

Small Model Languages as Tools for Reflection

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Abstract. The paper presents a way of investigating verbal communication and examining assumptions about it independently of particular approaches to linguistic analysis through the development of imaginary language systems using very limited models (small model languages), identifying limitations, and finding ways to extend them. The imaginary systems are compared to real verbal phenomena to highlight communicational principles and to show where questions arise. They can be pedagogical tools. A simple model is introduced as an example and ways of extending it are considered along with the questions that are raised in the process. Consideration is given to a model of empirical testing and the assumptions behind it. Some links to existing views are made along with tentative connections to cognate disciplines.

Keywords: language models, imaginary systems, empirical testing, assumptions, limitations, real data

1 Basic Idea

Languages are not only vastly complicated but, furthermore, linguistic phenomena can be approached from a variety of points of view to arrive at constructs of different sorts. As Saussure pointed out long ago, “[b]ien loin que l’objet précède le point de vue, on dirait que c’est le point de vue qui crée l’objet” (1972: 23).¹ In order to describe languages then, parts of languages (such as phonological or syntactic systems), or verbal interactions, one needs a “theory for

¹ “Far from the object (of study) preceding one’s point of view, one would rather say the point of view creates the object” [trans. PR]. One might note that the implication that languages and their components are the linguist’s constructs conflicts with Saussure’s claims to be defining “des choses et non des mots” (“things and not words” [PR], p. 31) and that language is an identifiable reality (“empreintes déposés dans chaque cerveau” (“imprints formed in each brain” [PR] p. 38)).



description”, i.e. a principled way of establishing constructs (or “point of view”), which can account for selected sets of observables in a coherent and empirically valid way (cf. Mulder, 1975: 87–104). The term “description” should not be viewed restrictively—any description must have an explanatory function in relation to the selected phenomena of whatever sort. However, any theory for description will involve a wide range of assumptions about the nature of the observables—i.e. which aspects of speech events to model and the relevant selection of phenomena, and methods. Such theories will be “arbitrary but appropriate”, as Hjelmslev (1953: 24–5) maintained. We might assume, for example, that “communication”—the transmission of information—is the fundamental characteristic to be considered, but that assumption too requires further investigation and definition. Alternative perspectives on speech, viewing speech as “expression” or as aesthetic or social phenomena, bring other assumptions and methods. For the purposes of this investigation, a communicational perspective will be assumed.

It might be best to investigate our assumptions in a relatively independent way, i.e. in a way which is not related to any particular theory for description. This might be done by setting up small-scale, imaginary communication systems as models with the aim of questioning our assumptions about what must go into verbal communication systems, the requirements on them, their limitations, and the decisions that must be made in setting them up. One can then compare the limited, imaginary systems with observed linguistic phenomena to determine additional perspectives and complexities that models need to address (although one should note immediately that “observed linguistic phenomena” are not as straightforward as the expression may indicate). That is, we might devise small-scale systems which can be used to create a virtual world of potential messages, and examine its interpretation (if any) in real-world communication. By limiting the scale of such systems, we can control variables better and make assumptions more transparent. We can call such imaginary systems “small model languages” (SMLs) and ask:

- What properties should such a small-scale system have?
- What can small-scale systems do?
- Do real languages have the same properties? If not, what changes are needed in the model?
- What assumptions are we making?
- What capacities are implied for speakers?
- How can SMLs be extended?

SMLs are thought experiments. It is important to note that SMLs should be explicit and independent of particular linguistic models. It is not the intention here to apply, or critique, any particular approach to linguistics, but rather to suggest a way of reflecting on assumptions. This process leads to the discussion of fundamental questions. Of course, other thinkers have arrived at similar proposals or ideas from different starting points. The use of SMLs can support other approaches in such cases, or suggest areas for questioning in others. It will not be possible to point out all of the connections between the outcomes of the simple SMLs presented below and existing proposals, although some links will be made.

One of the uses of SMLs is to be a teaching tool, although the notion of a “model” (below) can be applied in any linguistic approach. Since any approach can be translated into a self-contained set—a set of entities with their relations defined in it—all linguistic approaches include models. Sometimes, models are used more explicitly in linguistic analysis. Early discussions of

linguistic models are found in the work of Revzin (1966) and Mulder (1968). Approaches with significant emphasis on epistemology have developed ideas of modelling explicitly. One such approach is Mulder's "axiomatic functionalism", e.g. Mulder (1989 and 1998), and Hervey (1980), Dickins (1998). Explicit applications of modelling principles are found in, for example, Hervey (1978), Rastall (1993), Dickins (2007), and Bičan (2013) in phonological analysis, and Lieb (1968) used the concepts of modelling to develop semiotic theory. Weigand (2010) has adopted modelling principles in the analysis of dialogue. Here we are concerned with the use of imaginary models as ways of exploring ideas about verbal communication. I am not aware of any similar approach, although tagmemicists have long used imaginary language data as a way of practising the application of their descriptive approach (e.g. Pike, 1971, or Elson and Pickett, 1974). Martinet (e.g. 1975) occasionally contrasted real linguistic phenomena with imaginary structures and Wittgenstein (1953) used imaginary communication systems to investigate ideas about certain aspects of verbal behaviour. As should be obvious, the purpose here is not to practise a particular descriptive approach, but to investigate assumptions.

2 What do we mean by "model"?

There is an important area of logic called "model theory" (see, e.g., Bridge, 1972 or Schreider, 1975). Its main application is to be a "theory of interpretations" for mathematical or logico-mathematical ideas (*Stanford Encyclopedia of Philosophy, online*). According to the *Stanford Encyclopedia*, "model theory is the study of the interpretation of any language, formal or natural, by means of set-theoretic structures" (section 1). The notion of model in linguistics is only partially similar to that in model theory and it should be distinguished also from the "universal modelling language" used for software development. The SML approach only draws on basic ideas from model theory. The purpose here is not to investigate logical relations, natural language semantics, or to view linguistic phenomena in logical terms, but to apply a model-based approach to the exploration of assumptions about communication. Although models in linguistics only partially coincide with the model theoretician's notion of a model (see below), any set of related constructs can be viewed as a "model" in the sense adopted below, so a model-based approach is common to all linguistic analysis, whether modelling is implicit or explicit. Having a logical approach to describing languages emphatically does not imply the view that languages or language systems are logical or "logics", or the view that the investigation of languages should be undertaken via an exploration of a logical calculus. A model (or self-contained set, or relational system) is a tool and is, in its simplest form, a pair, consisting of a set of names of entities and the names of relations between those entities. We can express this as follows with the set $\{x, y, z, \dots\}$ and the relations R^1 to R^n .

$$\text{Model} = \langle \{x, y, z, \dots\}; R^1, \dots, R^n \rangle$$

Now, as the *Stanford Encyclopedia* makes clear, the notion of a model can be interpreted in different ways. As the authors point out (section 5),

To *model* a phenomenon is to construct a formal theory that describes and explains it. In a closely related sense, you *model* a system or structure that you plan to build by writing a description of it. These are very different senses of "model" from that in model theory; the

“model” of the phenomenon or the system is not a structure, but a theory, often in formal language.

They go on to point out that the distinctions become blurred in the case of scientific theories (and here we may include linguistic theories) because theories are closely connected to, and shade into, the means of interpreting them. In linguistics, the normal sense of “model” is just such an intermediate case. A linguistic theory for description and explanation is normally a way of modelling phenomena with a system of entities and relations. A theory consists of statements, but a linguistic theory embodies, and is used to develop, structures which can be interpreted in terms of real-world verbal events. For example, the theoretical statement that all languages are “doubly articulated” leads through definitions to models including phonemes contracting phonotactic relations to provide the phonological forms of grammatical units which contract syntactic relations. In particular descriptions, the phonological and grammatical structures conforming to the theory are then matched with speech phenomena.

The interpretation of the model is real-world entities and events, and the aim is to account for real-world phenomena using the entities and relations in the model. So, some rules are needed for developing expressions derived from the model (formation rules), and ways are needed to connect the class of expressions from the model to real-world phenomena (interpretation rules). Such rules are expressed informally below for the purposes of the approach, but more formal statements can be developed. Clearly, you can have models of any phenomena—the rotation of the earth, chemical reactions, numbers, etc. In this case, we are concerned with modelling speech signals and verbal interactions whose purpose is the transmission of information. “Information” is here left undefined, but is not restricted to the representation of factual information. It includes the information derived from speech acts about the disposition of the speaker, and the speaker’s orientation to the interlocutor, and the situational and textual context of speaking. The example below is largely restricted to grammatical modelling, but the approach is not intended to be restrictive. Indeed, the foregoing comments imply that speech can be viewed (and modelled) from a variety of different perspectives, and that speech events are complex totalities in social contexts.

3 Models in hypothetico-deductive testing and some questions arising

An important function of models (among others) is to provide explicit means of empirical testing. It is reasonable to say that most approaches to linguistics are broadly “hypothetico-deductive”, and this has been the case since (at least) the 1960s². A key role for modelling in a hypothetico-deductive approach is empirical testing. That process can also be seen in terms of a model, and a model of hypothetico-deductive testing can serve as an example of how models can be used to test assumptions.

Phonological, morphological, and syntactic analyses are the most obvious examples and typically contain a finite presentation of hypothesised units and the relations they contract, which give an account of the functional elements and relations in communication. These may be, for example, syntactic or morphological structures and the lexical elements entering them, or they may be phonemes and their phonotactic relations, or distinctive features and their

² Saussure’s *Mémoire* (1879) is hypothetico-deductive *avant la lettre* and Hjelmslev’s Glossematics is deductive in the Euclidean sense of “deduction”.

constructional relations. These “underlying structures” can be thought of as “deep structures” or as the most all-embracing models in an analysis. They are related by rules of formation to a potentially infinite class of specific, or predicted, structures—models for individual utterances. This may be thought of as *similar to* the “consequence class” of the model (Popper, 1975: 47 ff; 301 ff)—i.e. the set of specific structures implied by the underlying structure and the ways of deriving the specific models. For some, the two classes are related by generative and transformational rules, while—for others—the process is one of the application of simple logic or Cartesian multiplication and functions selecting allophones or allomorphs (realisational forms, generally). In either case, we have a model which can be presented in outline, as follows:

< {*underlying structures*}, {*predicted, specific structures*}: *Relations of formation*>

Clearly, this is a model containing a complex of many other models. In other areas of linguistics (sociolinguistics, for example), one can imagine a similar arrangement, albeit with different specific characteristics.

The output of a hypothetico-deductive approach—the set of predicted, specific structures—is compared with a set of utterances which are either observed or accepted as observable (often with a certain amount of idealisation of the data). Frequently, comparison of observables is involved, as in commutation or permutation, or the analysis of expression differences. Clearly, observables are not “raw data”, which—in turn—raises questions about our assumptions about “data” and the extent to which they are also constructs. In fact, linguists are rarely concerned with individual utterances; they are concerned with classes of utterances accepted as the same in given respects. The real-world utterances or potential utterances can be thought of as a class of potential falsifiers in Popper’s terms (above). A model of empirical testing can then be the class of predicted structures, the class of real-world utterances, and a relation of correspondence, such that for each predicted structure there is at least one real-world utterance which corresponds to it in relevant respects, i.e. those defined within the model, and for each utterance there is at least one corresponding predicted structure. There should be no predicted structures which do not correspond to an observable utterance or *vice versa*. Any discrepancy would constitute a refutation calling at least for some amendment in the model. (The expression “at least one” allows for structural homonymy and realisational variation.) The term “correspondence” is intended as a relatively neutral term, and is used with some reluctance. In using the term “correspondence” in the context of empirical testing, I do not wish to suggest that linguistics is, or should be, committed to a uniquely correspondence theory of truth (for a discussion of this point, see Rastall, 2011), or to suggest that “correspondence” is a simple matter of matching. However, thus, we get the testing model:

< {*predicted structures*}, {*real-world utterances*}: *relations of correspondence*>

One should bear in mind that Popper’s consequence class (and similar notions in other forms of hypothetico-deductivism) is a class of *statements*, which are either true or false. The output

of a *model* is a further class of models which may or may not “correspond” to observables in relevant respects³.

This model of testing contains a number of assumptions and raises numerous questions. The most obvious are the nature of the relation of correspondence, the role of theory in the selection of relevant data, and the tests on it. One cannot simply assume that real-world data have the properties of the model (one must perform tests on them), and the idea that models describe real-world speech data *in relevant respects* suggests that the relation cannot be one of absolute isomorphism. This supports the views of many scholars who advocate the integration of different perspectives in linguistic analysis (see below). However, one could also question the definition of the proposed “underlying” elements and relations, and how they are arrived at. One’s constructs are “theory-laden”.

Since the data are also constructs, one cannot assume a simple one-for-one identity. The empirical correspondence of predicted structures and real-world data in selected respects is clearly a *necessary* condition of the validity of the model (*if* the model is valid, *then* there is correspondence of predicted structures to real-world data and no non-correspondence). It is not a *sufficient* condition of the validity of the model. That is, there are other (notably theoretical) conditions involved and we must allow for the possibility that more than one model may account for the same set of observables (which, of course, happens). A pure instrumentalism, which refuses to define underlying entities or to accept their theory-laden nature, appears to be inadequate from this point of view. The latter question, however, raises a further question. Do the underlying structure and the processes linking it to predicted structures themselves correspond to any real-world entity? Here there is a clear division among scholars between those who attribute models and operations to speakers’ cognitive processes (recently reasserted by Chomsky, 2013) and those who see models as having an explanatory function only in relation to observable *speech* data (such as Mulder, 1989 and 1998). Clearly, those who attribute models and processes to speakers’ brains or minds need more justification than the achievement of the necessary condition of correspondence with utterances⁴. Connected to this question is the need for an ontological framework connecting more “abstract” units and relations to more concrete models and to classes of real-world speech events. One such framework is that of Mulder (1989) and Mulder and Hervey (2009 online). The entire issue is connected to the question of the degree of “ontological commitment” of linguists to the existence of classes.

Finally in this regard, the model of testing presupposes that any complex utterance must be accounted for by a complex predicted structure which is a function of the underlying structure and formation processes. In the cases of fixed expressions of various sorts—adjacency pairs, expressions of emotion (e.g. *what a nuisance!*), contextually fixed expressions (e.g. the checkout assistant’s *do you need help with packing?* or the dentist’s *open wide*), or proverbs (*waste not, want not* with a fossilised grammatical structure *not* in current English)—it is quite reasonable to doubt that assumption, i.e. one might see verbal activity as the appropriate use (and combination) of verbal “chunks” of varying degrees of complexity. While the complexity can be

³ This raises the question of whether, and in what sense, linguistic theories are “true”, as opposed to “valid” in their own terms for the phenomena they address.

⁴ Saussure spoke of language existing in the collectivity (1972: 38). This might be interpreted as an alternative view in which language is seen as a construct containing the communicational properties defining a speech community and in relation to which speakers form a sense of linguistic identity.

described, it would not necessarily be attributed in all details to the speaker or to every utterance.

This is not the place to go further into those questions. The key point here is that the adoption of a reflective attitude to models quickly leads to fundamental questions. SMLs achieve similar ends and we focus on them now, although we should note that the same range of questions applies to SMLs insofar as they are confronted with real-world data.

4 Some Limitations on SMLs

It is important to note the limitations on SMLs. SMLs are limited communication *systems*. The term “language” is highly polysemous. Here it must be understood in the way that “language system” can be used to refer to a construct for the understanding of selected communicational aspects of speech in a given community. The limited nature of SMLs is entirely intentional and means that *any SML can deal only with a restricted set of functions*. They do not have “universal purport”, but only restricted capacities for modelling message formation. The term “language” here may be regarded as to some extent “metaphorical” just as the use of the word “language” in model theory (above) or describing logical calculi or architectural styles as “languages” is clearly metaphorical⁵.

It is important to set up SMLs with selected communication functions in mind. In that way, they can help us to see some of the semiotic reasons for the nature of speech signals. Equally important is to compare our imaginary models with what we know of real languages. As noted above, all linguistics is concerned with modelling. What is suggested here is that imaginary SMLs for restricted functions can allow reflection on assumptions. For that reason, SMLs can have a pedagogical purpose. Students can be invited to develop SMLs for restricted functions, explore their capacities and limitations, compare with real phenomena, and question the assumptions that go into the construction of SMLs. This process can raise further research questions.

5 Requirements

We have seen in outline the necessary components of SMLs. Notably, for our example,⁶ we need distinct names for referring to the non-linguistic world (signs) and to be able to combine signs into complex signs. We need to know how the signs and complexes can be represented as groups and how each group is interpreted as a particular message in a virtual world of communication acts. In this we assume real-world messages modelled by signs would have to be distinguished, i.e. the signs in the system would have to be formally and semantically distinct—“functional” in the sense of “separately relevant” or “pertinent”. This is just another version of the fundamental communication principle that communication is impossible without some differentiation in the signal and, hence, that in any system minimally a sign must be distinguished from its absence (Shannon and Weaver, 1949: 9ff, and Mulder and Hervey, 1972: 13). Here we are concerned mainly with the formal properties of speech signals, but it should be remembered that speech messages are another way of looking at signals from a semantic (and/or pragmatic) point of view and that semantic models of messages are intrinsically linked to models of signals.

⁵ “Language” is here the linguist’s representation of it. This raises the question of whether language or a language is just a construct created by the linguist, or indeed a “myth”, as argued by Harris (1982).

⁶ Obviously, a phonological or sociolinguistic SML would have other requirements.

However, we are using “sign” here without close definition as any form-meaning unit, simple or complex. Clearly, analysis in terms of “signs” is itself an assumption, and the definition of “sign” as well as the possibility of modelling without signs also need further investigation. In fact, signs are also modelled, so including signs in SMLs introduces the important principle that all components of models are themselves models.

As noted above, SMLs have to be goal-oriented, so we would have to specify the communicational functions they address. For communicative interaction, an SML would have to be dynamic.

In mapping sign combinations to the real world, we need to consider, especially, the sequencing of signs. Ultimately, we should be able to create models for social cooperation. Of course, all of these requirements can themselves be seen as assumptions about the communication process.

6 Components of the Models

We have said we need a set of signs fulfilling specific functions. In animal communication, there might be a set of signals for alarm, courtship, aggression, submission, bonding, etc. The signals involved are not necessarily in the sound medium and are not necessarily discrete or sequenced. They may involve multiple media—e.g. acoustic as well as visual channels simultaneously. Human communication signals are also typically multi-modal, but the most prominent and distinctive human modality is verbal communication in the sound medium—a subset of communication acts in the sound medium, normally simultaneous with other ways of exploiting the sound medium (to display attitude or emotion, for example) and other media (e.g. visible gesture). Verbal communication and its modelling are thus selections from the totality of speech communication behaviour and part of our assumptions. Human languages are generally realised by sound, although they can be realised by other means such as signing or in writing. This raises the question of why the sound medium has been exploited by humans as a key evolutionary strategy, and the question takes the student into the pros and cons of the sound medium and its effects on verbal signalling.

It is natural to assume that linguistic signs must be discrete units *and not relative points on a cline*. A given sign is expected to be either *x* or *not-x* but with no overlap. It is part of our general experience that a sign is either *dock* or *dog*, *rat* or *rabbit* with no intermediary sign. In terms of *sign identity*, this is a reasonable assumption in line with the fundamentals of communication laid out by Shannon and Weaver, although we must note that there can be overlap between signs in phonological form (as when /z/ realizes both *have* and *be* in English)⁷ and there can be overlap in the semantic range of different signs (“paronymy” in Hervey’s terminology—Mulder and Hervey, 2009, online). For example, *teaching* and *instruction* overlap in meaning. Overlaps are, of course, not clines. Adherents of Cognitive Grammar, however, regard the semantic, pragmatic, and cognitive processes of language as continuous and non-discrete (e.g. Langacker, 2008). This can be considered an alternative position (and perhaps related to a different stage in the communication process), although they too must make connections with discrete entities. In the case of paratactic features, such as intonation, signs may be non-discrete in the sense that pitch changes exist on a cline, correlated with degrees of

⁷ Not the allomorph “/z/” which would imply sign identity through its meaning.

emotion or attitude. That is also the case with various features of animal communication. We also assume in this connection that the members of sets are in an *either/or* (but not both) relation (exclusive disjunction).

The assumption that signs combine in sequences is also based on our experience and involves a *both/and* relation, but simultaneous signs exist in verbal, visual, and non-human communication. All signals must take place in the dimension of time, but there may, or may not, be a sequence of identifiable component parts. In languages, we assume sequencing for combinations of signs, although simultaneous non-discrete features (stress, intonation, rhythm) must at some point be allowed for in our models.

In other words, we assume discrete and sequential units for the purpose of developing our SML and we have asked what those assumptions tell us. There is, of course, nothing to prevent the development of SMLs with alternative assumptions.

A number of other questions arise also at this point.

7 Questions

Which simultaneous features are there in natural languages? Why are they of limited use?

Why, and in what sense, are non-discrete features relatively “marginal”?

The “linear” sequence is a temporal sequence. What constraints does the temporal sequence bring?

In languages, there are expressive utterances—*oh, well!, woops, ouch!, whoopee* but more complex expressions of emotion or attitude, representation, or address require more than unanalysable reaction signals. Expressive utterances of that type appear to be on the margin of languages—not integrated into complexes—and very restricted. One can ask why that should be so and how the human communication strategy developed in this way.

While the answers to some of these questions are inevitably speculative, and it is not the purpose of this paper to provide answers, but rather to explore assumptions and the questions they raise, the exploration of SMLs may provide perspectives for research.

8 A simple case

Given the above assumptions and noting the issues that arise with model-formation for verbal phenomena, we could move on to a simple model. For example, we could imagine a communication system *whose purpose is to convey what exists in the world of experience*. We could proceed, as follows, by setting up:

- A sign asserting existence—an “actualiser”— E
- A set of names of identifiable parts of reality— $\{river, house, fish, \dots\} = \{s\}$
- = the pair of sets $\langle E, \{s\} \rangle$

And, with a relation of combination for signs, R , we arrive at a model as defined above.

$\langle E, \{s\}: R \rangle$

We introduce the formation rule: any one s may combine with E to form a well-formed sequence.

We get the set of combinations:

$$\{Es^1, s^1E, \dots, Es^n, s^nE\}$$

(in words this might be Exists river, river Exists, Exists house, house Exists,...)

This is a set of unordered pairs in which $Es^i = s^i E$. To model a real set of utterances one would need ways of forming correspondences between model signs and real-world utterances.

This system is clearly limited. We cannot “say” anything else in this “language”. We have not allowed for identification of location, negation of existence, possibility, questions, etc. There is no communicational exchange here. There is one-way communication only. Nevertheless, we can learn even from this SML. It has implications for the communicational capacity of its users. Any user would have to be able to identify component signs and associate signs in sequences. That implies the holding of signs in short-term memory for their ultimate synthesis into a complex sign. That complex sign would have to be compared with the world of experience. It goes qualitatively well beyond expressive cries. Another way of looking at this might be to say the following:

The SML can be interpreted by mapping rules which state:

- E tells the hearer to search for an entity in the real-world
- A name, s , tells the hearer the type of entity to search for, i.e. a denotable in the identified category.
- The relation of combination, R , tells the hearer to associate the named entity with the search.

Such mapping rules are meta-linguistic with respect to the SML. They act as models of communicators’ behavioural activity in relating a potential to a reality. They too make further assumptions—such as the ability to identify real-world denotables—and involve the limitation of real-world reference—and hence questions about the nature of non-real world reference.

The above SML has other lessons for us.

We can see that our SML is inefficient because of the large number of alternative equivalent expressions. There are sequences, but the sequences are not exploited for any communicational purpose. Every message can be conveyed in two equivalent ways. In this simple case, the inefficiency is of little significance, but as sign groups grow more complex, say with 3 or 4 signs in a sequence, then the number of variants increases exponentially. Where there might be 6 or 24 variants with the possibility of a different sign, s , appearing at any point in the sequence, the potential for communication losses would be great and the advantage of fixing the sequence to enhance predictability and interpretation would increase correspondingly. Alternatively, a difference in sequence could be correlated to a differentiation of message, as in Old Slavonic, where $S-V$ structures emphasised the subject role whereas $V-S$ structures emphasised the prominent information of the verb (Khaburgaev, 1974: 367).

However, as noted above, the idea of a sequence of signs is an assumption. E could be expressed in different ways. For example, E might be expressed by a simultaneous intonation pattern (as in the rise-fall pattern of Malay *hujan!* or the English falling intonation equivalent, *rain!*), or there might be a different tone for each s based on a formal indication of E . One might distinguish naming an entity with s from the assertion of the existence of s in the environment by, say, reversing the form of the sign, *revir* as opposed to *river*.

In real languages, however, we normally find an actualiser and a naming sign in a sequence (*There is/are, Es gibt, Il y a, (Arabic) fii, (Chinese) you³, etc.*). This strategy is clearly dominant,

although it requires the “effort” of identifying different signs, associating them, memorising and synthesising them into a complex message. This increase in syntagmatic “effort” is rewarded by the potential for naming larger numbers of real-world entities with distinct signs. It is likely that the use of simultaneous and non-discrete signals would be less efficient in that respect and might be less manageable from the point of view of maintaining large numbers of distinct signs⁸. Certainly, animal communication involving sound with clines of loudness or degrees of repetition is communicationally limited to relatively small numbers of expressive and address functions, and only rarely fulfils the function of representing a presence in the environment. Sequencing signs appears to be a significant communicational advantage and to be connected to the feature of “displacement” (identified by Hockett, 1958)—the ability to communicate about, and in particular represent, states of affairs not in the immediate environment (in space or time) or connected to immediate emotional responses or interactional needs. One might speculate that this strategy of sequencing signs was a key step in human communicational development allowing multiple perspectives on the world of *communicanda*.

9 Ways to extend the model

There are several ways to extend the model to “say” more things. They include: negation of existence, forming questions, adjusting the assertion of existence to allow for types of existence (permanent, temporary, possible, etc.), indicating location, expressing judgements, making suggestions, giving instructions, relating two real-world entities, etc. Let us look at how the model can develop to allow for some of these possibilities and the assumptions and effects of doing so.

10 Negation

If we wish to allow for the possibility of denying the existence or presence of an entity in the real-world environment, we need to introduce some sign, N = negation. Employing symbols as before, there are at least two possibilities for extending the model, A and B .

$$A = \langle E, N, \{s\}: R \rangle$$

$$B = \langle \{E, N\}, \{s\}: R \rangle$$

While apparently similar, A and B have different characteristics. Possibility A increases the sequence length and the number of alternatives— ENs , NEs , sEN , EsN , etc.—it is more analytic/transparent

It also introduces a second relation of combination— $Es R N$ (in words, *exist tree – not*) or $N R E R s$ (*not – exist tree*)—either way some sequencing of the combinations would arise. We exclude $Ns R E$ (*not tree – exist*). *If included, we would introduce a different set of messages and functional ordering. When the relation of combination is used twice, we raise the possibility that a difference in communication may be conveyed by the ordering of the combinations (bracketing)*. Obviously, our formation rules will have to be extended to allow the double use of R . Also, however, it is clear that N may occur or not occur. We have introduced a “facultative” possibility into the model.

⁸ Phonological economy also plays a role here, of course.

B is simpler. It introduces a negation element as a commutant (i.e. *E* and *N* are in exclusive disjunction in the same set)—*Es*, *Ns*, *sE*, *sN*, etc. It is more “opaque”/ synthetic.

In both approaches (and in the original model), there is a contrast between the closed inventory $\{E, N\}$ and the open inventory, $\{s\}$.

11 What do real languages do—*A* or *B*?

Languages are normally more like *A*. Occasionally, we find *B*-like structures, as in some simple expressions in Russian—*est' d'en'g'i*, *n'et d'en'eK* (“there is money” / “there is no money”), although Russian has other structures (*n'e javl'ajetsə*, *n'e sušestvujet*) of the *A* type.

I.e the more common case is (again) the analytic possibility which involves:

- more effort in terms of complexity
- an additional rule for combination
- a restriction on realisational sequence

One could suggest the following reasons for this apparently more complex choice.

- Restriction on sequence allows more predictability with a reference point in the utterance clarifying its function, i.e. *E* from a closed inventory establishes the function of the whole utterance and so *s* defines its syntactic function relative to *E*. (Here we have grammatical dependency with the closed inventory item in a fixed position acting as a signal of the structure being used. The facultative *N* can be introduced as an additional combination. Again, the occurrence and function of *N* would be dependent on either *E* or *Es*, but the dependency of *N* as an optional feature relates to its commutation with its own absence (“zero”), whereas the dependency of *s* relates to the variability in the *s* position compared with the relative fixity of *E* as a reference point in the sequence. We have introduced the need for “zero” in some sets.)
- In *A*, communicational clarity is bought at the expense of greater effort in articulation and memory (in accumulating the signal) as well as cognition in associating and synthesising its parts, but combinatory patterns reduce the effort by structuring the experience in a predictable way.
- The possibility is raised of creating alternative messages by varying the sequence (e.g. *not-tree exists* as opposed to *tree – not exists*). Extending the sequence increases the virtual world of messages, if this possibility is included in the model.
- In real languages, other functions may involve similar strategies—that is, “structural pressure” may lead to some regularisation by analogy (but see below).

But we must note the following:

- Rules of sequence and rules of combination are different
- Two combinatory patterns are possible.

So we add the rules:

For assertion, rule as above (combine *E* with any one *s*)

For negation—for any assertion structure, optionally combine the assertion with *N*. (i.e. for simplicity we choose not to exploit differences in combination at this point).

Sequence—in assertion *E* precedes *s* and in negation *E* precedes *s* which precedes *N*—*EsN*.

In fact, negation could be in the first, second, or third positions. It is an empirical matter to determine which is generally found in real languages and which model is appropriate for any

particular language. Similarly, we could negate E and then add s . Our imaginary models can proceed in different directions. By trying out each one, we find their limitations and degree of correspondence with real language phenomena. I.e. we need to determine which pattern is found in real languages and what communicational differences come with different possibilities.

In the current model, the only relation is that for the combination of signs. A second relation of dependency could be introduced, R^d . Such a relation would model the organisation of combinations, e.g. that s functions in relation to, and is to be associated with, E or that N functions in relation to, and is to be associated with, Es . Dependency relations give a different perspective on complex signs. From the point of view of the organisation of the complex group, the occurrence of E can be interpreted as an instruction to anticipate some s , and the occurrence of N to presuppose (look for) Es , as reference points. Similarly, the relation, $R^{sequence}$, could be included in the model, rather than as a formation rule. (For simplicity, we will not include those different relations and perspectives on signals, and leave sequence to formation rules, although in real language descriptions they would be included.)

12 The question function

Suppose now that we build a question function into our model. This is not just a matter of introducing a question sign, Q , into the model. We move from a model with a single function of *asserting* existence or non-existence in the real world to *enquiry* about existence or non-existence. The introduction of this function implies that two-way (cooperative) interaction can take place and so we will need means to reply to questions and ways of modelling interactions (“interaction rules”). Receivers of signals must recognise that the presence of the question sign is intended to elicit a response and they must have relevant ways of making a verbal response (as opposed to non-verbal interactions also found in animal communication). For example, Q could be taken as directing the receiver to inspect the world of experience and to affirm or disaffirm the existence of s in it. One way of doing that (verbally) would be to use the existing model to assert or negate. The model would now be as follows (with [...] for facultative signs, and symbols as before):

$$\langle E, [N], [Q], \{s\}: R \rangle$$

And we need to amend the rules for combination and sequence. At least three ways of forming Q are conceivable according to the above considerations: i.e.

Place Q in sequential relation to Es , EsN , e.g. EsQ , $EsNQ$ —where Q is a discrete sign like *ma* in Chinese or *-kah* in Malay. Its position in the sequence may be final, as in those languages, but could be elsewhere, as with *est-ce-que* as the first sign in a French sequence or the particle, *l'i*, in Russian, which tends to be second in the sequence.

Or exploit sequence difference with sE , SeN for assertions, and Es , EsN for questions (for example, tree exists [not]? vs. exists tree [not]? As in German *Er geht/Geht er?*)

Or use a non-discrete feature— $Es \searrow$ (assertion with falling intonation) vs. $Es \nearrow$ (question with rising intonation)—i.e. discrete and non-discrete can be combined, as in numerous languages.

Clearly, all three possibilities occur in real languages. However, we might note that the same should be true of negation, but in real languages intonation and sequence inversion are not

likely to be used for negation. This difference in the models raises the question why there should be such a difference between negation and question formation, which both involve closed inventories. A possible route to the answer may lie in the difference in function, where variation in pitch in the signal can be an attempt to elicit a response, which is central to the question function.

Using the above interaction rule, replies might be: *Es*, *EsN*.

In real languages and where the response is in the same modality⁹, however, what we commonly find is either the actualiser alone or *yes/no* responses as in English (or both). In Malay, for example, the question *ada gula?* (“Is there (any) sugar?”) can have the responses *ada* (“there is”) or *tiada* (“there isn’t”). To allow for such possibilities, not only would we have to amend our model but also we need to account for the communicational properties of the responses. The use of the actualiser alone implies that the repetition of *s* is redundant and presupposed in short-term memory, and we presuppose the notion of “communicational focus”, which is here on affirmation or dis-affirmation. It would also be an example of reduction of effort in the signal by the omission of a “known” item. The *yes/no* response takes the process even further by introducing signs of affirmation or dis-affirmation formally unconnected to the original *Q* form at the expense of additional, but distinctive, signs. That is, the “reduced” responses appear to decrease communicational “effort” and redundancy, and to introduce distinctive signs for the response function, but to increase the demand on short-term memory. In both cases, the exchange involves the first speaker using an address function to elicit information and the second speaker using a representational function to satisfy the questioner’s need. One might imagine an interaction model in which we find:

$$\langle \{Q \text{ signs}\}, \{\text{affirmation signs}\}, \{\text{dis-affirmation signs}\}: R^{\text{response}} \rangle$$

That is the set of all signs from the extended model containing *Q* above, the set of all signs asserting existence from the model, the set of all signs denying existence from the model, and a relation of response.

We can then specify the rules that:

- If a *Q* sign is addressed to the receiver, then the receiver responds cooperatively and
- For every *Q* sign, there is an *affirmation sign* and a *dis-affirmation sign*, where s^i in the *Q* sign is the same as s^i in the assertion or denial of existence and
- The receiver selects the relevant affirmation or dis-affirmation sign on the basis of direct real-world experience.

The *affirmation* and *dis-affirmation signs* could have alternatives, in which affirmation follows the same rules but substitutes either *E* or *N* or *yes/no* responses. In English, both response patterns are available, e.g. *yes/there is*, *No/there isn’t*. This possibility raises the question of the factors determining the selection.

Our extensions to the model have introduced numerous additional considerations, not least the way in which models can be connected, e.g. by allowing the extension of one model to be a set in another, and the social functions of utterances. The model—at this point—excludes a refusal to reply, a change of subject, or a way of expressing an inability to answer (such as *I don’t know*). The limitations of the model and the choices we face in developing it have revealed

⁹ Nodding, head-shaking, shoulder-shrugging etc. are also possible visual responses.

various issues in our understanding of the communication process. Furthermore, we can see how models can be adapted in comparison with observed phenomena. It can be seen that communicational models imply social interaction, and thus lead on to issues in such fields as sociolinguistics and conversation analysis (see below). For example, where a selection is made from alternative responses, a model of the disposing and inhibiting factors is required.

13 Asserting and questioning location

The assertion or denial of location (of the sort *exists tree here*, *exists river not there*, etc.) involves similar considerations to those for adding other functions, except that in the case of locations we have another open inventory of signs. Initially, we will deal only with simple signs of location.

e.g.

$\langle \{ \{Locations\} \}, \{s\}, E, [N], [Q]: R \rangle$

(Locations: {here, there, front, behind, above.....})

So, following the above rules, we would be able to form:

{EsL, LEs, EsLN, EsLQ, EsLNQ, etc.}

In this model, the set of *location signs* have different possible positions—a possibility which might be exploited for communicational purposes, although we have not done so here. *Location signs* and the set {s} do not overlap and generally in real languages we might expect the set of location signs to be formally identifiable and distinct in form from other signs. Their function is thus distinct in any complex. However, various signs in the set {s} could indicate location. One would then expect that their location function would be differentiated from their naming function. It is typical of *s*-type signs that in reality they serve multiple syntactic and semantic functions and hence their functions are defined relative to signs with a fixed function. Normally, for the distinction in question, that is achieved through a morphological feature (e.g. locative case) or some location indicator such as a preposition. One might speculate that such features arise to differentiate naming and location functions. At any rate, it is commonly found that location signs with no other functions are often not marked by any sign of location function (*here*, *there*, *below*, *above*, etc.), whereas signs with multiple functions are so marked—in *London*, *below ground*, etc. Martinet (e.g. 1975) speaks of “autonomous monemes” in the former cases. Where signs can only refer to location (or time) and have distinctive forms (a class of forms not used as forms for other signs) and/or fixed relative positions in the sequence (as in Chinese), further indications of function seem to be redundant. In some languages, of course, that may not be the case.

A further possibility is that location signs could commute with *E* –*here tree*, *there tree not*, etc. In that case, in the model we would have $\{ \{Locations\}, E \}$ as well as the above. More importantly, we can see that in real languages negation can combine with members of different sets; *exists tree here – not* vs. *exists tree – not here*. Our rules of combination would have to be amended to allow different optional combinations of negation to address this possibility, which greatly increases the communicational potential of the model. The model thus far only deals with static location and not direction to a location, which would require another extension and

raise questions about the communicational means for distinguishing location and direction. Further interactional rules are needed for responses to location questions to link the entity named by s^i to the location named by l^j and to affirm or dis-affirm as before.

14 Judgements

The set of judgement signs, J , (e.g. *good, fast, high*, etc.), like the set of locations and negation, might appear in the model in different ways and in different combinations. For example:

$\langle \{J\}, \{s\}, E, N, Q: R \rangle$ and/or

$\langle \{J\}, \{s\}, \{j\}, E, N, Q: R \rangle$

To allow:

EsJ : *exists tree – good*

sJ : *tree – good*

$EsJN$: *exists tree – good – not*

$EsNJ$: *exists tree – not good*

SNJ : *tree not good*

Suitable combination rules would be needed and, with increasing group size, it is clear that further sequence rules would be needed also. Increasing complexity in those areas is the price of increasing communicational possibilities. Clearly, further interaction rules are conceivable here for agreement and disagreement. If $\{L\}$ were included as an option to $\{s\}$, we could form signs of the sort LJ , LJN (*here good, there far not*, etc.), but $\{L\}$ would have a different function and the model would need relevant amendments.

15 Making suggestions and giving instructions

As a final example, let us look at the functions of making suggestions and giving instructions which require differences in our model.

It should be obvious that these two functions involve quite different communicational purposes from the ones we have considered around the assertion of existence, so E is not involved here, and nor are the *Judgement signs*. While N and *Location signs* will still be needed, Q will not¹⁰, but interactional rules for assent and dissent will be needed. For some suggestions and instructions $\{s\}$ will also be required. That is, for suggestions, we will need a suggestion sign, S (such as *let's* in English or *pust'*, *davajt'e* or the enclitic *-t'e* in Russian, although other means are conceivable such as inversion or a distinctive intonation pattern), a set of signs for actions, $\{actions\}$ (such as *go, drink, run*, etc.), and the combination relation.

$\langle S, \{actions\}, [N], [Q]: R \rangle$

With rules similar to those above and sequencing S before a , we get a set of signs $\{Sa^1, \dots, Sa^n, Sa^iN, Sa^iQ, Sa^iNQ\}$. (*let's go, let's drink, let's drink not, let's drink Q, let's drink not Q*, etc.)

¹⁰ Of course, a suggestion might take a question form, as in English *Shall we dance?* with non-correspondence of form and function.

If {s} is included in the model, *i.e. if we build in an overlap with the model for assertion of existence*, and sequence the combinations so that an *s* may combine with an action in the sequence *Sa*, then we allow for such signs as *Sas* (“let’s drink water”). This, of course, introduces a different grammatical relation for the members of {s} to enter. A further optional combination is with *Locations signs*.

In this model, we have to allow again for the possibility of “bracketing” (or, better “grouping”¹¹), *i.e.* that some signs are more closely connected in the group than others and that some signs are optional. Here *S* may combine with *a* and *a* with *s*, but not *S* with *s*¹². As before, there may be various sequences and means to achieve communicational effects, and we must compare with real language phenomena. (It would be interesting to consider the treatment of affirmation/dis-affirmation, agreement/disagreement, assent/refusal in different languages to determine the distinctions in the interaction rules. As is well known, in English for example, *yes* and *no* indicate agreement and the selection depends on the modality of the initial assertion, whereas the same signs can indicate affirmation and dis-affirmation respectively with different rules in “closed” questions—a feature which frequently confuses learners.)

We thus arrive at:

$\langle S, \{actions\}, [N], [Q], [\{Locations\}], [\{s\}]; R \rangle$

Where:

S combines with any *a*;

Any *Sa* combines with either *N* or *Q* or both;

An *a* may combine with an *s* and

Any group may combine with a *Location sign*.

For instructions, an instruction sign, *I*, is needed instead of *S*. As before, the form of such a sign may be discrete, non-discrete or a feature of sequence.

$\langle I, \{actions\}, [N], [Q], [\{Locations\}], [\{s\}]; R \rangle$

16 Concluding remarks

The purpose of this exploration was to reveal the assumptions behind our descriptive modelling of languages and the potentialities of models by working with small-scale models, and gradually increasing their complexity and functions. As increasing complexity has been introduced, so the communicational possibilities and the concomitant complexities have increased. No doubt, many possibilities have not been covered in this initial exploration, but we have seen the sorts of decisions that need to be made in making models, and have compared imaginary models with real linguistic phenomena. As a result it has been possible to connect our investigation to principles of communication, particularly in relation to questions of sequence and reference points in groups, and to identify questions about why particular communication strategies are found rather than other logically possible ones (and thus to contrast with animal

¹¹ As Mulder (1989) argued, bracketing in syntax tends to be associated with analytical “cutting”, but we might think more usefully in terms of how signs group together to form constructions.

¹² At least in this model. In English, we can have a suggestion sign such as *how about* in *how about a coffee*.

communication). The models we have developed have allowed us to see different types of relation in combination, dependency, and sequence as well as the role of facultative signs and the ordering of combinations. We have thus been led to consider implications for communication capacities on the part of speakers and hearers, and move towards strategies for interaction.

SMLs are deliberately very restricted. The questions we have raised have, of course, been addressed from different points of view by other scholars operating with models in different fields. In particular, we have touched on areas of sociolinguistics and discourse which have been extensively discussed in the last twenty years. The modelling of interactions may be connected to issues in conversation. To repeat, the purpose here is to offer a way of analysing assumptions and not to discuss particular models. Where SMLs coincide with current thinking, they offer a degree of support. For example, in sociolinguistics, Mahmoudian (2009) has pointed out that the correlation of a linguistic system with a “speech community”, whose communicational features the linguistic system purports to represent, faces the problem of the sheer (social) diversity of verbal behaviour in the “community” and the variety of systems in operation. In British English, for example, the standard variety has /h/ in initial, prevocalic position for a large number of lexical items, but in some other varieties there is no /h/. Since one can hardly speak of discrete “communities”, at least two variant systems must be in operation¹³. Furthermore, it is quite normal for speakers of the “non-/h/” variety to pronounce [h] in the relevant positions when speaking formally, with self-conscious “correctness”, or in using relatively technical expressions (or when addressing those who habitually pronounce /h/). Speakers of the “/h/” variety do not always pronounce [h] and vary in which words have an initial /h/. The same diversity is true of a range of other British English phonological features too (such as the presence or absence of epenthetic /j/ in such words as *new*, *consume*, or *suit*, for example). Variation of this sort is not restricted to phonology and Mahmoudian calls for a multi-level approach to linguistic description to present a more realistic view allowing for sociolinguistic diversity and determining factors.

In discourse analysis too, multi-level approaches have been called for (e.g. by Delmas, 2012, in relation to media and political discourse). In the use of proverbs (mentioned above), for example, it is clear that multiple perspectives are similarly needed to provide understanding. For example, the Malay (and also Peribahasa Indonesia) proverb *gajah sama gajah berjuang, pelanduk mati di tengah-tengah* (literally, “elephant with elephant fight, mouse deer dead in (the) middle”) has a standard grammatical structure with standard lexical units, but grammar and lexis do not fully account for the expression. It is obvious that the literal meaning (glossed as “when two elephants fight, the mouse deer gets killed in the middle”) is of less importance than the metaphorical interpretation “when two powerful opponents fight, weaker people may suffer if they get involved” and the clear implication “keep clear of disputes between powerful opponents”. There is also a strong association of this proverb with the politics of non-alignment of Indonesia and Malaysia, where it is used to explain the policy of non-alignment and was used extensively in the context of the confrontation between the USA and the former Soviet Union. Furthermore in a related context, recently, Weigand (2010) has advocated an approach to dialogue involving the integration of multiple perspectives and communicational modalities

¹³ But, actually, a whole range of overlapping varieties.

with an explicit probabilistic model, which aims to account for the relatively unpredictable ways in which dialogue may develop according to a wide range of potential motivating factors.

SMLs suggest (in agreement with thinkers such as Mahmoudian, Delmas, Weigand, and others) that real-world verbal behaviour can (and must) be modelled from different perspectives and that a formal communicational model captures only one aspect of a complex phenomenon, not the totality of verbal behaviour. Different aspects need integration. Such a view is consistent with the neuro-scientific views that there is no single “language centre” in the brain, and that human verbal behaviour involves the coordination and integration of multiple complex brain functions (among many references, see e.g. Arbib, 2007, *online*, on the modular integration of brain functions in language).

A significant feature of our models is that they contain signs from both closed and open inventories. Signs in closed inventories may be limited to just one as in *E*, *N*, *Q*, or *S*, although real languages may offer alternative means of addressing the same functions or alternatives in the set—different negation signs (e.g. *not* vs. *never* in English, *ne...pas*, *ne...jamais*, *ne...plus* etc. in French) or alternative ways of making suggestions (*Let's* or *Shall we...?*). However that may be, the contrast of signs from closed and open inventories (emphasised by Martinet in many publications) is important for the sequence in a signal as signs from limited inventories act as reference points which are diagnostic of the signal structure. They also allow the development of one type of dependency. Where signs are facultative, there is another type of dependency involving commutation with zero rather than variability of function as opposed to fixed function. This is similar to the distinction drawn by Mulder and Hervey (2009, *online*) between “functional dependency” (the determination of syntactic function in relation to a nuclear unit) and “occurrence dependency” (concerned with the contextual relations of presence or absence of units in a structure). We have seen that facultative signs may also contract relations with more than one other sign, and hence the question of the scope of combinatory relations becomes important, and this in turn raises the issue of bracketing, its signalling, and a classification of combination relations. In real languages, of course, this possibility is not limited to facultative signs of the sorts we have considered. The issues around sequential combination and complexity are clearly important in arriving at understanding of verbal capacity in humans and its role in evolutionary development, as well as (speculatively) the evolutionary development of verbal communication through exploitation of communicative potentials.

Another outcome is that different linguistic functions can be addressed with different but overlapping models. Different models can have different rules of formation and interpretation. Functions involving communicational interaction require “interaction models” beyond models for the creation of a world of messages. The idea that models for different functions *overlap* presents a different view of the integration of linguistic systems from some current thinking. On the “overlap view”, languages are more like organic accretions of different communication systems for different functions which exploit common sets and relations. This possibility raises the question of whether different means might be used for same or similar messages in different functions. While that implies some inefficiency in the overall system, such features could be seen as evidence for the “accretion” view. Examples might be the different forms of pronouns in Indo-European languages or the different roots of the verb “to be” in those languages. In Malay, negation is signalled by *tiada* as opposed to *ada* in actualiser structures (*tiada gula* “there is no sugar” vs. *ada gula* “there is sugar”); *tak/tidak* in predications; *bukan* in equative sentences;

or *jangan* in imperatives. (*Sahaya tak pergi* (“I’m not going”), *Sahaya bukan orang askar* (“I am not a soldier”), *Jangan pergi* (“Don’t go”). In English, the verbs *say*, *tell*, and *speak* are used for different functions, partially overlapping with *dire* and *parler* in French or *sagen* and *sprechen* in German, whereas the aspectual pair *govor’it’/skazat’* (clearly from different roots) can be used to cover all the possibilities in Russian. Similar diversity is found in some number systems, e.g. Russian *raz*, *od’in*, *p’ervyj* (“one” (in counting), “one” (in naming a number), “first”) or Japanese *ichi*, *ni*, (“one”, “two”) etc. in counting but *hitotsu*, *futatsu*, etc. in specifying an amount.

Naturally, we have not considered all the possible communicational functions. In particular, we have not looked at the representation of states of affairs involving a relation between two or more entities in experience, such as *John sees Mary* through naming relations and two or more signs naming participants in such relations, although it should be clear how such modelling would proceed and that there would be overlaps between the names of relations (*see*, *like*, etc.) and the set of action names in suggestions and instructions as well as the set of naming signs in existence structures and the names of participants in two-place relations.

If we take the view that functional models overlap, then members of the set of (perceptual object) naming signs {s} will occur in multiple contexts—not least with two possible relations to signs naming actions (functioning as “subject” and “object”). The relations contracted by members of {s} do not lead to a strict partition of the set—say, into those which perform a subject and those which perform an object function, or into those which can and those which cannot be in construction with a location sign—but members of {s} will enter some relations more frequently than others, and thus *associations* of agency, instrumentality, or location may develop for signs such as *man*, *hammer*, and *river*, and hence the metaphorical quality of signs used in other contexts (*my hammer does a good job*, *the river washes the shore*, etc.). The need to mark the function of a member of {s} in different contexts raises the question of how that is achieved. Martinet’s (1975) discussion of the different communicational perspectives in subject and ergative languages is significant in this respect. In other words, comparison of the set of predicted specific models with actual verbal behaviour raises further aspects of communication for integration.

SMLs further have implications for our understanding of human communicational capacities. For instance, the modelling of interaction or the communication of two-place relations implies further communicational capacities on the part of speakers, which are important for understanding human development, such as identifying connecting or causal relations between two or more identified components in the environment. The accretion view of overlapping communicational functions raises the question of its consistency with models of language acquisition and learning.

SMLs do not replace existing models based on particular linguistic approaches. They may lead on to particular proposals, support them, or challenge them. The purpose here was not to consider every possibility, but to explain an approach and how it might aid understanding through the analysis of assumptions in the modelling process, and thereby raise questions.

The particular SML used above as an example of the method is not intended as a theory of language. When linguistic models are proposed, they are intended either to present a framework of ideas about language (theory of language), to present a method for the analysis of verbal phenomena (theory for description), or to give an account of a particular class of observables

(description of the phonology, grammar, etc. of a particular speech community). Such models state outcomes of thinking, which can—of course—be questioned from numerous perspectives. However, SMLs are developed specifically to identify our assumptions and limitations prior to actual modelling. They are, therefore, not in competition with existing models, but are—so to speak—precursors of actual models. As we have seen, our SML has raised numerous questions of epistemology, ontology, and method. It has allowed us to connect linguistic ideas to approaches in connected fields. For example, it has also allowed us to identify a range of semiotic issues—in particular the relation of models to signals and signalling behaviour, and hence to the mental capacities implied by semiotic behaviour.

There are, however, no cognitive claims for our SML. In fact, the approach here raises the question of what evidence would be necessary to make a cognitive claim, i.e. attribute a linguistic model to actual cognitive processes. Such evidence would have to go beyond meeting the necessary condition of modelling observable speech behaviour, and include identifiable physical processes in the brain and correlate them with experimental data. It would also have to take into account the theoretical presuppositions of linguistic analysis. However, our SML can be used hypothetically. That is, if we adopt our SML, then there are *implications* for human communicational capacities (for example, relating to prioritisation and short-term memory and interactional behaviour). The accumulation of small-scale functions in SMLs suggests a view of language with multiple accreted and overlapping systems, where such systems connect to non-verbal communicative behaviours through the integration of multiple constructs from different perspectives. Such ideas can be tested for consistency. The approach further implies the understanding of language with thinking in neighbouring disciplines.

The SML, as it stands, is limited to communication about perceived reality. That raises questions about how our conception of semiosis (to use Sebeok's (1986) useful term) must be adapted to handle communication about our "many-sorted universe" (Popper, 1975: 37)—including our sense of "reality" beyond sensory perception. It also raises the important question of the motivation to speak. Our model allows for expressions of the form *EsL*, such as *there's a car outside*. *A posteriori* we know the speaker in such a case wishes to draw the attention of a hearer to the existence of a certain type of perceptual reality in a certain location, but we do not know what motivates the speaker to speak, to speak about that particular circumstance, or how that particular expression is selected from those possible (e.g. *what's that car doing there?*). This suggests that our ideas about verbal communication and its disposing factors need to be seen in the wider context of our construction of the world and actions in it, and also implies agreement with Quine's monistic view that, "knowledge, mind, and meaning are part of the same world that they have to do with, and they are to be studied in the same empirical spirit that animates natural science" (2003: 142)¹⁴.

Our SML was constructed in a way which was intended to be inherently reasonable and reasonably representative of linguistic thinking. Other approaches are not in any way precluded—others can set up different SMLs and analyse their assumptions (I hope they do!), but our model has allowed us to place linguistic ideas in relation to a range of philosophical,

¹⁴ This does not imply agreement with all of Quine's views on language, but—in my opinion—there is a strong tendency for linguists to imply, or slip into the discourse of, an extreme dualism—rejected by most philosophers and scientists—in which speakers "use language", i.e. in which language is hypostatized and divorced from the speaker's mind which "uses" it.

semiotic, and psychological issues. In doing so, the approach underlines the nature of all linguistic models as *constructs for the understanding*.

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