti & Ochs, 1979
	Mandarin	Li & Thompson, 1975
Right dislocation	Niger-Congo	Hyman, 1975
	Hungarian, English, etc.	Hetzron, 1975
Agreement	Several	Givón, 1976
	Tok Pisin	Sankoff & Brown, 1976
Relativization	Tok Pisin	Sankoff & Brown, 1976
	Malagasy	Keenan, 1976a
	Hittite	Justus, 1976
	English	Kuno, 1976
Complementation	French	Hyman & Zimmer, 1976
Detopicalization	Indo-European	Lehmann, 1976
	Several	Li & Thompson, 1976
Aspect	French, Malay, Old English, Russian	Hopper, 1977

Note, however, that this kind of historical claim does not imply any *ongoing* correlation between forms and the functions that brought them about. For example, a mechanism like subject–verb agreement may have achieved a certain amount of "functional autonomy" (Allport, 1961),

existing now as an obligatory device that has little or nothing to do with topic marking in its use by modern-day speakers. A somewhat stronger functionalist position goes beyond the evolutionary analysis of form–function relationships and advances a claim regarding synchronic correlation.

Level 2: synchronic correlation. The claim of synchronic correlation is that, *in* ongoing processing, linguistic forms are associated with one or more communicative functions, in a manner that suggests a causal relationship. In this view, the functional pressures that operated in language history to create surface forms continue to operate in everyday communication to maintain those surface forms now in use by speakers and hearers. For example, subject–verb agreement may be maintained across languages because it is *still* needed to double mark topics and reduce ambiguity. If that form were not available, something like it would have to be reinvented by speakers. In other words, the claim is that most surface forms never evolve into full functional autonomy.

Several methods have been used to establish synchronic correlations of this type. One is the analysis of "natural text units," preferably informal conversations. Such natural text units provide enough context to allow us to detect the relationships between form and function, such as instances of topic shifting across sentences, cases in which disambiguation of reference is necessary, or instances where topics must be reintroduced because of memory constraints. For example, Duranti and Ochs (1979) have analyzed several Italian texts for the occurrence of left-dislocated (LD) structures. LD structures are active voice utterances in which direct and/or indirect objects occur in initial position, for example, *I spaghetti li voglio*, "The spaghetti I want them." The passive voice supposedly evolved to fill this kind of focusing role. And yet LD structures are preferred overwhelmingly in informal conversation, suggesting that the LD form is somehow easier to plan or produce. By analyzing the contexts in which all instances of LD structures occurred, Duranti and Ochs came to several interesting conclusions. First, LD forms seem to reflect a "middle degree" of givenness along a given–new continuum. They are almost always elements that have already been introduced into the discourse (for example, they are invariably marked with definite articles). However, they also occur at points where two or more potential referents of the same person, number, and gender are available in the discourse space. Because pronominalization or ellipsis would lead to ambiguity, the element must be *reintroduced* before a relevant comment can be made. However, degree of givenness alone is not sufficient to motivate all the LD instances. For example, LDs were several times more frequent in conversations with more than two participants. They often seem to serve as a kind of "pseudo-topicalization" in which a speaker can take or

maintain the floor by thrusting relevant material out into initial position – a useful weapon in conversations involving more than two Italians. Hence givenness and problems in turn taking both contribute to the use of LD structures.

Although linguists engaged in this kind of text analysis typically do not use statistical techniques, the approach just illustrated fits conceptually with correlational models using multiple regression analyses. In principle, it should be possible to determine the amount of variance contributed by each factor, in different and perhaps interacting combinations. Such studies would provide evidence that apparently arbitrary syntactic devices are used just because they play a particular communicative role in conversations. It is worth noting, however, that correlational evidence obtained from free speech records can never conclusively establish a causal relationship among variables.

There are, however, additional sources of evidence for synchronic correlation in experiments that manipulate the determinants of the use of linguistic devices in an antecedent–consequent relationship. In most such studies, functional inputs such as givenness–newness of information are treated as independent variables. The dependent variables are the use of one or more grammatical forms, such as initialization or pronominalization. The use of these grammatical forms can be measured in several ways, including production, reaction times and judgments in comprehension and sentence verification, and acceptability ratings. A summary of such studies is presented in Tables 6.3 and 6.4 (for more detailed reviews, see Bates & MacWhinney, 1979; MacWhinney, 1980).

Most of these experiments are designed to assess the relationship between one form and one function. For example, Osgood (1971) has shown that adults are more likely to use definite articles to encode given information than information that is relatively new in discourse. Perhaps justifiably, many linguists regard such demonstrations as trivial demonstrations of facts that are intuitively obvious to any native speaker. However, with a more complex experimental design we can obtain information that is *not* readily available by armchair analysis. One such approach is to manipulate a single function as the independent variable, but leave several options open for the forms that serve as dependent variables. For example, MacWhinney and Bates (1978) manipulated givenness of information in a simple picture-description task, with adults and 3- to 6-year-old children in Hungarian-, Italian-, and English-speaking communities. The given–new dimension was a good predictor of stress and ellipsis and a much weaker predictor of pronominalization; it had almost no effect on the use of sentence-initial position. Furthermore, these relationships interacted with language and with age in complex ways. This approach gives us some idea of the control of a given functional determinant over the use of various potentially available structures. Another approach is

Table 6.3. *Level 2 psycholinguistic evidence for a synchronic correlation between perspective/salience and the device of initialization in adult English*

Technique	Starting point found to:	Reference
Rating	be more "potent"	M. Johnson, 1967
	be drawn larger	Johnson-Laird, 1968a
	be more human, animate, and concrete	H. Clark & Begun, 1971
Elicited production	be good and potent	Boucher & Osgood, 1969
	be animate	H. Clark, 1965
	be animate	Jarvella & Sinnott, 1972
	be large	Johnson-Laird, 1968b
	move first	Osgood, 1971
Problem solving	be more easily moved	Huttenlocher & Strauss, 1968
	be constructed first	H. Clark, 1968
Free recall	be remembered best	B. Anderson, 1963
	be remembered best	H. Clark, 1965
	be remembered best	H. Clark & Card, 1969
	be remembered best	Coleman, 1965
	be remembered best	Kintsch, 1974
Cued recall	be the best cue	Prentice, 1966
	aid recall of passive	Schlesinger, 1968
	aid recall of passive	Turner & Rommetveit, 1968
	work best as a cue when active	Blumenthal & Boakes, 1967

to administer several independent variables and assess their effects on the use of a single surface form. For example, Flores d'Arcais (1975) had demonstrated that animacy, relative size, and direction of movement in picture stimuli all have some effect on the selection of elements to serve as sentence subject in a picture-description task. However, animacy has a much larger effect than either of the two perceptual salience dimensions. Such "one-to-many" or "many-to-one" studies can tell us not only about the presence or absence of synchronic correlations, but also about the relative weights of various functional constraints in determining the use of different surface forms.

Ideally, in the strongest possible statement of a synchronic correlation approach, we should be able to predict *all* uses of surface forms. To do so, we would obviously have to have a great deal of information about the functional constraints that are operating in a given situation, such as

Table 6.4. *Level 2 psycholinguistic evidence for a synchronic correlation between givenness or topicality and five syntactic devices in adult English*

Device	Technique	Finding	Reference
Initialization	Acceptability	Starting points code givenness	Bock, 1977
	Acceptability	Starting points code givenness	Grieve & Wales, 1973
	Acceptability	Starting points code givenness	Hupet & LeBouedec, 1977
	Acceptability	Starting points code givenness	Kleinbort & Anisfeld, 1974
	Acceptability	Starting points code givenness	Wright & Glucksberg, 1976
	Elicited production	Passives code discourse topicality	Carroll, 1958
	Elicited production	Passives code discourse topicality	Tannenbaum & Williams, 1968
	Elicited production	Passives code discourse topicality	Turner & Rommetveit, 1968
	Comprehension	Passive "set" can be induced	Olson & Filby, 1972
	Comprehension	Passive "set" can be induced	Wright, 1969
Ellipsis	Production	Ellipsis codes givenness	Delis & Slater, 1977
Pronominalization	Production	Pronouns code givenness	Delis & Slater, 1977
	Recall	Pronouns serve to bind events	Lesgold, 1972
	Elicited production	Pronouns serve to bind events	Osgood, 1971
Stress	Text analysis	Stress marks contrast	Berman & Szamosi, 1972
	Text analysis	Stress marks contrast	Bolinger, 1972
	Text analysis	Stress marks contrast	Gunter, 1966
Definite article	Elicited production	Definite article codes givenness	Grieve, 1973
	Elicited production	Definite article codes givenness	Osgood, 1973

newness–givenness of information, the type of semantic information that must be mapped, the number of participants in the discourse, and the memory load as a function of both semantic and pragmatic information. Furthermore, we would need to know the relative weights and interactions of these functional constraints in a given context. We are of course a long way from this situation of total predictability. Even if we had the necessary information, the appropriate multivariate statistics for modeling these interactions are still being developed (Rousseau & Sankoff, 1978). Nevertheless, we can at least begin to create conceptual models that take these interacting factors into account.

Suppose that we did eventually achieve the goal of total predictability, capturing all the existing synchronic correlations between form and function. Suppose, for example, that we could invariably predict the semantic element that a speaker will choose to serve as the surface subject of a sentence (e.g., the nominal element that occurs in initial position, agrees with the verb in person and number, and is pronominalized in the nominative case). There is still a great deal that we would not know about the way in which children acquire grammar and about the way in which adults store and access form–function relations. The fact that synchronic correlations are there does not necessarily mean that children use them in acquiring language. They may enter into the linguistic system by a completely different route, guided by abstract and possibly innate clues about the nature of surface conventions in grammar. Furthermore, these correlations could in principle be only peripherally related to adult grammatical competence. They may be epiphenomenal, by-products of an abstract grammatical machinery that manipulates its own autonomous mental symbols.

Level 3: acquisition. The acquisition claim is that the correlation between form and function is sufficiently strong to permit the acquisition or discovery of surface conventions without any other clues about linguistic structure. In other words, children may exploit the correlation between form and function to "crack the code" of their native language. Researchers working from this point of view must adopt a developmental version of the historical method already described. First, they must show that a given function is established in the child's repertoire prior to acquisition of a related form. Second, they must show that the form was acquired in an effort to solve that communicative problem, as the child gropes with a series of alternative surface forms within a particular "function slot." Such studies often involve evidence for creative intermediate stages in form–function mapping in which the child's problem-solving efforts become transparent, and in this respect they are similar to the arguments proposed by Givón (1976) and Sankoff and Brown (1976) at Level 1. Table 6.5 summarizes some of the current evidence for a developmental relation between syntax and pragmatic functions.

Table 6.5. *Level 3 evidence for a developmental relation between syntax and pragmatic functions*

Device	Pragmatic variables	Reference
Lexicalization vs. ellipsis	Informativeness	Greenfield & Zukow, 1978
	Complexity	Bloom, Miller, & Hood, 1975
	Comment	deLaguna, 1963
	Comment	Sechehaye, 1926
	Comment	Vygotsky, 1934/1962
	Newness–givenness	MacWhinney & Bates, 1978
Fronting in two-word utterances	Informativeness	Greenfield & Zukow, 1978
	Importance	Lindner, 1898
	Importance	O'Shea, 1907
	Perspective	MacWhinney, 1975a
	Newness	Dezsö, 1970
	Newness	Fava & Tirondola, unpublished
	Newness	Meggyes, 1971
	Newness	Park, unpublished
	Newness	Viktor, 1917
	Focus	Leonard & Schwartz, 1977
Stress	Newness	Wieman, 1976
	Contrast	Hornby, 1971
	Contrast	Hornby & Hass, 1970
	Contrast	MacWhinney & Bates, 1978
Pronominalization	Givenness	MacWhinney & Bates, 1978
Indefinite article	Newness	MacWhinney & Bates, 1978
Definite article	Givenness	Bresson, 1974
	Givenness	Brown, 1973
	Givenness	MacWhinney & Bates, 1978
	Givenness	Maratsos, 1974b, 1976
	Givenness	Warden, 1976

To illustrate how developmental data can provide evidence for the Level 3 version of the functionalist position, let us consider some possible "functional routes" into the discovery of the surface phenomena associated with the sentence subject. For the moment, let us concentrate on three subject phenomena: initialization, noun–verb agreement, and subject pronouns. Applying the developmental criteria just described, Bates and MacWhinney (1979) have reviewed evidence suggesting that the topic–comment function is established in the one-word stage, prior to any use of word order. Similar evidence is available to suggest that the function of "agency" is also available to children before the acquisition of syntax. Hence both topic and agent are functions that precede the onset of word order in child language. In some languages (e.g., Hungarian and Italian), the first word-order hypotheses that children use tend to reflect the topic–comment division (with comments preceding topics). On the other hand, in other languages (notably English), early two- and three-

word speech tends to reflect information about agency, with agents or actors preceding action words (Braine, 1976; Brown, 1973). Hence either topic or agent may be expressed in early two-word syntax. What happens to these primitive strategies when other subject phenomena are acquired? Evidence from Fava and Tirondola (unpublished) and Snow (1977) suggests that the set of correlated subject phenomena may be acquired in separate bits, each mapped onto a different aspect of meaning. For example, Fava and Tirondola's Italian children used agreement and pronominalization to map information related to agency, whereas word order was retained for several weeks in the service of topicalization.

Eventually, children have to construct some kind of single "subject" category that can handle the full range of meanings capable of "subjectivalization," and that will govern the full set of correlated surface devices that adults use in subjectivalization. In other words, a heterogeneous set of meaning structures must be mapped onto a heterogeneous set of grammatical devices. There are a variety of views on how this transition takes place. Brown (1973), Sinclair (1975), Maratsos and Chalkley (1980), and Valian (1977) have all argued that the full range of grammatical forms in adult language can only be described with an abstract set of symbols like "+Subject" – symbols or categories that in some way transcend semantic or pragmatic meanings. Valian adopts Chomsky's nativist anomalist view that such categories are part of the genetic predisposition of our species; they need not be discovered or constructed because they are available to the child from the onset of language acquisition. Maratsos and Chalkley, on the other hand, take a non-nativist anomalist view in which categories like subject are derived from experience with formal regularities. More precisely, the child is said to derive such categories by scanning the set of correlated devices that make up subjectivalization (word order, pronominalization and agreement, the behavior of certain reflexive particles). The child notes that these surface forms behave as a block, and constructs an internal mental symbol "+Subject" that will be used in all internal manipulations and mappings onto these surface devices. Note that in the Maratsos and Chalkley approach this symbol is entirely independent of meaning structures like "actor" or "topic"; nor are actor and topic in any way involved in the ontogenetic derivation of the subject category. A third approach is a mixture of Level 3 analogy with an anomalist approach to the nature of adult competence. Brown and Sinclair both suggest that children may use natural categories like "actor," "topic," and "action" on the way to discovering abstract categories like "subject" and "predicate," in a sort of "getting hot, getting cold" game of clues about the nature of grammar. However, at some point the child will have to trade in his natural categories for abstract symbols like "+Subject." In other writings, we have referred to this discontinuous passage as the *developmental shift hypothesis*.

In the final and most radical functionalist view, the categories of adult grammar retain their full functionalist definitions. In other words, a correlated set of surface devices like those that constitute subjectivalization continue to map directly onto a category made up of semantic and pragmatic meanings. After we have outlined that position, we can return to the question of falsifiability, discussing the kinds of evidence that can distinguish Level 4 from the Level 3 developmental shift hypothesis, and from anomalist positions like those of Valian and Maratsos and Chalkley.

Level 4: adult competence. The adult competence claim is that the grammar or system of representation that mediates the interaction between form and function can be fully described in terms of natural functional categories and performance constraints. This is the strongest version of the functionalist hypothesis, in which abstract or purely formal grammars are viewed as epiphenomena of natural processes. In other words, although certain kinds of abstract linguistic models may very well describe sentences, they do not describe tacit knowledge and/or the workings of the mind in processing utterances. A psychologically real description of language can and should be written entirely in terms of cognitive categories and speech processes, without additional symbols.

Note that this view in no way denies the reality of surface rules or conventions, that is, those peculiar facts which make Turkish differ from English, from Chinese, from Navajo. Grammatical conventions cannot "look like" the meanings they convey. The mapping from meaning into sound must necessarily be indirect for several reasons. Firstly, except for a few rare onomatopoeic expressions like the word *sneeze*, sounds do not resemble the things they stand for. Secondly, language can provide explicit conventions for only a subset of the possible kinds of meanings or thoughts that we might want to convey. In this regard, Slobin (personal communication, 1979) has noted:

> A sentence is like a conventionalized line drawing. You have to abstract away from everything you know or can picture about a situation, and present a schematic version which conveys the essentials. In terms of grammatical marking, there is not enough time in the speech situation for any language to allow for the formal encoding of everything which could possibly be significant to the message. Probably there is not enough interest either. Language *evokes* ideas; it does not represent them. Linguistic expression is thus *not* a straightforward map of consciousness or thought. It is a highly selective and conventionally schematic map.

Thirdly, it is rarely the case that a single surface convention serves one and only one communicative function. Rather, most aspects of the grammar are governed by several competing aspects of the communicative

situation (cognitive structures, social goals, perception, and production constraints). We will return shortly to some ideas about the role of competition in explanatory models of language. For our present purposes, the point is that surface grammatical conventions cannot be isomorphic with functions, even from the point of view of a Level 4 functionalist. However, the relations among arbitrary surface devices should be predictable from processing constraints; and these surface patterns should map onto a set of "natural" and eminently knowable categories without requiring a complex set of intermediary formal objects. Level 4 functionalism is, then, a theory about the nature of *intermediate* structures in the representation of grammatical knowledge.

What kind of research is relevant to Level 4 claims? First of all, a Level 4 model presupposes Levels 1, 2, and 3. Functional categories like "topic" and "agent" can figure preeminently in a psychologically real system of representation only if they have operated for some time – in language history, in the ontogenesis of language in children, and in use by adults. Hence Level 4 requires the full data base that supports correlation and acquisition models. In addition, however, this kind of a functionalist claim will require new methods for manipulating and interrelating those data. The ultimate test is whether a grammar or model of representation can be built out of the elements, categories, and relationships yielded by a functional analysis of a given language.

This brings us to the criteria for selecting among grammars. For a linguist of the Saussurian mode, grammars are selected on purely formal, descriptive grounds. The "best" grammar is that grammar which describes all the possible sentences in a language (and excludes impossible sentences) with the smallest number of rules and elements. However, the Chomskian notion of "competence" introduces another criterion for selection among competing descriptive systems: If a grammar is also a model of psychologically real, tacit knowledge of a language, then the "best" grammar is the one that provides a best fit to the nature of a language-using mind. In principle, a less parsimonious grammar may be preferable as a model of competence if it is more plausible on psychological grounds. But what does "psychological plausibility" mean? Presumably, a complete model of linguistic knowledge should describe and predict a variety of psycholinguistic facts in addition to the set of possible sentences in a language. We might create such a model by describing tacit knowledge of sentence structure in one component, and constructing additional components to handle other "performance" facts (memory, attention, motivation, etc.). Alternatively, it might be possible to construct a unified model in which competence and performance facts are described with the same elements, categories, and relational symbols. Such a unified model might be less elegant in its formal description of sentence relations than a model devoted exclusively to that subset of

linguistic knowledge. We assume, however, that an inelegant model will be preferable to a more elegant one if it manages to describe and predict a larger range of facts with a minimal amount of baggage. What is clumsy at one level may be more parsimonious at another.

It seems likely, given our present understanding of form–function relations, that a pure Level 4 functionalist model is *logically* possible but *empirically* implausible. There are certain peculiar subsystems within languages, such as the German gender system, which have defied description in functional terms. There is no conceivable way to map these gender markings onto meaningful "natural" intermediate categories like "sex." This does not mean that the arbitrary German gender system had no function in language history, nor that gender markings are useless baggage within synchronic use of the language. It is possible that such arbitrary systems were used at some point in history to code distinctions such as animacy and inanimacy; but that with time the original distinctions have weakened and the classifications become arbitrary (Bloomfield, 1933/1961, pp. 271–2). However, the category is still needed to mark many of the original distinctions (Grebe, 1973, pp. 161–4). Consider the way that we use numbers and letters in setting up an ad hoc descriptive system, for example, "functionalist Levels 1, 2, 3 and 4." Numerical concepts of ordinality are only marginally related to the concepts being expressed. We could just as well have said "Levels *A*, *B*, *C*, and *D*" or "black, white, orange, and blue." However, once such a convention is established in communication, it is difficult to get rid of it, if we are going to continue to understand each other. Readily available metaphorical markings like sex and shape may be used in moments of rapid lexical expansion to differentiate types within a class; once established, they become *perceptually* necessary even if they are *conceptually* opaque. At Levels 1 and 2, then, a functionalist argument could be made regarding systems like gender morphology in German. At Level 3, however, it is extraordinarily unlikely that children could use this function in acquiring the morphological system. Because there are no meanings to serve as mnemonics for recovering a given gender ending, the child must simply memorize the endings by rote, as part of the word (MacWhinney, 1978). A grammar, or model of the set of intermediate categories that constitute knowledge of grammar, will probably have to be written using formal symbols like "+F" and "+M" that correspond to the set of correlated surface forms used to map particular lexical items, within particular semantic relationships.

In short, Level 4 functionalism is useful as a pure analytic position, but is unlikely to work all the time in the analysis of most languages. It may, however, be useful for *parts* of the grammar. For example, we will argue later that a reasonable Level 4 description could be made for the relationship between the surface forms that constitute subjectivalization

(e.g., word order, verb agreement) and the underlying categories of "topic" and "agent." We may not need intermediate formal symbols like "+S" to model the way those functions are mapped. Before turning to details of the topic system, however, we think it would be useful to present in more general terms our own position regarding causal relationships between form and function, using the four positions just outlined as analytic tools.

6.2. The competition model of form–function relations

Our arguments in favor of a competition model of grammar revolve around six basic tenets. We believe that a full articulation of the functionalist model will need to build on each of these six tenets. But exactly how these tenets interrelate and how they should be further constrained (N. Chomsky, 1976) must remain a task for future research. At the present stage in the development of this approach, what seems to be most in order is an outline of the principles that should underlie the basic approach.

Tenet 1: channel limitations. The resources of the acoustic–articulatory channel for mapping meanings are limited in two ways: (1) Only four kinds of signals are possible – lexical items, word-order patterns, morphological markings, and intonational contours – and (2) the interactions of these four kinds of signals are further constrained by a variety of perceptual–mnemonic–articulatory factors that converge to create implicational relations among types of surface solutions. To illustrate how these limits operate, let us consider a simple metaphor. Two players are each seated before a Chinese checkerboard. One player has a relatively complex, nonlinear pattern of marbles on his board; the other player has an empty board. The two players cannot see or hear each other. They are connected only by a long tube that permits one marble at a time to be passed between players. Player A must send his marbles down the tube in such a fashion that player B can reconstruct the same nonlinear pattern on his board. These are the only restrictions. The participants will have repeated opportunities to find out if they are successful, and they can work out any solution they like to the problem of mapping nonlinear board patterns onto a linear marble channel. It will soon become clear, however, that the solutions must involve some combination of four types:

1. They can develop rules that particular *colors* or *types* of marbles belong in particular spots on the checkerboard, or in particular pattern configurations;
2. they can develop rules that the *order* of marbles coming down the tube determines their position on the board;

3. they can develop rules connecting particular *markings* on the marbles to positions on the board (with the constraint that these must be small and minimal markings – otherwise one could cheat by writing a picture of the board on each marble!); and
4. they can vary the *speed* or *spin* on the marbles coming down the tube to determine their position in the pattern.

Regardless of which solutions, in what combinations, the participants choose, the nature of the task of mapping nonlinear information onto linear channel with a set of discrete, minimal elements formally constrains the set of possible solutions to the task. The analogies to language are obvious, though overly simple. Mapping by color or type of marble corresponds roughly to choice of lexical items within semantic-pragmatic categories. Order of marbles is analogous to word-order solutions. Mapping through marble markings corresponds to morphological marking of lexical items. The spin, speed, and intensity of marble travel down the chute stands in loose analogy to prosodic phenomena in speech. Nor are these four types of solutions independent of one another. The first and last marble down the chute will probably be the easiest to track; it will be harder to keep track of middle positions. Calculations of speed, spin, and intensity will tend to sum and slide as the marbles come in, so that these solutions will probably interact with order and clarity of marking. As we systematically vary marble color or class with marble markings, it may sometimes be difficult to tell whether we have a new marble per se or a version of marble marking. In other words, there will be interactions between "lexical" and "morphological" solutions. Finally, it is likely that symmetrical patterns across a complex mapping through time will be easier to construct and decode than more irregular patterns (Garner, 1974).

Much of the functionalist literature in diachronic linguistics has involved implicational relations like these within language (e.g., Antinucci, 1977; Bartsch & Vennemann, 1972; Lehmann, 1973). For example, there is a strong statistical tendency for SVO languages to make use of prepositions rather than postpositions, whereas in SOV languages the opposite is the case – as though it were somehow easier to put all the "verby" stuff (e.g., verbs, adjectives, locative phrases) in the same position relative to nouns, either pre- or post-positionally. Vennemann (1974) has suggested that such implicational universals indicate a tendency for languages to make consistent, symmetrical use of either *operator + operand* or *operand + operator* as basic orders. Kuno (1974) has noted how another set of universals reflects the attempt to preserve the "inherent unity" of the verb phrase so that V and O are always close together in a sentence (see also Maratsos & Abramovitch, 1975). Unfortunately, in the absence of a greater amount of psycholinguistic evidence that some

combinations are indeed more perceivable or memorable than others, it is difficult to evaluate fully the various functionalistic explanations for such linguistic universals. For present purposes, our point is that the limited stock of channel resources available in mapping nonlinear meanings onto the linear acoustic–articulatory channel can be further depleted by complex interactions among types of surface forms according to their relative "processibility." These varying constraints determine the surface territory or "real estate" that is available for distribution to a larger set of meanings and communicative functions.

Tenet 2: informational pressures on the channel. The set of meanings that any individual might wish to convey is infinite – although there are characteristic classes or types of meanings that seem to be universal (e.g., the relationship among the agent, the action, and the thing acted upon). Furthermore, in a given communicative situation, the same referent may play several communicative roles, just as, in the marble analogy, the same marble may play a role in several cross-hatching patterns on the board. For example, the referent "John" may be an actor in a complex situation, and at the same time be standing in a discourse relation that is relatively independent of his role as an actor. Also, John himself may be present in the communicative situation, demanding an appropriate amount of deference to his status – so we have to be particularly careful how we refer to him, and toward what ends. How can we mark so many patterned relations onto one marble? For purposes of illustration, we will concentrate here on three separable classes of information that can all be assigned to the same referent: semantic-cognitive, pragmatic-attentional, and social-motivational information. However, as we hope to illustrate with regard to one section of the pragmatic component, there are complex competitions and interactions *within* each sector (e.g., factors influencing topic selection), as well as *between* sectors (e.g., topic versus agent).

Tenet 3: two classes of solutions. Given the competitions dictated by Tenets 1 and 2, we suggest that pathways or solutions to the competition for surface forms can be classed into two basic types: "divide the spoils" and "peaceful coexistence." The divide-the-spoils solution refers to a distribution of surface territory in which each sector receives its own set of mappings, that is, a one-function–one-signal approach. For example, a language may reserve word order primarily to mark information about specific case role relations. Pragmatic information will be mapped instead with some combinations of stress and particular lexical items. Alternatively, a language may mark case role information primarily through morphological markings. The word-order signals are then "free" to encode pragmatic information.

The peaceful-coexistence solution is, by contrast, a form of many-to-one mapping. Briefly stated, peaceful coexistence solutions reflect certain statistical regularities in discourse in which two distinct roles are shared by the same element a very large proportion of the time. Given this high-probability overlap, the language may decide not to "waste" two distinct mappings where one will generally suffice. For example, given the statistical fact that human agents tend to be the topic about 80 to 90 percent of the time in informal discourse (see, e.g., Duranti & Ochs, 1979), languages may use particular high-priority surface mappings to encode *both* agent and topic. In short, these two sectors may share a common surface device, in this case the correlated set of surface features involved in subjectivalization. For situations in which the agent is not the topic, alternative routes will have to be found – perhaps low-priority, relatively cumbersome devices that the language can "afford" for low-probability cases (e.g., passives, clefts). In a few cases, the language may allow such low-probability events to remain ambiguous. Thus Lisu has no way of coding agency apart from topicality (Li & Thompson, 1976, p. 473). We will discuss situations like this in more detail later on, when we round out our discussion of Tenet 3 by presenting a prototype model for describing heterogeneous grammatical categories governing peaceful-coexistence solutions.

Tenet 4: conventionalization. Research on human and animal learning is based upon the premise that previously successful solutions tend to be repeated in new instances, even in cases where the solution might be slightly less than optimal. Furthermore, learned behaviors tend to move toward an increasingly stereotyped form as nonessential elements of the original solution drop out (B. Schwartz, 1978). There is, apparently, some kind of trade-off between current fit and the time and effort involved in making new calculations for each new encounter. The phenomenon of stereotypy within individuals is related to the development of convention between individuals. In encounters between organisms, the cost of new calculations and readjustments to fit the moment may be particularly high multiplicative rather than additive, because each new adjustment by organism A requires accounting by B, and so forth. Insofar as organisms need to predict one another's behavior, there will be a constant pressure toward conventionalization or stereotyping of signals. This evolutionary process has been noted by many ethologists interested in communicative displays in animals (Bateson, 1973; Eibl-Eibesfeldt, 1977), and by students of communication in human infants (e.g., Bates, Camaioni, & Volterra, 1975; Bruner, 1975). However, in a complex behavioral system, social predictability is only one of several functional pressures on form. If conventional behavior is in the service of several functions, there will

necessarily be a competition between conventionalization and the functional fit of the behavior to a variety of goals.

Applying the principle of conventionalization to the emergence of grammar, we must assume that languages strive toward a "group solution" in meeting the competing constraints of communication. At a given moment in processing, the set of mappings that constitute the group solution may be less than optimal for a particular individual. However, he must adopt the group solution despite some extra costs in efficiency of processing in order to be understood by a fellow human being. The conventional nature of language imposes an inherent conservatism on language change under functional pressures. Any changes that do take place, in response to the functional constraints experienced by individuals, must take place across the group using that language.

Tenet 5: disequilibrium. It is unlikely that any single group solution will preserve the optimal fit between form and function for all members of the group. Thus languages are always undergoing a certain amount of disequilibrium and adjustment. Because changes take place gradually across time (involving mutual adjustments of many individuals to one another), a "repair" or adjustment of the system in one sector may have repercussions throughout the rest of the system that do not become evident until the initial change is well under way. Vennemann (1974) has proposed, for example, that symmetry principles in processing and phonological erosion in production are two competing constraints on language that almost invariably have a contradictory effect on one another. He proposes that this particular competition is responsible for the historical fact that languages move back and forth from SVO and SOV standard orders. Morphological markings may evolve out of individual lexical items that obey a symmetrical "operator-operand" order. However, production pressure may erode these individual words into inflections attached to other words – "attached" in the sense that they are no longer merely adjacent, but are uttered within the intonational contours of a single item. Through further phonological erosion, these inflections may eventually disappear altogether, so that it becomes necessary to "reinvent" separate lexical items that must meet a new group order, and so forth.

Tenet 6: vestigial solutions. The gradual shift from one set of group solutions to another will mean that, at transitional moments, some conventions will have lost their initial motivational base. In the long run, these vestigial conventions or anomalies should be the "weakest" points in the system and should give way to other, better-motivated ways of mapping meaning into sound. A number of linguists and psychologists have provided evidence that functional anomalies are "attacked" by new generations of children who are acquiring the transitional form of the language, so that language change results (e.g., Halle, 1962; Slobin, 1977). Nevertheless, children will also have to have interim strategies or learning mechanisms for picking up vestigial conventions that provide no experiential fit to their own communicative efforts.

These six tenets are implicit in much of the current functionalist research on diachronic linguistics, and might be viewed as an elaboration of Level 1 (see Table 6.1 for references). However, the concepts of *conventionalization* and *vestigiality* are not predicted at the other three functionalist levels. If it is the case that languages temporarily retain vestigial conventions, then it cannot be true all the time that individuals use surface forms for ongoing functional reasons (Level 2). And if there are certain surface forms that have no experiential base whatsoever, then children cannot use functional information to acquire those forms (Level 3). Finally, a model of grammatical knowledge in individuals may need some ad hoc formal symbols or categories to handle those surface facts which have temporarily lost their communicative base (Level 4).

Within the competition model, then, the explanatory principles of conventionalization and vestigiality exist to handle the exceptions to a purely functional system. If they are to have any real explanatory value, these principles must not be applied in a circular fashion; if we simply label as "vestigial" any linguistic phenomenon that we have failed to explain in functional terms, then the notion of vestigiality becomes a fudge factor and nothing more. A complete competition model of form–function relationships must contain a theory of vestigiality that predicts where such events are likely to occur in the language, and how vestigial forms are acquired by children and stored and accessed by adults.

There is no such theory right now, as far as we know. However, a number of ideas that have been proposed by linguists and psycholinguists could be built into a theory of vestigiality. At Level 1, predictions about the nature of vestigial structures are based upon the assumption in a competition model that waste is expensive, and functional anomalies will be tolerated only in sectors where the competition is minimal, and/or only for a relatively brief period in language history. Level 2 functionalism must claim that vestigial solutions would involve additional processing time, anomalist or rote solutions, and inefficiencies in storage and retrieval. Level 3 functionalism must maintain that vestigial solutions would be acquired later, be less productive of overgeneralizations, and not lead to further developmental progressions. Some ideas relevant to a theory of vestigial structures include the following:

1. Vestigial or functionally anomalous structures should be among the first to disappear during language change, as the language reshuffles its precious resources.

2. Temporary exceptions to functional rules should occur primarily in language-specific rather than language-universal aspects of the grammar.

This prediction is based on the assumption that universal aspects of grammar emerge in response to universal and inescapable functional pressures, where "drift" or erosion of a form–function relationship is very unlikely.

3. There may be certain kinds of vestigial devices that do occur in a large set of languages. These devices are likely to be high-probability solutions to a common but temporary moment in language change. For example, when a language is changing from case inflection to word order to encode information about agency, there may be a particularly heavy use of clitic pronouns as a "backup device," to double mark the agent in sentences where word order is ambiguous. To sustain this temporary backup system, certain conventions about agreement between the clitic and the corresponding noun argument may emerge, to make the relationship particularly clear. Once a more reliable word-order system is established, these ancillary conventions may no longer be necessary, and so they drift in different phonological directions within a few generations.

4. Functionally anomalous information is more likely to remain in the language if it involves the form of individual lexical items rather than rules governing constituents from different lexical categories. One consequence should be that meaningless morphological markers would be easier to maintain in the language than meaningless rules of word order. This prediction is based on the assumption that the lexicon is well suited for storing arbitrary phonological information about discrete items, that is, rote information. Hence, although a given vestigial marker is not used to identify the lexical item itself (i.e., it is not part of the word), it may be less expensive to store the leftover marker with other phonological symbols in the lexicon than to create a component to store symbols for syntactic relationships that no longer have a basis in meaning (MacWhinney, 1978).

5. Children will tend to avoid vestigial forms, to delay their acquisition to a relatively late point in development. For example, MacWhinney (1978) has provided evidence that productive (i.e., nonrote) use of gender in German is acquired later than productive use of case marking. Both gender and case marking map onto the same set of devices, but case is functionally motivated whereas gender is not. In the same vein, Moeser and Bregman (1972) have shown in experiments on artificial language learning in adults that meaningless patterns are extremely difficult to acquire compared with patterns that can be assimilated to some semantic base.

6. If a functionally autonomous form is acquired early, its semantic range may be very small indeed, perhaps confined to a few individual lexical items (as in the Hungarian rule of *v* deletion [MacWhinney, 1978]). In short, the grammatical device may be memorized as part of a particular lexical set or as a nonproductive idiomatic expression.

7. In addition to rote as an acquisition device, children may make relatively greater use of imitation in acquiring vestigial forms. This prediction is based on the assumption that a meaningless item cannot be acquired for its communicative purpose, and hence must be perceived and used at first purely as an interesting vocal event. Newport, L. Gleitman, and H. Gleitman (1977) have provided evidence suggesting that some language-specific aspects of grammar (e.g., auxiliary fronting in English) are "environmentally sensitive," whereas other more universal aspects of grammar are "environmentally insensitive." Environmentally sensitive forms tend to be correlated with aspects of use of those forms by parents, whereas the more universal aspects of grammar apparently require only minimal modeling by the adult. We propose that vestigial structures are more likely to be environmentally sensitive. These are by definition forms that the child is not looking for, because he has no communicative use for them. Hence such functional anomalies will be acquired only if the child is heavily exposed to them by parental modeling.

These ideas are predictions, ideas for future research, and not conclusions based on accumulated evidence. They are presented simply to show that a theory of vestigiality within a competition model could be more than a catalogue of exceptions to functionalist principles. In the next two sections, we will try to be more specific about empirical tests of the competition model, describing some aspects of the topic–comment system and relations between topicalization and case role information.

6.3. Topic–comment relations and grammar: competition within the system

Prague school functionalists (Dezső, 1972; Firbas, 1964; Sgall, Hajičova, & Benešova, 1973) and British functionalists (Firth, 1957; Halliday, 1967) claim that discourse relations like topic and comment are grammatically marked; hence any systematic description of the grammar must take these relations into account. This view is becoming widely accepted in American linguistics (see, e.g., Givón, 1979; Li, 1975, 1976), and there are now a number of proposals describing the relationship among the topic–comment system, the case role system, and various aspects of surface grammar. The semantic-pragmatic meanings that constitute topic and comment have proven elusive and frustrating to linguists who want to incorporate them within a formal grammar. There is very little agreement about the internal structure of this system, and every investigator who studies it feels the need to add new terms and new distinctions. Table 6.6 lists just a few of the terms that linguists and psychologists have used to describe some aspect of the topic–comment system. In some proposals, there is one and only one topic function that is associated with multiple forms (e.g., Givón

Table 6.6. *Topic–comment terminology*

	Reference
Bipolar terms	
New information/Old information	Bates, 1976; Chafe, 1976; Fava & Tirondola, unpublished
New information/Given information	H. Clark & Haviland, 1977
Comment/Topic	Bates, 1976; deLaguna, 1927/1963; Hornby, 1972; Sechehaye, 1926; Vygotsky, 1934/1962
Figure/Ground	Bates, 1976; MacWhinney, 1974
Bound information/Free information	Rommetveit, 1974
Conversational dynamic element/Conversational static element	Firbas, 1964
Rheme/Theme	Halliday, 1967
Bifunctional terms	
Information focus/Theme	Halliday, 1967
Secondary topicalization/Primary topicalization	Fillmore, 1968a
Focus/Topic	N. Chomsky, 1971; Jackendoff, 1972; Dezső, 1970
Emphasis/Theme	Dezső, 1970
Related logical terms	
Preposition/Presupposition	Bates, 1976
Predicate/Argument	Reichenbach, 1947
Operator/Nucleus	Seuren, 1969

Source: Bates & MacWhinney, 1979.

1979). In other proposals, there are a variety of functional distinctions that are marked onto surface forms (e.g., Chafe, 1976). This diversity of views is discussed in more detail in Bates and MacWhinney (1979). Our point for present purposes is that the topic–comment system, although admittedly an important part of the grammar, turns out to be very difficult to describe.

Why is the topic–comment system so difficult to analyze? Although there is some disagreement concerning details, there is, by way of comparison, much more agreement among investigators concerning the major semantic roles that underlie the case system. However, the case role system corresponds to a world of external objects and events, a referent world that all share and all can use to verify whether an associated linguistic expression has been used properly. The topic–comment system involves elusive internal states, the speaker's ideas about how to structure discourse, "stage" utterances, foreground and background information.

In studying how grammatical forms map onto discourse functions, the linguist is forced to describe psychological structures and mental states that are not well understood even by the psychologists. But we have to begin somewhere.

Our own efforts to describe the topic–comment system revolve around five structural features: one *function*, with *multiple motives*, applied in *layers of points*, in varying *degrees of specification*, resulting in a need for a *diversity of surface options*.

A single function. *Topic* is defined as *what is being talked about*, and *comment* is defined as *the point being made about that topic*. In other words, the topic–comment system involves a single communicative function of point making, albeit applied in a variety of ways in the service of a variety of motives.

Multiple motives. Some writers have, in contrast with our proposal, defined topic as given information, comment as new information. In our approach, factors like givenness and newness are motives that affect the *selection* of points to be made and things to make points about. But they do not define the function itself. Indeed, a variety of motives compete and converge to determine selection of topics and comments. We will discuss three of these motives here: givenness–newness, perspective, and salience. For a fuller analysis of this system see MacWhinney (1980).

Let us first consider givenness. Givenness is a central motive for topic selection, just as newness is a motive for the selection of comments. These facts are no doubt based on some simple principles of politeness and relevance in discourse (Grice, 1975). Because discourse is a cooperative enterprise we must struggle to provide continuity and to make comments only about information that is already available to both speaker and hearer. Similarly, we add our comments to this shared network of information in an effort to be new, interesting, and at the same time mutually relevant.

However, the topic–comment division is also made in situations in which all the information in the utterance is equally new. In such situations, it is easier to observe how other motives for topic selection operate. One of these has been variously described as "point-of-view" (Friedman, 1955; Owens, Dafoe, & Bower, 1977), "perspective" (S. Dik, 1978; MacWhinney, 1977), "ego-perspective" (Ertel, 1974, 1977), and the "me-first principle" (Cooper & Ross, 1975). Topic selection tends to move along a continuum from elements of discourse closely identified with the speaker to less speakerlike elements of discourse (e.g., agents rather than experiences, instruments rather than locations). Hence, by default, the rest of the relations in a proposition (some or all of which will go into the

comment) tend to be relatively more distant from ego. The notion of a case role hierarchy for promotion to subject has been discussed by Dik (1978); Duranti and Ochs (1979); Fillmore (1968a); Givón (1976, p. 152); Kuno (1976, p. 432); and Zubin (1979). According to these writers, the hierarchy for promotion to subject is

agent > experiencer > dative > instrument > patient > location

This hierarchy reflects, in large measure, a preference for animates over inanimates and humans over nonhumans in establishing the point of view for a sentence.

Within case categories, perspective also interacts with the person system to influence promotion to subject (Givón, 1976; Kuno, 1976). Following the "closeness-to-ego" principle, first-person subjects are more probable than second-person, and first- and second-person arguments enjoy certain syntactic privileges over third-person arguments of the same verb. Silverstein (1976) has shown a similar person hierarchy in his description of ergative languages and the process of "ergativization."

In sum, the function of perspective taking influences the selection of topic, and hence the selection of subjectivalization devices associated with topic, via case role hierarchies and person hierarchies within cases. In addition to the relationship between subject and topic, perspective can influence ordering within nominal compounds where no verb is involved. For example, Cooper and Ross (1975) have shown that the me-first principle predicts noun ordering in idiomatic compounds such as "cowboys and Indians" or "man and machine."

There are certainly exceptions to me-first orderings, such as the fact that it is more polite in English to say "you and I" than "I and you" – although some exceptions might in fact "prove the rule" in that they are intentional reversals of a natural tendency in order to be particularly polite or deferential. None of the authors cited so far has argued that the effects of perspective are absolutely determinate across all languages. However, it is possible for the resulting hierarchies to become completely conventionalized in some languages. For example, in Navajo the order of mention of nominal elements in a sentence is fully determined by their relative animacy, with more animate elements coming first. One of the more interesting implications of a functionalist approach involves the historical passage from a probabilistic ordering preference, based on universal tendencies, to the development of a convention that is fully determinate. We will return to this point shortly.

Givenness and perspective still do not account for all instances of topic and comment selection. Both these choices are associated with perceptual and attentional "vividness" or "salience" – a poorly understood dimension, one that requires a great deal of information about specific situations and about the role of attention in information processing. Nevertheless,

as Horgan (1978) has shown in delineating the role of idiosyncratic salience effects on child word order, these factors do seem to operate systematically once we have located them. For example, one of Horgan's subjects coded the word *ball* in initial position in describing any picture that had a ball in it – a reliable reflection of his personal preferences, that is, what was important or salient for him. Presumably, once a speaker has decided what is salient, then surface forms that vary with salience can be assigned in turn. The problem for both the psychologist and the linguist is to come up with an operational definition of the highly idiosyncratic notion of salience.

Layers. Consider the following sentence:

> It was *this* beer, not the other one, which was drunk by the man who only *recently* came back from Cincinnati (as opposed to the guy who came back from there a week ago).

Obviously there is more than one topic–comment relationship within this sentence. Moreover, the same element serves as a comment at one level, and as a topic at another:

Topic	*Comment*
the other one	*this* beer
this beer	was drunk by the man
the man	who had only *recently* returned from Cincinnati
had returned from Cincinnati	only *recently*
the guy who came back from there a week ago	the man who had only *recently* returned from Cincinnati

We suggest that the point-making function is recursive, and can be applied within a given utterance an indefinite number of times. Notations could be used to describe such nested point-making relations. These notations would be formally analogous to predicate-argument bracketing in the logical analysis of complex expressions.

Degrees of specification. There is a wide range of variation in the amount of specification necessary to establish topics and make points about them. Here the same point is being made about the same topic, but the circumstances surrounding that point clearly vary:

(1) Magnificent!
(2) That was magnificent!
(3) That violin solo was magnificent!
(4) That violin solo in the third movement of the Beethoven piece was magnificent!

(5) I went to the symphony last night and, among other things, heard a Beethoven symphony. There was a violin solo in the third movement that was magnificent!
(6) In my country we have a form of music in which . . .

The topic for the comment "magnificent" is the same in all six cases. But these different utterances reflect an increase in the degree of topic specification necessary for the point to be understood – ranging from zero specification to a passage that threatens to be infinitely long. The same continuum also applies to comment specification, which can range from a small nonverbal gesture (e.g., pointing, shrugging, grinning) to extremely long passages of "commentary."

Devices. Given the complexities of the point-making function, any language must provide many devices to carry out its communicative work. In our view, some of the confusion in the literature on form–function relations in discourse results from a failure to separate these psychological dimensions in explaining the determination of surface forms associated with the topic system.

Later on we will describe some Level 2 and Level 3 research that we are carrying out to test the validity of the competition model within the topic–comment system. First, however, we must describe further competitions between topicalization and other basic communicative functions.

6.4. Topic–comment relations and grammar: competition with other systems

As noted in the preceding section, perspective or similarity to ego is one of the motives that operates to determine topic selection. This tendency provides a reliable point of contact between topicalization and the case role system, resulting in the high correlation between topic and agent in the assignment of surface forms, particularly the surface forms associated with the conventional notion of "subject." Although topic and agent tend to be assigned to the same element in most sentences, there will inevitably be instances where these two roles are assigned to different arguments of the same verb. For example, principles of salience or givenness may motivate the selection of an inanimate object as the topic, whereas the animate referent is automatically assigned the agent role. What happens in these instances of competition?

The respective contributions of topic and agent are discussed in detail in a recent volume entitled *Subject and Topic* (Li, 1976). The debate centers on three kinds of underlying grammatical categories: agent, topic, and a hypothetical grammatical category called "subject" that is neither agent nor topic, but is defined exclusively in formal terms. Let us consider

how these categories are apportioned in different languages. The case role hierarchy just described reflects a continuum from more to less speakerlike elements. Although the continuum itself appears to be universal, languages vary in the point at which they draw a conventional boundary separating elements that can be mapped as subjects (Dik, 1978). For example, in English it is possible to assign the subject role to such far-removed arguments on the hierarchy as instrument and location. In Dutch, instruments and locatives cannot be encoded as subjects regardless of what points the Dutchman wants to make about them. There are, however, no known languages in which instruments can be mapped as subjects but agents cannot. In short, there are differences among languages in the "metaphoric range" with which agency dominates subject assignment, but the core or "best" subject is always an agent.

Working from the other side of the competition, there are some languages in which subject phenomena seem to be governed almost exclusively by the category "topic." Some of the debate in the Li volume centers on Philippine languages, particularly Tagalog. In Tagalog, there is an NP that is marked both by the preposition *ang* and by a prefix on the verb. Some Philippinists call this *ang* NP the "focus"; others call it the "topic"; still others choose to treat it as a type of subject in the more traditional sense. The view that the *ang* NP is a "true" subject is difficult to maintain. Keenan (1976b) has provided an extensive list of phenomena that correlate across languages with the role of subject. Applying some of these criteria, Schachter (1976, 1977) has noted that the *ang* NP does not control either reflexivization or co-referential complement subject deletion – properties that Keenan views as central to defining subjects. On the other hand, the *ang* NP does not function entirely as a true topic, that is, a category determined entirely by pragmatic constraints. For example, Schwartz (1976) has argued from data on the closely related Ilocano language that only one focused element can appear in a given sentence. By contrast, in languages like Lisu there can be several topics in a single sentence (layered, as in the beer example cited earlier). Schwartz suggests that this one-per-sentence restriction transforms the *ang* element into a more abstract category that should be defined separately from the topicalization function itself. Similarly, the Philippine focus element cannot be a genitive, whereas topics in other languages can easily be genitives. Finally, the tendency of the Philippine focus to be marked by agreement on the verb convinces some linguists that the *ang* element really is a sentential subject. Hence they would conclude that Tagalog, like all languages, must be described with a universal "subject" category that is neither topic nor agent, although it is associated statistically with both.

Li and Thompson (1976) have proposed a fourfold typology for the languages of the world to describe this kind of distributional evidence.

The typology is based on a contrast between *subject-prominent* languages like English and *topic-prominent* languages like Lisu. The Philippine languages fall into a third category. Li and Thompson suggest that these languages began with a true topic, which became bound to the case frame of the verb through agreement particles (cf. Givón, 1976). Hence Tagalog and Ilocano have neither clear subjects nor clear topics. The fourth type is exemplified by Japanese, with both subject and topic clearly marked on the surface by separate elements. This type of language supposedly develops out of a subject-prominent language through the increased use of separate topic markers.

The Li and Thompson classification presupposes that subject can exist as an autonomous category. We propose, instead, that the contrast between subject-prominent and topic-prominent languages is really a result of a competition between agent and topic for control of surface phenomena. In the terms that we have introduced here, Japanese and Tagalog can be viewed as two cases of a divide-the-spoils solution. In Tagalog, however, the agent is more clearly marked than the topic, whereas in Japanese the opposite is true. By contrast, English and Lisu represent two different kinds of peaceful-coexistence solutions. English merges agent and topic in most cases, capitalizing on the role of perspective in creating a statistical overlap between these two categories. When the overlap does break down, agency is more likely to dominate in assignment of subjectivalization. Lisu also capitalizes on the overlap between topic and agent, but leans toward topic as a determiner when the two categories diverge.

Our modification of the Li and Thompson typology could be subjected to an experimental test. The various findings noted in Tables 6.3 and 6.4 provide evidence (1) that topics are processed more easily, quickly, and so on as subjects or initial-position elements, and (2) that agents also make "better" subjects in a variety of psycholinguistic tests. Similarly, evidence referenced in Table 6.5 demonstrates that children use both topic and agent information in the acquisition of subject phenomena. None of these lines of evidence, however, tells us what to expect in a situation of competition between topic and agent. We would predict that, in experiments designed to set topic and agent against one another, speakers of Japanese, Lisu, Tagalog, and English would behave quite differently. Suppose we present subjects with picture-description situations (similar to those described in MacWhinney & Bates, 1978), in which one protagonist is set up as topic (using some combination of givenness and salience to achieve that effect) and another protagonist in the same action is more clearly biased as the agent of that particular act. Presumably, an English speaker would be more likely to select the agent as the surface subject of the sentence in his description, whereas the Lisu speaker would assign analogous surface forms to the topic. This would be an excellent

example of Level 2 synchronic correlation. It would also support a Level 1 theory about the relationship between form and function across languages. Similarly, if we could demonstrate that Lisu children are drawn more clearly to topic-defined subjects, whereas English children are more likely to use agency in subject assignment, then we might be able to set up Level 3 evidence to test the proposed typology for topic–agent relations.

Although we do not have information of this sort on the more exotic topic-prominent languages discussed in the Li volume, in some of our own ongoing research we are carrying out production experiments contrasting agency and various aspects of topicality in case-marked (Serbo-Croatian, Hungarian) versus word-order (Italian and English) languages. The prediction is that topicalization effects on word order will be greater in the case-inflected languages, where there is an alternative means for marking agency. Part of the problem in carrying out such experiments involves the difficulty of setting up a topic bias. Weak topic manipulations (e.g., two pictures in a row in which one element is given while the others vary) may not be a good analogue to real-life topicalization, where a theme is established along lengthy passages of discourse (see Karmiloff-Smith, 1979b, for evidence on the strength of well-established topic effects across narratives). In MacWhinney and Bates's (1978) experiment on the effects of givenness, a brief givenness manipulation did result in more variations in ordering in Hungarian than in Italian or English, as predicted. However, in current research we are using lengthier topic manipulations, with control over perspective and salience, to determine just how strong the effect of topic is in determining word order in inflected languages.

An alternative type of experiment involves sentence comprehension, when topic information and agent information are set in conflict, in interaction with associated surface forms. We have, for example, used the "enactment" paradigm (Bever, 1970; Dewart, unpublished; Sinclair & Bronckart, 1972; Slobin, Chapter 5) in which adults or children receive a three-element sentence in NVN, NNV, or VNN order and are asked to decide or demonstrate "who did it." The information available for agent selection comes from word order, topicalization (e.g., "This is a cow. Now we're going to talk about this cow. The cow a horse kicks"), contrastive stress (e.g., "THE cow a horse kicks"), and animacy (e.g., reversible sentences like "THE cow a horse kicks" versus nonreversible sentences like "THE PENCIL a horse kicks"). In this kind of many-to-one manipulation, we have set into conflict not only information biasing the speaker toward animacy and topic, but information from surface forms that may vary in the degree to which they exercise absolute as opposed to probabilistic determination of the subject–verb relationship. So far we have results only for the contrast between Italian and English (Bates, McNew, MacWhinney, deVescovi, & Smith, in press). These two lan-

guages are both supposedly SVO word-order languages, without case markings for agency (except in the personal pronouns, which are of course eliminated from the experiment). Hence, in principle, the formal conventions of the languages are the same and could map onto underlying categories in much the same fashion. In practice, however, Italians make much more use of alternative word orders than English speakers, at least in informal discourse. Therefore Italians have considerably more experience in using semantic and pragmatic information to interpret various word orders, and this functional difference seems to have an enormous impact on the ways in which Italian and English speakers interpret sentences in this experiment. In English, word order is used heavily. In NVN sentences, the tendency to choose the first noun as agent is almost absolute, even when animacy provides conflicting information (e.g., "The pencil kicks the cow"). In NNV and VNN sentences alike, there is also a strong (though probabilistic) word-order tendency, with significant preference for the *second* noun as agent in both of the noncanonical orders. This second-noun strategy is, in fact, in keeping with permissible alternative orders of left dislocation ("Egg creams I like") and right dislocation ("Really gets on my nerves, that guy") in colloquial English. Italians, by contrast, show a massive preference for animacy, even in NVN sentences. Thus the Italian adult is far more likely to choose the cow as agent than an English speaker in "The pencil kicks the cow." For the NNV and VNN types, when animacy information is not available, the Italians seem to be particularly sensitive to topic and stress to help disambiguate the utterance. There is no word-order strategy analogous to the one adopted by English adults for noncanonical sentences.

These results suggest that the "functional underpinnings" of what is superficially the same kind of formal language can vary enormously. Though both Italian and English are formally word-order languages, the role of word order is more strongly conventionalized in English usage than in Italian. This psycholinguistic fact is consistent with historical facts about the two languages, insofar as Italian is still in transition from its case-marked Latin ancestor to a more fully word-order-based format. Hence we may have captured the functional system that creates formal changes *in vivo* at a transitional moment. In some ongoing research by our group, the same kinds of experiments are being administered in Serbo-Croatian, with particular emphasis on a dialect area between Yugoslavia and Italy where the case system is beginning to erode, but has not gone as far as modern Italian in the transition from case to word order. We expect the "functional map" surrounding performance in this dialect to look much more flexible than, for example, performance by speakers of a less ambiguous, intact case system like Hungarian.

These experiments are in progress, and any results to date are certainly inconclusive. They are presented primarily to illustrate how Level 2 and

3 experiments can be used to map out the "weights" attached to different form–function relations within a competition model. It is our hope that this approach will also be useful for diachronic studies of historical language change (Level 1) and the pathways that children take in the acquisition of form–function mappings (Level 3). It is not enough simply to show that there *is* a relationship between meaning and form (e.g., that definite articles tend to be used to map old information), because such information is available through much more parsimonious armchair techniques. Our goal is not to verify well-known one-to-one mappings, but to examine the *relative* causal control of different forms and functions in a network of relationships, for different kinds of language use (e.g., comprehension versus production), at different points in development, in a carefully selected set of languages that contrast in the kinds of solutions to competition that they provide.

Although research like this could support a Level 4 hypothesis about the nature of the intermediate structures in a form–function mapping, it is in principle possible to explain these findings with functionalist grammars or any of a variety of purely formal systems. However, information like this does make it possible to speculate about just how a Level 4 functionalist description might be built for certain aspects of the grammar. We will conclude with some thoughts about how to construct a grammar for at least parts of a language using only such "natural" functional categories as topic and agent.

6.5. On the internal structure of grammatical categories

First of all, we will define a grammatical category as the set of elements that can be mapped onto a single surface grammatical device, or onto a correlated set of surface grammatical devices. For example, the set of related surface devices that constitute subjectivalization (e.g., initialization, agreement with the verb, nominative case pronouns) are used to map a corresponding class of elements that we will call the category "subject." Similar definitions apply to the categories of verb, noun, and so on. We should note at the outset that this definition is technically at odds with a transformational grammar account of deep-structure subject. Strictly speaking, "subject" is a relation rather than a category in the standard or extended standard theory. It is defined as the noun phrase that is directly dominated by the S-node (Sentence) and that combines with a VP in a hierarchically organized syntactic tree. However, whether it is defined as a relation (as in Chomsky's standard theory) or a category (as in relational grammar of Perlmutter & Postal, 1977), "subject" is treated as an abstract symbol that is the direct input to the transformational component. Such symbols are primary, axiomatic, and unitary. They have no internal structure. Presumably any element marked +S,

+V, +N, and so forth is an equally good candidate for mapping onto corresponding surface forms. The semantic component can act to *interpret* these symbols and to project them onto a variety of semantic categories and/or relations. However, these symbols cannot be defined in terms of their eventual semantic interpretations. In other words, traditional transformational grammars assume an independence of syntactic and semantic categories. Moreover, as Noam Chomsky (1971) has emphasized, it is the syntactic component, and not the semantic or stylistic component, that controls the structural "well-formedness" of the sentence. By contrast, a Level 4 functionalist approach seeks to equate the categories that are mapped onto surface grammar with a set of semantic-pragmatic elements, bypassing an independent, abstract, and unitary set of syntactic categories or symbols.

But what kind of category can contain all of the elements that can be mapped, for example, as surface subjects? Adult English speakers can generate, comprehend, and judge as grammatical a variety of sentences that contain nonagentive subjects (e.g., "The knife cuts" or "The door opened"), nontopicalized agents (e.g., "*John* hit the ball, not Fred" or "In ran the rabbit"), stative as opposed to active verbs (e.g., "John knew Mary very well"), and abstract "entitylike" nouns (e.g., "John's drinking bothers me"). If we are to include this capacity in our description of the native speaker's linguistic knowledge, how do we account for the fact that no single semantic or pragmatic category can contain all the elements that are mapped with a particular surface form? How do we describe the semantic-pragmatic heterogeneity of form-class membership in the grammar?

Criterial attribute models

Traditionally, classes or categories have been defined according to a *criterial attribute model* (see, e.g., Bourne, 1967). Within such models, a category is defined by a set of features shared by all members, which are necessary and sufficient conditions for category membership. If we accept this traditional approach to the internal structure of categories, then we are forced to define categories like subject, noun, and verb so abstractly that we arrive at the equivalent of single-feature definitions like [+S], [+N], and [+V]. To illustrate how the criterial attribute model would work in this case, take the example presented in Figure 6.1. Here we have four individuals or entities (A, B, C, D) that are candidates for category membership. Each of these entities (objects, events, etc.) is comprised of a set of features: A contains features 1 through 7; B contains 3, 4, 5, 6, and 9; C contains 3, 4, 7, and 8; D contains only 1 and 2. Can these four entities be members of the same category? Within a criterial attribute model, they cannot. Thus we cannot form one category con-

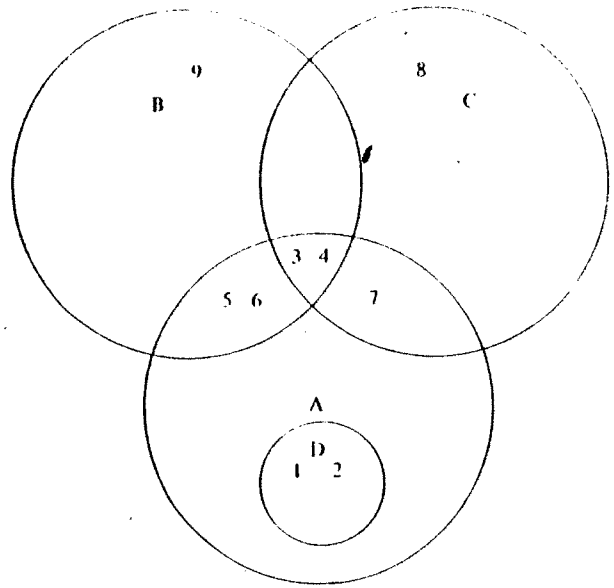

Figure 6.1. An illustration of the category definition problem. Letters A–D label the Euler circles and stand for objects exhibiting the features numbered 1–9.

sisting of entities A through D. The *extension* of this class (i.e., the descriptive list of the members with all their features) includes the *union* of the full set of features 1 through 9. However, the *intension* of the class (i.e., the defining features shared by all members) can include no more than features 3 and 4, the *intersect* of A, B, and C. Because D falls outside that intersect, it cannot be a member, even though its features (1, 2) are contained in the union of A through C. This situation can be summarized as follows:

1. Possession of criterial features 3 and 4 is a necessary and sufficient condition for category membership.
2. Possession of additional features (1, 2, 5–9) is irrelevant to category membership.
3. It is not possible for two individuals to be members of the same class without overlapping in features (at *least* the criterial features).
4. All relevant features are weighted equally, and degrees of possession of features are irrelevant to determining category membership. In other words, there are no grounds by which one member can be a "better" instance of the category than another.
5. Even if a given individual possesses noncriterial features in common with members of the class (D in Figure 6.1), that individual is in no way "closer" to membership in the category.

If we were to assume for a moment that the criterial attribute model could be an appropriate description of the psychological structure of grammatical categories, then it would become obvious why adult competence must be described in terms of abstract syntactic symbols with no internal structure. There would be essentially *no* intersect shared by all the semantic and pragmatic elements that can be mapped as subjects, or as nouns, or as verbs. The "criterial attribute" that unites all the meanings that can be subjectivalized in English would have to be the fact that all of them can be treated as noun phrases. Because English has nominalization mechanisms for turning just about any element into a noun phrase, we would be left with nothing other than /+NP/ and /+S/ to define the grammatical category of subject. Thus, if we accept the criterial attribute model of category structure, we must also accept the system of autonomous syntax as an inevitable corollary.

Prototype models

There is, however, an alternative to the criterial attribute model. This alternative is Rosch's theory of prototypes (see Rosch & Lloyd, 1978). Although this theory has been applied so far primarily to the internal structure of lexical categories (see, e.g., Bowerman, 1976), more recently a few linguists have begun exploring some applications of prototype theory to grammatical categories (Givón, 1979; Lakoff, 1977; Langacker, 1978; Talmy, 1977), and to language learning (Bowerman, 1976; Braine & Wells, 1978; deVilliers, 1980; Schlesinger, 1977b). Rosch's own work deserves more thorough treatment than we can afford here, but fortunately the reader can consult deVilliers (1980) for a brief but thorough review of that research. In this section of the chapter, we will limit ourselves to a condensed set of summary statements about the prototype model for category structure, so that we can demonstrate its applicability to language acquisition as described by the functionalist competition model.

The essential tenets of the prototype approach to category structure can be summarized as follows:

1. *Central tendency*. A category is defined neither by the union nor by the intersect of its members. Rather, a category is defined in terms of a prototypical, or central tendency, member that contains the maximal number of features in common with members of its own set. In a topological system made up of many categories, the prototype stands a *minimum distance* from members of its own set and a *maximum distance* from members of other sets.

2. *Family resemblance*. Category membership is determined on the basis of "family resemblance" to the prototype, that is, on the basis of an overlap in features with the prototypic member.

3. *Goodness of membership*. Just as the prototype is the "best" instance of the category, "goodness" of category membership is defined by the *amount* of overlap in features with the prototype.

4. *Heterogeneous membership*. It is possible for two items to belong to the same category via their overlap with the prototype, but to share no overlap whatsoever with one another (i.e., Cousin John has the family nose and eyes, Uncle Bill has the mouth and hair, whereas Harriet (the prototype) has all four).

5. *Fuzziness*. Although the center of a category may be easy to define, it is more difficult to define peripheral (i.e., minimum-overlap) instances that have more features in common with other sets than with the category of interest. In other words, categories have fuzzy and ill-defined borders that may shift depending on the needs of the category user.

6. *Weighting*. Prototype models can also be used to describe instances in which some *features* of the prototype are more heavily weighted than others. As Tversky (1977) notes, weighting differences may be either *static* (intensive) or *dynamic* (diagnostic). Static weightings focus importance on certain features in all contexts, whereas dynamic weightings change the relative importance of one feature or another in a given context. As certain features increase in their weight or importance in making categorization decisions, a prototype model may come to resemble a criterial attribute model. Hence we can describe prototype structures and criterial attribute structures as two ends of a continuum with feature-weighted models in between. Although not proposed by Rosch herself, the notion of feature weighting is entirely compatible with Rosch's general position. Some recent applications of the feature weighting approach can be found in Tversky's (1977) research on similarity judgments.

If we apply this model to Figure 6.1, the category will be defined in terms of the prototypic member A, because A contains more features in common with the other members of the category than do B, C, or D. This category structure would emerge more clearly if we provided a more complex diagram with several "neighboring" categories. Such a diagram would demonstrate that A has *fewer* features in common with these other classes than do B, C, or D. Although D shares no overlap in features with either B or C, it is entitled to category membership because of its family resemblance to A via features 1 and 2. However, because D shares fewer features with A than any of the other members, it is essentially a "bad" exemplar of the set. Element B, which overlaps with A on four features (3, 4, 5, 6) is the second-best member of the set, and C (which shares only the three features 3, 4, 7) is the third-ranking member. In this model, all the features are weighted equally. However, if the features differed in salience or weighting, then these ranks might change. For example, if 4 and 7 were the most important features of A, then C would be a better exemplar of the set than B.

In an interesting series of experiments, Rosch has demonstrated the psychological reality of prototype structure in a variety of natural categories. She has found that adults have little difficulty rank ordering members of a set. They can easily determine that robins are excellent birds and that ostriches are very poor birds. Prototypic members are easier to comprehend, to produce on demand, and to recall than peripheral members. Moreover, this holds true even when relative frequency in the language is controlled. Information that is learned about a prototypic member is rapidly and easily generalized to peripheral instances, whereas information learned about a peripheral case does not "spread" to the rest of the category so easily. Adults can be shown to derive prototypes in the laboratory, summing across instances in artificial concept learning experiments (Posner & Keele, 1968). In fact, they may even construct a prototype or "best exemplar" that is not administered in the actual stimulus set, an idealization that is judged as "better" than the examples that were actually seen. However, prototypes are not always derived by summing across a large set. Rosch and Mervis (1975) suggest that children build categories around prototypes that are the first exemplars of the set (e.g., the family dog rather than the publicly approved "best" dog). Hence category structure may have to shift across development from first to best instances.

Another point worth mentioning in our brief summary is that the prototype versus criterial attribute dimension in category structure is completely independent of two other dimensions: mode of representation (discrete versus analogue) and abstractness (superordinate versus subordinate class levels). Some confusion in the literature has revolved around the fact that some of Rosch's earlier research investigated domains, such as color, that have analogue structure. Her experiments can also be replicated, however, with stimuli taken from domains that are best described with a discrete feature system. Though prototypes *can* be images or pictures, they are not *defined* as images or pictures. Also, prototypes can exist at any level of superordination in a class hierarchy. The superordinate class "vehicle" can have a prototypic member (in our culture, probably "car"). The class of "cars" can in turn be organized around a prototypic member (perhaps an American sedan, or some composite of small four-door compacts); American compact cars may form a class around a prototypic member (e.g., a Chevette); and so forth. In other work Rosch has also explored this "vertical" dimension, suggesting that it is organized around the so-called basic level or most common level of use. For example, "car" is a basic level in the transportation tree just given; "vehicle" is too superordinate for use in most instances, and "American sedan" is too subordinate and specific for use in all but a handful of cases. In a sense, the basic level is the prototypic level of use in this vertical dimension. However, this abstractness dimension is independent of the "horizontal" dimension of category structure *within* levels.

Finally, we should also note that Rosch does not deny the psychological reality of criterial attribute category structure in some cases, for some purposes. Clearly adults *can* organize categories into the kinds of clear and exhaustive class structures that characterize scientific taxonomies (see, e.g., Bourne, 1967). Rosch's point, however, is that natural categories typically are not organized into criterial attributes for most of the things we do most of the time.

Although prototype theory began as a model of adult categorization, it also provides some striking continuities with what we know about classification abilities in children. Vygotsky (1934/1962) and Bruner (1966) have noted that preschool children tend to group or sort stimuli into "complexive groupings," or family-resemblance structures. For example, a 3-year-old asked to "Put the ones together that are alike" may group a doll, a truck, and a bottle. When probed, he may explain his sorting as follows: "The dolly can ride in the truck, and she can drink the bottle." In other words, the *production* of categories in this age range involves heterogeneous groups, based on featural overlap but not necessarily on intersection of features. Inhelder and Piaget (1959) have reported similar findings for the sorting behaviors of preoperational children. They have argued that the capacity to impose criterial attribute categories on an array is a manifestation of concrete operational logic, and hence is not available until somewhere around 5 to 7 years of age. Bowerman (1976) has suggested that lexical categories in preschool children (particularly very young children) show the same characteristics of complexive groupings. For example, a child might call a nonfurry four-legged animal "kitty," a furry object without legs "kitty," and a nonfurry legless animal with a tail "kitty." However, Thomson and Chapman (1976) have demonstrated that in *comprehension* the child judges some kitties as "better" than others. As E. Clark (1977) has noted, the child seems to be categorizing novel instances according to a logic that can be paraphrased as "This is kind of like a kitty." According to prototype theory, the ways in which children make these extensions are determined by the shape of the prototype and the relative weights of the features it contains.

To summarize, evidence on adult categorization from Rosch and her associates suggests that natural categories are organized around prototypic instances, with membership assigned via family resemblance to the prototype. Evidence on categorization in children suggests that the capacity for criterial attribute classification does not emerge until 5 to 7 years of age. The complexive groupings that characterize preoperational classification can also be used to describe the organization of the lexicon in young children, in both comprehension and production. If we could use similar complexive groupings or prototypes to delineate a model of

grammatical categories, we would have made progress toward a more unified theory of natural categories, particularly in very young children.

Prototype theory and grammatical categories

We propose that grammatical categories may also be organized around prototypic members, with assignment of the corresponding surface forms that mark category membership being based upon family resemblance to those prototypes. This solution has been proposed explicitly by Lakoff (1977), Talmy (1977), Langacker (1978), deVilliers (1980), and Schlesinger (1977a), and is implicit in the work of Braine and Wells (1978) and Leonard (1976). Most of the work done by these researchers has concentrated on semantic prototypes, for example, agent as the basis of subject, action as the basis of predicate and/or verb. Furthermore, experimental work from this perspective has been carried out entirely in English, as far as we know. In our view, the prototype model could be expanded to describe peaceful coexistence and competition between semantic *and* pragmatic factors, for example, agent and topic as categories underlying subject phenomena. This approach would provide a good fit not only to facts about English, but to psycholinguistic studies of different language types.

Although Keenan (1976b) has listed more than thirty properties that define "subject" across languages, we will restrict our discussion to three correlated surface conventions: word order, verb agreement, and case markings on pronouns. Hence the category "subject" is defined as the set of elements that are reliably encoded with these three surface forms. Insofar as languages exploit the high probability of overlap between topic and agent by assigning them to the same surface devices, both topic and agent must be built into a Level 4 functionalist description of the grammatical category "subject." A prototype theory permits us to represent this situation directly within a single category structure.

1. *Central tendency*. The category "subject" is defined neither by the union nor by the intersect of its members; rather, that category "subject" is defined in terms of the central tendency member "agent–topic." This prototypic subject shares the largest number of features in common with other subjects; at the same time it has the smallest number of features in common with competing form classes, such as "predicate." In adult English, the central tendency of this subject category lies at the intersect of the agent system and the topic–comment system, with the motive of perspective taking serving as a bridge between agency and topicality (see MacWhinney, 1980). In short, perspective taking is the functional reason why an agent–topic is the prototypic subject.

2. *Family resemblance*. Assignment of the correlated set of surface forms that constitute subjectivalization (i.e., word order, agreement, nominal case) is determined via family resemblance to this agent–topic prototype, that is, to elements that possess some subset of the features of agent–topic. For example, instruments may be mapped as subject via overlap with a subset of agent–topic features (e.g., /+cause/; see the discussion further on in this section). This is the process that Lakoff (1977) refers to as "partial matching." Similar processes of "metaphoric extension" are proposed by deVilliers (1978) and Schlesinger (1979).

3. *Goodness of membership*. Goodness of membership is defined by the *amount* of overlap of potential subjects with agent–topic features. Evidence for the psychological reality of this principle comes from experiments demonstrating that agents and topics are each "good" subjects, insofar as they are far more probable in normal discourse across languages (Duranti & Ochs, 1979); they appear as determinants of the emergence of subjectivalization mechanisms in the histories of particular languages (Li, 1975, 1976); they are easier to comprehend, produce, and verify in laboratory studies with adults (Tables 6.3 and 6.4); and they are acquired earlier by children (Bates & MacWhinney, 1979). Furthermore, there is evidence that topic–agents make better subjects than either agent or topic taken separately (Bates, McNew, MacWhinney, deVescovi, & Smith, in press), a finding which suggests that this particular combination lies at the core of the subject category. This does not mean that peripheral elements *cannot* be mapped as subjects. But they will not become the subject of a sentence when a "better" candidate is available, except under specifiable conditions. (See "Weighting," further along in this list.)

4. *Heterogeneous membership*. It is possible for two items to belong to a category via their overlap with the prototype, and yet share no overlap at all with one another. One element can be exclusively an agent and another exclusively a topic, and both can still be mapped as acceptable subjects. Similarly, one element can be exclusively a comment and another element can be exclusively a process, and both can still qualify for selection as predicates. This is the essence of the peaceful-coexistence solution in the competition model that we have proposed.

5. *Fuzziness*. Although the center of the category "subject" is clearly defined, it is more difficult to make decisions concerning the acceptability of peripheral members. A crucial claim for our version of prototype theory is that there exist difficulties in grammaticality judgments for elements at the semantic-pragmatic periphery of form-class categories. There is evidence for such "fuzzy boundary" phenomena, for example, at the outer boundary between "verb" and "noun" where certain meanings take on mappings appropriate for both classes (Ross, 1973). The advantage of a prototype theory is that both crisp grammaticality judgments and fuzzy or uncertain judgments are predicted with the same unified set of features. In other words, the prototype theory approach can provide a precise theory of imprecise phenomena.

6. *Weighting*. The role of feature weighting in subject selection can be

illustrated by the English passive. In most English sentences the subject is the agent: The *static* weight of the agency feature(s) for English subject selection is fairly high. However, in some cases, dynamic weighting of certain features of topicality can overcome the static weight of agency and lead to the production of a passive. As Horgan (1978) and others have noted, this increased weight on topicality as a feature usually occurs only in the context of formal written discourse. Variations in the occurrence of informal left-dislocated structures (Duranti & Ochs, 1979) may also reflect the operation of dynamic weighting.

The model just outlined can account for most of the existing psycholinguistic data on subject selection. We have concentrated on evidence supporting a prototype model of topic–agent as the defining member of the category governing the surface phenomena of subject. In principle, similar descriptions could be provided for other form-class categories such as nouns and verbs.

With regard to nouns, there is evidence that the central tendency or highest-probability member of the class of nouns is the physical object; for verbs, the "best member" is an intentional action resulting in a change of state in some recipient (Gentner, 1982; see also Slobin, 1979). Adjectives, a third major form class, are typically used to encode qualities or states that have some of the static properties of objects but are at the same time intangible and temporally limited like many actions. These three categories, with their respective "best members," form a "neighborhood of families," a category space in which each category is defined in part through contrast with its neighbors. This means that a given element may have all of the features that are central to a good noun and still be denied "best membership" because it also shares features with the category of verbs. Thus *lightning* is a noun, but also overlaps with certain prototypic features of the verb category; *feature* is a noun, but contains elements that draw it toward the "state" category of adjectives. Ross (1972) has provided syntactic evidence suggesting that there is a continuum between the form classes of "verb" and "adjective." At the center of this continuum are items that take on some of the surface mappings of verbs, though they are treated as adjectives in other grammatical contexts. A similar continuum has been proposed for the transition from "nouniness" to "verbiness." Most of the work on fuzzy boundaries in these form classes has concentrated on a category space made up of semantic features (e.g., +cause, +intention, +static). Applying the same logic used to analyze "subject" as both a semantic and a pragmatic category, we suggest that "verbs" may be best defined in terms of a combination of features including discourse features from the overlapping role of "comment." Indeed, just as agent and topic are joined together via the "bridge function" of perspective taking, verbs and adjectives may have more in common as predicates, in contrast with nouns, via a bridge function of commenting. In support of this suggestion, consider the fact that the verb or predicate in a sentence is more likely to be new information, whereas nouns are frequently used to encode information that is already given in the context (Bates, 1976).

To explore in more detail the overlaps and boundaries among such semantically-pragmatically defined form classes, we will need a more detailed theory of the features that constitute the internal structure of these categories. For example, the two gross categories of "topic" and "agent" presumably contain a set of internal features. "Topic" might be made up of such motivational features as "givenness" and "themacity." "Agent" would contain features like "animacy," "intention," "cause," and "human." Similarly, if the category "*noun*" is indeed best defined in terms of a prototypic physical object, then we will need a psychologically real feature theory to define the internal structure of the object concept (see Gratch, 1975, for a review of "features" or elements of knowledge that constitute the object concept in young infants). And a better definition of "verbs" will require a better theory of "intentional action" as a definitional prototypic member. In short, we are far from a detailed semantic-pragmatic analysis of grammatical categories. But such analyses are in principle possible, and empirically verifiable.

A final advantage of prototype theory in the description of grammatical knowledge is that it provides a plausible route whereby children might pass from poorly organized clusters of information about how to use surface forms to more precise and perhaps criterial definitions of the same grammatical category. Recall the description we provided earlier of the Italian child's acquisition of subject phenomena. Unlike some English children, who begin the two-word period by reliably mapping agent-action and action-object in appropriate orders, the Italian child begins with word-order tendencies that are best described as a comment-topic ordering. At that point in development, the *only* surface phenomenon correlated with subject is initial ordering. When case-marked pronouns and verb agreement are acquired, some children seem to use a divide-the-spoils policy of assigning initial position to the topic system, whereas agreement and case marking are used to mark agency. Eventually, the Italian child learns to coordinate the three surface phenomena into a single system that is mapped by some combination of topic and agent. That "coalition" could be described by merger into a single subject category, organized around a prototypical topic–agent member. Once such a unified category is established, the child may remain there into adulthood. In other words, in the terms described in Section 6.1, there may never be a developmental shift from semantic-pragmatic categories into a more abstract system. Alternatively, through gradual experience with the many kinds of elements that adults can use as sentence subjects, the child may reorganize his unified category around a single abstract formal symbol like "+S,"

arriving eventually at a formal, autonomous grammar more compatible with those described by transformational grammarians. The point is that, whether or not adults organize their grammatical knowledge in purely functional terms (Level 4), prototype theory provides a way of describing intermediate grammars that children might use as a bridge to a more formal system. As a best guess about when such a change might take place, we suggest the period from 5 to 7 years of age, when children show independent, nonlinguistic evidence of an ability to construct and apply classifications based on criterial attributes.

To summarize, we feel that there is considerable support for functionalist approaches to the acquisition and use of grammar at Levels 1, 2, and 3. Furthermore, there is hope for a precise theory of vestigiality, to predict and explain the existence of anomalous structures that serve no ongoing communicative function. Whether the facts that support Levels 1 to 3 can be built into a Level 4 functionalist grammar remains to be seen. There have, for example, been several proposals in the last few years for nontransformational, generative grammars that map surface forms directly onto a combination of case role information and pragmatic categories (theme, perspective, topic). These include Dik's *Functional Grammar* (1978) and Lakoff and Thompson's double hierarchy theory (1977). Prototype theory provides some possible solutions to the problem of heterogeneous class membership in adult use of the language. Even if prototype theory proves too weak to handle the full range of phenomena in adult language, it may still prove to be a useful system for describing transitional moments between the child's first primitive definitions of grammatical categories and later, more precise knowledge of his language. The analyses we have proposed in this state-of-the-art chapter contain a high ratio of promissory notes, particularly with regard to the many cross-linguistic experiments that remain to be done. Nevertheless, we believe that we have shown that all of the four levels of the functionalist position can be profitably treated as testable hypotheses that lead to interesting predictions.