

Completeness and limitation of natural languages*

MANFRED BIERWISCH

Abstract

Expressibility, namely the condition that whatever can be thought can be said, is for strong reasons considered as an essential property of natural languages. To avoid circularity, thought cannot be identified here as what language expresses. The present paper argues that completeness of language with regard to thought is a natural consequence of the fact that the language faculty is essentially the capacity to acquire and use combinatorial systems of symbols. In contrast to iconic signs, symbolic systems do not depend on similarity between signal and meaning, but are based on convention. This symbolic nature of language provides access to any domain of human experience, since no situational connection or similarity between signal and denotatum is required; the combinatorial character allows for any degree of detail, as it provides for expressions of arbitrary complexity. The symbolic and combinatorial nature of human languages implies their discrete and abstract character, by which they are limited to the expression of discrete meanings. Mental structures that are bound to similarity with the signal they rely on are therefore outside the range of language. Percepts of faces and the meaning of music are briefly discussed as mental representations that cannot be verbalized. The symbolic nature of language sets the limits of expressibility, but it also allows for metalanguage and definitions, which in turn are means to overcome local constraints on expressibility. Finally, expressibility is to be distinguished from codability, i.e., the preference for optimal expression and its consequences, which shape conventions and use of symbols.

1. Expressibility and its limitation

The impact that thought has on language — and vice versa — obviously depends on specific properties of natural languages. The following remarks are concerned with aspects of the human language capacity which in this respect

are crucial and in fact un-escapable. The relevant properties will be shown to relate directly to the fact that natural languages are inherently combinatorial symbolic systems.

More specific considerations about the way in which language determines or is shaped by particular aspects of thought, perception, emotion, and other types of mental and physical behavior all depend on the capacity to build up and systematically combine symbolic expressions.

A crucial point to start with is the widely accepted assumption that natural languages are complete in the sense that, whatever one may have in mind, can at least in principle be expressed by linguistic means. This claim, which has been formulated in different ways e.g., by Frege (1923), Tarski (1956), or Katz (1972), is supposed to indicate one of the crucial, and perhaps the decisive, property of natural languages. Here is the version of what Searle (1969: 20) calls “the principle of expressibility:

- (1) For any meaning X and any speaker S whenever S means X , then it is possible that there is some expression E such that E is an exact expression or formulation of X . Symbolically: $(S)(X)(S \text{ means } X \rightarrow P(\exists E)(E \text{ is an exact expression of } X))$.

In simpler terms, “whatever can be meant can be said.” (Searle 1969: 88)¹. This is an important claim, concerning an extremely powerful aspect of the human Faculty of Language: There is nothing in the mental world that cannot be verbalized. There are various formulations of this principle, all of which encounter, however, a serious difficulty, originating from the lack to independently specify what counts as a possible meaning or thought X . Although a fair range of intricate puzzles and proposed solutions deal with the identification and delimitation of thoughts², they do not touch the basic problem of the principle of Expressibility, namely its implicit circularity. As a matter of fact, (1) claims — independent of details concerning the formulation of differences between thoughts — that what can be meant or thought is just what can be linguistically expressed. This becomes obvious if one looks at (2), the strictly equivalent logical contraposition of (1):

- (2) For any meaning X and any speaker S , when it is not possible that there is an expression E that exactly expresses or formulates X , then S does not mean X . Symbolically: $(S)(X)(\neg P(\exists E)(E \text{ is an exact expression of } X) \rightarrow \neg(S \text{ means } X))$.

Again in simpler terms: what cannot be said cannot be meant. In other words, a meaning or thought is just what can be said. Hence, without further ado, the principle of Expressibility would not only claim that natural languages are *complete*, it declares them at the same time to be *exclusive* in the sense that nothing can be meant that is outside the reach of expressions of language. On

this account, language, by definition, would completely determine what we can possibly think or mean. This appears, in fact, to be the position expressed in the famous thesis 5.6. of Wittgenstein (1922):

- (3) *Die Grenzen meiner Sprache bedeuten die Grenzen meiner Welt.*
 ‘The boundaries of my language are the boundaries of my world.’

If one construes the notion of “my world” as the totality of my actual or potential experiences, i.e., the range of things and situations I can possibly encounter or be concerned with, then the question arises, whether my language (in the literal, non-metaphorical sense of natural language) does indeed determine the boundaries and the structure of what constitutes “my world”³, such that nothing can show up, whose structure is not reflected in the organization of my language. Without going into speculations about the ontology of “my world” and its boundaries, I will argue that there are in fact indispensable aspects of the external and internal reality which are by no means outside of “my world”, for which there is, however, no linguistic expression, let alone an exact linguistic formulation. And this, I will argue, is not just an accidental gap of one or the other linguistic component, but is due to systematic reasons. The contention is, in other words, that experiences and intentions human beings are well aware of may include or be based on phenomena that cannot be expressed or formulated by linguistic means. Hence alongside the principle of expressibility (1), we have (4), which might be called the limitation of expressibility:

- (4) There are speakers S and experiences X , such that S is aware of X and there cannot be an expression E such that E is an exact expression or formulation of X . Symbolically: $(\exists S)(\exists X)(S \text{ is aware of } X \wedge \neg P(\exists E)(E \text{ is an exact expression of } X))$

In simpler terms: certain experiences cannot be verbalized. In order to make explicit the difference between the limitation and the negation of (1), the formulation of (4) is strictly parallel to what would be the negation of (1), namely the claim that there are meanings which cannot be expressed. In other words, although (4) is intended to delimit the principle of Expressibility, it is not its denial. The crucial point is, of course, the distinction between “ S means X ” and “ S is aware of X ”, a distinction that urgently needs to be explained in more detail. If to that effect the domain of what can be meant is restricted to thoughts that can be linguistically expressed, allowing at the same time for experiences that are not or even cannot be expressed by linguistic means, then the assumption, that thoughts are just what can be represented by linguistic expressions, need no longer be a vicious circle. Thoughts are now distinguished from mental phenomena that escape linguistic expression.

With this proviso, natural languages are indeed complete in the sense of Universality noted by Tarski (1956), who assumes that they can express

thoughts of whatever can meaningfully be spoken about. I will argue, however, that natural languages create by the same token boundaries within the mental world, leaving unexpressed what for principled reasons cannot be meant by linguistic expressions.

In order to clarify the distinction between what can be meant and formulated by means of linguistic expressions and what one may be aware of without being able or willing to express it linguistically. I will mention two possible distinctions that are not at issue here. First, the distinction in question does not concern a thought and the difficulty to express it, as noted e.g., in Augustinus' famous statement that he knows the answer to the question "what is time?", as long as he is not asked. Or to give a simpler example, the well known difficulties involved in reliable route directions in a complicated place or other tasks to verbalize intricate spatial conditions.

Second, as noted in Note 2, Frege (1918) carefully distinguishes thoughts from the activity of grasping them, a distinction that turns on the individual's mental processes in contrast to their invariant, replicable structure or content. Different subjects may entertain the same thought, but on the basis of their own mental activities. However important the distinction between mental processes and their invariant structures might be⁴ — it is not the difference between things to be meant and the wider range of things to be aware of or to be experienced. Just as different subjects can grasp the same thought they can also be aware of the same taste, identify the same face, or appreciate the same tune, but while they can express the thought, it is impossible to verbalize the taste, the face, or the tune. In other words, recognizing a face or appreciating a tune is as different from the face or the tune as grasping a thought differs from the thought, but only the latter is available for verbal expression.⁵

Instead of merely complementing the principle of Expressibility (1) by its limitation stated in (4), I will go one step further, arguing that the completeness of natural languages is inextricably related to their boundaries, such that after all (1) is correct just because (4) holds.

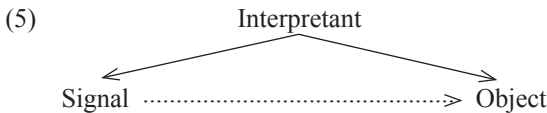
One important point has to be added. On closer inspection, it is clear that the principle of expressibility (1) and its limitation (4) do not only rely on the difference between thought and experience, they also make different claims with respect to their expression. While (1) requires the availability of linguistic expressions, (4) denies their possibility, but does not exclude expression altogether, as indicated by the term verbalization in the informal version of (4). To illustrate the point, a smile or a sigh may quite distinctly express certain emotions, which cannot be verbalized (even though it is possible to talk about them). Ballet and expressive dancing, under this perspective, are systematic ways of crucially nonverbal expression. More generally, then, a large array of different modalities can be used to express experiences for which no verbalization is available. Hence (4) delimits the completeness of language by extend-

ing the range of phenomena to be considered in two directions: It includes experiences in addition to thoughts⁶, and it reveals verbalization as the relevant, specifically delimited domain of expression.

In what follows, I will discuss properties of the language capacity, from which the completeness and limitation of natural languages derive. More specifically, I will argue that there are in fact mental phenomena that escape linguistic expression, and I will try to explain why this is so and why natural languages are nevertheless complete.

2. Three types of signs

A reasonable point to start with is the basic classification of signs developed in Peirce (1931–1935). The general notion of sign, which includes natural languages alongside with all sorts of codes and systems of signalization, is based on the interpretant relating a signal to an object, such that the signal represents the object, schematically:



Although the signal is plausibly to be construed as a physical event or object of some sort, the relevant aspect is its invariant, reproducible structure. It is this structure, which the interpretant relates to the object in question. The interpretant as conceived by Peirce is best be construed as the condition due to which the signal stands for the object⁷. This relation is asymmetrical, as the signal represents the object, but not vice versa, although it does support comprehension as well as production of signals. Finally, the term “object” abbreviates any possible configuration of entities and conditions of external or internal aspects of the sign-user’s environment. Hence physical as well as mental or social phenomena can be objects in the sense of (5). It must be added, though, that for all types of objects, it is their invariant structure, rather than the particular occurrence which the interpretant relates to. Although this is parallel to the signal side, it creates an additional problem on the object side, which includes physical as well as mental phenomena. While external phenomena exhibit their structure in essentially the same way as signals, this does not carry over to internal or mental phenomena, where occurrences and their structure might easily be identified or confused. How, after all, can one distinguish between ones recollection of a visit to Venice and its structure?⁸ However this problem is to be dealt with, the type-token distinction, which is at issue here, is fundamental for all sign systems, including the different aspects of natural languages.

Now, the relation between signal and object, indicated in (5) by the dotted arrow, is the indispensable condition, on the basis of which the interpretant may connect signal and object. Three fundamentally different types of signs have been fore-grounded on this basis by Peirce: indexical, iconic, and symbolic signs. The classification in question may be sketched as follows.

Indices are signs whose signal is related to the object by direct situational connection, including in particular causal dependency (which turns indexical signs into what is often called symptoms). Well known examples are noted in (6), where the linguistic items in (b) and (c) illustrate rather different kinds of situational dependency (reflected also in different grammatical properties).

- (6) a. Smoke — fire, spots on the skin — measles, pointing finger — direction, crying — pain
 b. Interjections like *ouch*, *wow*, *ooh*,
 c. Indexical words like *I*, *we*, *here*, *now*

Icons are signs the signal of which shares characteristic structural properties with the object it represents. Signal and object of an icon are similar or analogous in crucial respects, such that the relevant properties of the object are reproduced by the signal. Examples are given in (7):

- (7) a. Diagrams, maps, pictures, pantomime
 b. Words like *cuckoo*, *bow-wow*, *whisper*, *tingle*, *bump*, *crack*

Symbols are signs the signal of which is neither bound to situational presence of the object nor dependent on it by shared properties. The connection is arbitrary in both respects, based merely on stipulation by the sign users. The stipulation might either be the result of implicit convention or of explicit regulation. Examples of both kinds are given in (8):

- (8) a. Implicit conventions: Symbolic gestures like nodding or shaking the head, clapping the hands; numerals, letters, words, phrases
 b. Explicit conventions: Traffic signs, Morse code, trumpet signals; technical terms, symbols of logic, chemistry, and other formal systems

This is a rather sketchy illustration, but the main point should be clear enough: Signs relate signals to objects by at least one of three conditions: direct situational connection, similarity, or convention. It might be useful to look at three types of signs representing the same object, viz. actual time, using different kinds of clocks, all of which are ultimately based on physical processes depending on time-course.

- (9) a. Indices: sand-glass, sun-dial rely on direct perception of time-course effects

- b. Icons: hands on a dial represent portions of the time course by analogy
- c. Symbols: digital clocks represent time intervals in terms of decimal coding

In spite of the causal connection between the physical time course and its representation, the interpretant relies on essentially different mechanisms and relations: Only indices display the effect of the physical event directly, while icons map it on analogous positions or angles of various hands, actually an integration of iconic and symbolic aspects, as the distinction between size and function of hands is clearly conventional. Finally digital displays rely not only on conventionally fixed units of time measurement, but also on their representation by means of the decimal code. Among the interesting conditions of signals representing time in different ways, one aspect needs to be emphasized in the present context. The signal of indexical clocks is continuous and motivated, as the time course directly corresponds to the position of the shadow or the amount of sand. Iconic clocks are motivated, mapping time intervals on analogous angles, and they are basically continuous, but may be discrete, switching the hands according to discrete positions. The signal of digital clocks, however, is necessarily discrete and arbitrary, depending on the choice of numbers. This difference between discrete and continuous relation between signal and object and the indispensable discreteness of symbols will turn out to be fundamental for the character of natural languages. Some further remarks with respect to the typology of signs might be added.

First, besides the distinction based on the signal-object relation, other differences might be observed, e.g., with respect to the material replicability or the permanence of the signal: spots caused by measles cannot be repeated like e.g., crying indicating pain, etc. As a matter of fact, Peirce distinguished about ten types of signs according to different criteria of this sort, which need not concern us here.

Second, and more importantly, the distinction between indices, icons, and symbols does not yield mutually exclusive systems, as the examples in (6)–(9) already show: Maps are icons in crucial respects, relying on structural analogy between parts of the map and the represented areas, but they also use conventional, symbolic elements to distinguish e.g., types of streets or cities, rivers and mountains, etc. Similarly, words like *me*, *we*, *now*, or *here* are indexical, depending (under direct interpretation) on situational connection to their object, but they are nevertheless conventional symbols, like lexical items in general. And cases of onomatopoeia or synesthesia like *cuckoo* and *murmur* are conventional symbols that exploit iconic similarity between signal and object⁹. More generally, natural languages are crucially symbolic systems that nevertheless may incorporate various aspects of indexical and iconic signs¹⁰.

Third, the three types of signal-object relation are not just definitional distinctions between different sign systems; they rather correspond to substantially different capacities by which the interpretant-function is realized. The perception and production of signals and objects, and the interpretant relation among them may depend on specific mechanisms, eventually based on particular neuronal dispositions. Differences distinguishing symbols must be identified and acquired item by item, while situational differences between indices or similarity conditions of icons can be derived from previously established relations and need not be introduced separately. In simplified terms: Symbols, based on convention, require and depend on specific capacities of symbol-acquisition, while indices and icons may exploit mechanisms that exist independently of their function in sign systems.

Finally, important consequences derive from the properties different types of signs exhibit. Indices, depending on situational connections, cannot represent objects that are absent from the actual situation. Icons require signals to share structural properties with the objects they represent. Although this is less restrictive than the condition indices are subject to, it still constrains the range of potential objects to domains which the structure of the signals can be alike, such as e.g., two-dimensional pictures representing three dimensional objects¹¹. Symbols, however, are neither restricted by conditions on situational presence nor by structural similarity. They may hence represent objects from an unlimited variety of domains, from physical shape and visual perception to emotional values, economic interest, or theory of evolution. This practically unlimited extension of scope is intrinsically bound to another crucial condition: Symbols are discrete and hence abstract with regard to their objects, insofar as they can only represent discrete structures¹² in the domain of objects. Both, the abstractness and the unlimited range of domains will turn out to be decisive for the nature of natural languages.

Now, all languages are sign systems, but not all sign systems are natural languages. Hence the specificity of human languages and their prerequisites must be sorted out.

3. Five constitutive conditions of the faculty of language

There is little doubt that the language faculty is a species specific result of phylogenetic evolution. It is certainly not the only, but perhaps the most important human specificity, and it is presumably the property with the most far-reaching consequences, as it permeates and reorganizes practically all individual and social aspects of life, many of which come into being just through the disposal of language.

Although the language faculty has the effects of a coherent, unified disposition, unfolding along organized maturational conditions like other biologically

determined capacities, it recruits a variety of components that are due to different and partially independent evolutionary processes. The following provisional sketch singles out five conditions of different character, which are plausibly to be identified as necessary preconditions or integrated components of the faculty of language, without denying the participation of other relevant factors.

- (10) a. Organization and control of behavior by an internal model of the environment
- b. Production and recognition of reproducible, structured signals
- c. Recursive-hierarchical organization of perceptual and motoric structures underlying the organization of behavior
- d. Capacity to acquire labeled concepts, i.e., classifying names (symbols)
- e. Life within social groups with corresponding communicative structures.

The evolutionary origin and elaboration of internal models representing an organism's external and internal environment to direct and control its behavior as noted in (10a) is too complex a phenomenon to be even sketched here. It is simply to be taken for granted as the necessary basis on which objects in the sense discussed so far can be identified. In other words, the internal model of the environment is the overall domain of entities and structures which linguistic signs can represent. It must be emphasized, however, that recourse to this internal model by means of different types of signs, notably by means of symbolic systems, can only come about as one of the various ways in which the organism's relation to the environment is realized. In other words, in addition to, or perhaps long before, thoughts might be accessed by symbolic signs, the internal model must be assumed to support all sorts of experiences, whether verbalized or not.

Production and recognition of structured signals relies on integrated mechanisms which are recruited and perhaps modulated by the language faculty. They obviously have their own evolutionary history, in which the necessary physiological properties originated. Two points are to be noted, though. First, the vocalization and acoustic communication of other primates is by no means the direct predecessor of human language, however comparable (in spite of all differences) the vocal tract and the communicative behavior might be. The pertinent facts and problems are surveyed e.g., in Wallmann (1992). Second, although the phonetic realization is the basic, preferred, and normal modality of linguistic signals, it is not the only possible option, as the systematic analysis of sign language in Klima and Bellugi (1979) revealed. Accumulating results prove sign languages to share all relevant properties with spoken language. For expository reasons, further discussion will be restricted to the

phonetic modality, keeping in mind, however, that the visual signals of sign language exhibit the same capacity and the same general properties.

A systematic account of hierarchical, recursive structures underlying complex behavior, including even fairly elementary patterns like walking or hammering, has been proposed in Miller et al. (1960), and it is not difficult to observe organized structures of this sort in many domains of perception, motoric action, or social interaction, and across a wide range of biological species. It is a natural consequence that hierarchy formation shows up in the structure of language as well. The formal characterization of plans for structured behavior developed in Miller et al. (1960) is easily shown to be equivalent to a Context Free Grammar as investigated in Chomsky (1963). Hence the power to create and execute constituent structure must be a phylogenetic achievement the language capacity can rely on. It might furthermore be the case, as argued by Hauser et al. (2002), that a particular property of context free grammars, which is indeed a characteristic structural possibility of natural languages¹³, is a distinct condition of the language capacity¹⁴. In any case, the capacity to build up and systematically use combinatorial mental representations to organize complex sequences of behavior must be the result of phylogenetic processes the language capacity can rely on.

A much more specific, in fact rather peculiar, but extremely consequential, condition is the capacity to acquire what one might call labeled concepts, viz. representations of patterns that classify objects (in the general sense of (5) above), associated with patterns of reproducible signals. This capacity too has a language independent pre-history, although it seems to be by far less widespread than the use of signals or complex plans of action and perception. Whether and to what extent labeled concepts play a role in animal communication is an unsettled question. It has been found, however, that the capacity to acquire symbolic signs, i.e., signals with free, conventional relation to the objects they represent, is available to a surprising range of species, including primates and dolphins, but also dogs, as a careful study reported in Kaminski et al. (2004) demonstrates. It must be emphasized that isolated symbols are not language, but their disposal is a crucial, in fact indispensable prerequisite.

Finally the whole system of conditions that warrant the organization of life in social groups with all its interdependencies and individual specificities has a complex phylogenetic basis without which the language capacity would certainly not have evolved. It must be stressed, however, that extralinguistic communication, which plays a constitutive role in groups of social animals, is not to be confused with human language nor even considered as its predecessor. Notice that all kinds of nonverbal communication — facial expression, gestures, dressing, etc. — participate in social interaction, including verbal exchanges, organizing human life in general.

These five components, complex conditions in themselves, have rather different biological origins and relationships, and it is not clear whether this is all what the language capacity relies on. None of these conditions can be dismissed, however, and none of them alone and by itself constitutes the human language capacity.

4. Essentials of the faculty of language

Given the prerequisites sketched so far, what distinctly characterizes the language faculty is the ability of (recursive) *combination* combined with the capacity for *symbols*. The integration of these two ingredients — formation of complex structures noted in (10c) and acquisition of symbols noted in (10d) — is accompanied by essential modifications in both of them:

- (11) a. Symbols that figure in linguistic expression are inherently combinatorial with respect to the structure of signals as well as the structure they represent.
- b. Combinatorial structure of language is inherently symbolic, combining elements that belong to two different domains: the structure of signals and the structure assigned to parts of the environment.

By (11a), morphemes, words, phrases are distinguished from symbols like traffic signs, national flags, or heraldic signs, which are not combinatorial¹⁵. Thus, the elements in (12a) combine according to rather specific inherent properties to yield (12b), which represents two different complexes (with 's being either the Genitive inflection or the reduced copula *is*), exhibiting different properties as to further combinatorial options, while (12c) is not a possible combination at all.

- (12) a. Paul, come, ing, 's
- b. Paul's coming
- c. *Paul coming's

As to (11b), comments in at least two respects are indicated. First, language differs from iconic combinatorial sign systems like maps, pictures, or music, the elements of which combine according to principles which preserve the similarity between signal and object. Thus, directions and distances between parts of the map reflect corresponding directions and proportional distances between the parts of reality they represent. Similarly, duration, or repetition in music represents duration, and repetition of whatever music represents. Second, combining symbols is tantamount to combining elements that belong at the same time to two domains the combinatorial principles of which do not

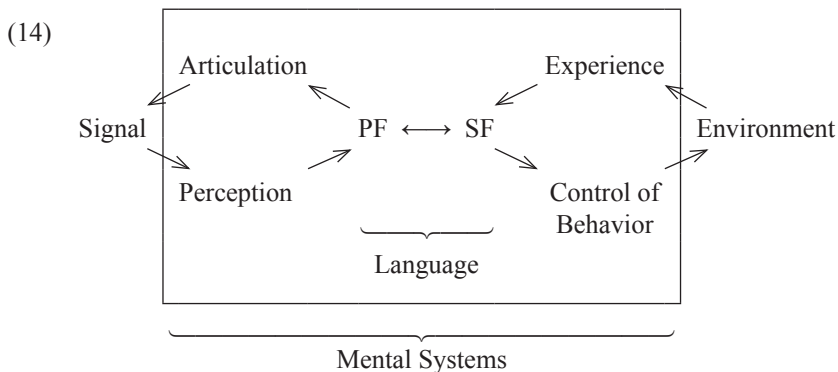
coincide, as just noted. Well known cases of ambiguity like (13), where either two recollections of Mary or the recollections of Mary and Sue are compared, illustrate the point once more.

(13) Mary remembers Paul just as well as Sue

While the signal of the parts and their combination is identical for both readings, the relation between the represented objects is systematically different.¹⁶ Now, if phenomena like those in (12) and (13) are the result of the operation Merge, which creates complex expressions from their component parts, then this operation (and its consequences) must be sensitive to the properties of both the signal and the represented entities of the composite expressions. With this proviso, it seems to be appropriate, as Chomsky (2004) suggests, to consider Merge as the central and perhaps only property by which the language faculty is set apart from other mental capacities¹⁷.

The gist of these remarks is the fact that language as a combinatorial system of symbols ties together complex, nonisomorphic structures from two completely different domains. It seems that the integration of these two conditions — symbols and composition — separates language from other domains of mental structure. There are symbols outside of language, and there is, in particular, combinatorial structure in many domains, but the systematic co-combination of independent domains is unique and specific to language¹⁸.

As a basis for further discussion, it might be useful to have a look at the way in which linguistic expressions relate to other aspects of mind. Starting with the schema (5), the function of the Interpretant in the case of natural language can be made more explicit by the box in (14), where the term Object is replaced by the more general notion Environment.



PF is the standard abbreviation of Phonetic Form, SF is short for semantic form, a representational system that comes with different names in different frameworks¹⁹. Putting aside matters of detail, PF and SF can invariably be

considered as interfaces of language with the input- and output-systems supporting various aspects of internal and overt human behavior. Some additional remarks about the parts of (14) might be in place.

First, the arrows in (14) indicate connections and prevailing, but not necessarily unidirectional dependencies, and certainly not the actual flow of information. Thus SF depends on patterns that control overt behavior just as much as it can participate in their determination. Similar remarks apply to patterns shaping actual experiences and to the articulation and perception of signals.

Second, the production and perception of signals, by which PF is connected to actual and virtual physical events, relies on highly integrated and mutually dependent mechanisms, which are, moreover encapsulated in the sense of Fodor (1983). In other words, *articulation* and *perception* (henceforth abbreviated as A-P), although based on different sensory organs, constitute a unified module which particularly serves the faculty of language.

Third, the relation between SF and the environment involves a by far more diverse range of more or less encapsulated modules and components, including the various modes of sensory perception, motoric action, formation of plans and intentions, conditions of social interaction, relying on the so-called Theory of Other Minds, accompanied by patterns of emotion and motivation, to mention just the most obvious subsystems supporting experience and activity. Thus, the mental systems which interface with SF, henceforth abbreviated by C-I (for *conceptual-intentional systems*) are in obvious ways more complex and diverse than A-P, which interfaces with PF.

Fourth, besides this asymmetry regarding diversity and complexity, A-P and C-I are asymmetrical in yet another, actually two-fold way, which cannot be displayed in a schema like (14). On the one hand, the peripheral organs on which A-P relies, are all involved in C-I systems as well, although they are integrated in the autonomous module of signal processing: Language comprehension is part of general auditory perception, speech production involves articulation that could go beyond language²⁰. On the other hand, A-P as a whole must be considered as one of the components contributing to C-I, because signals in the realm of A-P can also be perceived and controlled by the mechanisms of C-I (and spoken about by means of language), independently of actual language use. In other words, A-P can become one of the modules C-I has access to, ultimately supporting e.g., metalanguage²¹.

Finally, the actual sign function, which is the essence of the Interpretant in (5), boils down to the relation between PF and SF. The double-arrow in (14) indicates the interdependence between the two sides of the sign, based on essentially implicit conventions. They determine the properties of basic symbols, which are projected by combinatorial principles to expressions of increasing complexity, as hinted at in (12) and (13) above. The arrow connecting PF and SF does not show, however, the fundamental asymmetry between the two sides

of the sign. Although it is not independent from the asymmetry already noted, it clearly imposes its own functional characteristics on the components it connects: PF and the signals it ultimately determines, represents or stands for SF and the configurations it determines. In this sense, PF represents SF, but not vice versa. In traditional terms, PF determines the form of signs, or the *signans*, SF determines their meaning or *signatum*.

As an intermediate summary, we notice that natural languages are symbolic systems and can therefore represent objects and situations from all domains of experience, and they are inherently combinatorial, which provides an unlimited range of complex expressions, allowing the representation of unlimited detail with respect to all aspects of experience. This warrants the completeness of natural languages in the sense of expressibility stated in (1). I will now go on to show that this is possible just because natural languages are discrete and abstract with respect to form as well as meaning, thereby creating the boundaries of expressibility noted in (4).

5. Five characteristics of natural languages

The conditions discussed so far, notably those inherent in combinatorial symbols, imply or presuppose a number of characteristic properties of natural languages, which directly bear on the way in which language and thought depend on each other.

5.1. *Heteromorphy of PF and SF*

As noted above, PF and SF are the interfaces of the fundamentally different systems in A-P and C-I, respectively. Due to their asymmetry, PF and SF are based on essentially different structural principles, indicated in (15).

- (15) a. The organization of PF is essentially linear, corresponding to the temporal structure of the signal.
 b. The structure of SF is based on nonlinear, hierarchical dependencies, corresponding to conceptual functor-argument relations.

The sequential nature of PF, based on segments corresponding to time slots of the signal, holds for all layers of complexity, from segments and syllables to phonological words, phrases and complete utterances.²² The whole wealth of principles, rules and constraints on the combination of features and segments put forward in phonology²³ accounts for conditions imposed on this central skeleton. It is important to notice that this linear combination is the basic prin-

ciple of PF both within and between basic symbols (morphemes, words, or lexical items).

While the linear organization of segments and syllables in PF is pretty obvious, the nature of basic elements of SF and their nonlinear dependency is less evident. It should be clear enough, however, that the components involved in the meaning of a word like *tree* do not exhibit a linear ordering like the segments of PF. (There is not first a physical object, which then is a plant, and then has a stem, roots, and branches, etc.) The components of SF exhibit, however, systematic dependencies of the sort noted in (15b). To illustrate the point: if (16b) is a close paraphrase of (one meaning of) (16a), one can identify the components tentatively indicated in (16c), recognizing also the dependencies indicated by brackets, plus the condition that each occurrence of *x* and *y* must represent the same entity.

- (16) a. lie
 b. make a statement one knows to be untrue
 c. [[X KNOWS [NOT [TRUE Y]]]] AND [X STATES Y]]

Without entering the overwhelming literature dealing with representational systems for the semantic structure of natural languages, two points can nevertheless be made. First, as noted in (15b), the connection between the components of SF relies on a general functor-argument relation²⁴. Hence even though an illustration like (16c) is based on sequence of some kind of basic semantic elements, on which a hierarchical bracketing is imposed, it would be misleading to consider this ordering to be more than a notational choice.²⁵ Structures of SF must not be conceived as being sequential in any way comparable to PF. Second, the connection among elements in SF is due to the functor-argument relation both within and across lexical items²⁶. An immediate case in point is (16c), an approximation of the SF of both the simple item *lie* and its paraphrase (16b). It is, of course, a by no means trivial matter, to show how something like (16c) results from combining the SF of the items in (16b), a problem that must be left aside here. But see the references in Note. 23 for proposals.

In any case, PF and SF are based on fundamentally different principles, underlying heteromorphic interface-structures with no simple mapping between their respective elements and relations. Both are, however, homogeneous in the sense that the principles of combination are the same in simple and complex expressions. With this perspective in mind, the morpho-syntax of a given language can be seen to organize the PF-SF-correspondence of its expressions. More specifically, morphology accounts, roughly, for the intricacies of this mapping with respect to words (or lexical items), while syntax takes care of their combination. See Wunderlich (2008) for further discussion of these matters.²⁷

5.2. *Conventionality and arbitrariness*

The heteromorphism of PF and SF is bound to the symbolic, conventional nature of linguistic expressions. Strictly symbolic systems do not rely on similarity between the signals and their meaning, neither for basic symbols nor for their combination. Hence PF and SF can be completely heteromorphic. Iconic systems on the other hand must, by definition, exhibit some similarity or isomorphism between signals and their meaning. This can include all relevant aspects of the signal of basic signs and their combinatorial relations, as in photographs or realistic paintings. But iconicity can also be accompanied by or partially based on systematic conventions, as e.g., in the system of structural formulae in chemistry, or in different types of maps and diagrams. Now, natural languages do not exclude iconic aspects either.²⁸ As mentioned earlier, iconicity can be used e.g., in poetry, or simply stabilize conventions. Besides synesthetic motivation for lexical items like German *Blitz* and *Donner* (lightning and thunder), certain combinatorial options can also be used in iconic ways, like the well known correspondence between order of mention and order of event, illustrated in (17a) vs. (17b), which can easily be spoiled by symbolic means, however, as (17c) illustrates.

- (17) a. He jumped over the fence and ate an apple
 b. He ate an apple and jumped over the fence
 c. He ate an apple, after jumping over the fence

In general, though, the correspondence between PF and SF does not depend on similarity, neither for basic elements, nor for their combination, as grammatically regulated alternations like *Paul's proposal* vs. *the proposal of Paul* indicate. Occasional synesthesia in lexical items and iconic motivation in Morpho-Syntax notwithstanding, the form-meaning correspondence in language relies crucially on convention in both respects.²⁹ Acknowledging this central role of conventionality prompts two contrary observations.

On the one hand, the interest in general principles, Universal Grammar, and systematic rules as the prominent features in knowledge of language favors the tendency to consider conventionality, plausibly called Saussurean arbitrariness in Chomsky (2000), as a side issue which somehow interferes with the otherwise systematic character of natural languages. In view of the previous discussion, though, conventionality cannot be considered as marginal. It is not only a central condition of language as opposed to other mental domains, it has also decisive consequences for the very nature of linguistic expressions, as we will see shortly.

On the other hand, conventionality must not be confused with pure chance or unconstrained arbitrariness. The organization of PF and SF and the correspondence between them is determined not only by the principles of linearity

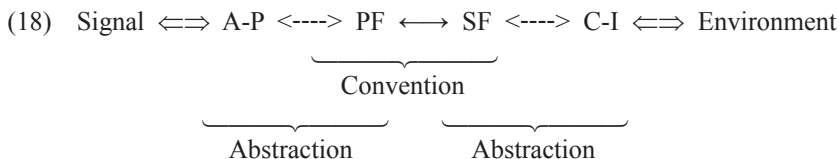
and functor-argument-relation noted in (15); it is also subject to further conditions and constraints, which altogether make up the faculty of language as constituted by Universal Grammar, the content of which is not known in advance, but must be construed as a rational research program in the sense proposed in Wunderlich (2007). In other words, the range of arbitrary choice providing candidates for symbolic expressions is created and constrained by the principles of Universal Grammar and the complex motivations on the basis of which particular conventions are created and acquired.

5.3. *Discreteness and abstraction*

The conventionality of symbolic as opposed to iconic signs is intrinsically bound to their discrete structure — again an asymmetrical relation: symbols are always discrete, while discrete signs are not necessarily symbols, since icons (and indices) may be continuous or discrete. For illustration, remember the different types of clocks. Numerical displays are inevitably discrete, whether they indicate hours, minutes, seconds, or parts of them, while analogous displays may be continuous or discrete, depending on the arrangements of hands and dials. It should be added, that iconic representations might in turn have a symbolic, hence discrete underpinning, like e.g., the different hands of a clock and their interpretation, which is clearly symbolic, iconicity being restricted to the actual values. As an important consequence we notice that discrete signals, whether iconic or symbolic, represent discrete (aspects of) objects. Although time might conceptually be continuous — discrete clocks can indicate only discrete portions of time.

These observations highlight two essential aspects of natural languages. First, the two components of symbols, form and meaning, impose necessarily discrete distinctions on each other. Hence PF and SF are inevitably discrete structures, not a new insight, but still a central aspect of linguistic expressions. To put it the other way round, all continuous aspects of either the signal (such as intensity of voice or changing pitch) or meaning (such as shades of color or varying norms of size) cannot be part of the linguistic structure. Second, neither the signal of linguistic expressions nor the external and internal environment to which they refer exclude continuous structures and processes. Hence the linguistic expressions dealing with these input and output conditions necessarily map continuous phenomena on discrete structures. As perception, processing and control of reality clearly involve continuous aspects of experience and corresponding modes of mental representation, it follows that PF and SF, interfacing with their respective extralinguistic domains, must warrant the abstraction that accomodates mental reality to discrete, symbolic representations.

Abbreviating again by A-P and C-I the mental systems which language interacts with, the conditions just discussed can be abbreviated by the following schema:



Where and how exactly the reduction takes place, cannot be explored here. It is presumably the effect of different mechanisms, which are not in general bound to language, although the language faculty possibly involves principles that provide the relevant categorization, as discussed in Bierwisch (2001). In any case, PF and SF are necessarily abstract structures that adjust mental realities of different character.³⁰ It should be remembered that the arrow connecting PF and SF covers the whole range of basic symbols as well as their combinatorial capacities captured by the rules and principles of morphosyntax.

5.4. *Lexicalization*

The decisive effect of combinatorial symbols is the fact that basic symbols are fixed by convention, while complex symbols are generated by combination, providing the predetermined correspondence between form and meaning. Hence complex symbols are motivated, although not by similarity, but by rule. This is the gist of the received locution according to which speakers are expected to produce new sentences, but not new words. The delimitation of (old) words from (new) phrases is not so clear, however, since there is only a fuzzy boundary separating lexical items from fixed phrases like *how do you do* and lots of other stereotypes, whose actual properties, though compositionally motivated, might go beyond the regular combination. The by far more fundamental problem, though, derives from the fact that implicit conventions, unlike explicit stipulations, do not make up a closed and unchangeable array of established symbols. To be sure, a reliable stock of basic symbols is an absolute essential for any symbolic system, but the possibility to add new items (and to enrich already existing ones) is an equally built-in momentum of the language faculty. Crucial evidence for this claim comes from children's acquisition of new items by so-called fast mapping, which instantaneously correlates form and meaning of an item on first encounter, even if the intended correlation can only be inferred on the basis of situational context, as discussed in Bloom (2002). This phenomenon is a characteristic ingredient of language acquisition, but there is no reason to suppose that the capacity to incorporate new

items or new features of existing items disappears in maturation. In fact, the capacity to enrich the lexical system on demand (presumably along established lines by means of already available elements) is an indispensable condition for the principle of expressibility, since in order to make it possible to express whatever can be thought, knowledge of language might be forced to extend the lexical repertoire e.g., by names for new entities or terms for properties not distinguished before. Katz (1972) explicitly discusses this possibility as implied by the principle of expressibility.³¹

The upshot of these considerations is not the claim that the lexical system is a vague and unreliable collection of fuzzy entries, but rather that the fixed, idiosyncratic lexical information is open to modifications by implicit conventions, which the system as a whole is prepared for. As a moment's reflection shows, implicit conventions could hardly be established at all without the possibility to incorporate and adapt new basic symbols.

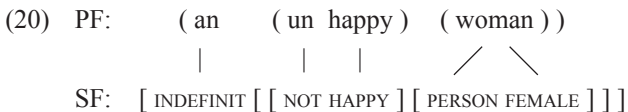
5.5. Projective and nonprojective correspondence

The characteristics discussed so far are due to the fact that the language faculty supports the acquisition and use of combinatorial symbols based on implicit convention. We now turn to an amendment of these conditions that the organization of combinatorial symbols does not necessarily imply. The issue concerns the complexity of the relation between PF and SF noted earlier.

A straightforward correspondence between a linear structure like PF and a nonlinear hierarchy like SF would preserve at least the part-whole relation of elements in one domain by the corresponding elements in the other domain, such that hierarchical connection is mirrored by linear inclusion. More technically:

- (19) The mapping between PF and SF is projective, iff for any A and B in SF which correspond to a and b in PF the following holds:
 A is part of B if and only if a is part of b.

Projective correspondence of this kind plays in fact an important role within lexical items as well as in their combination, as loosely illustrated in (20), where parentheses indicate prosodic grouping and square brackets provisionally mark semantic configurations.



The morphological and syntactic organization of natural languages obeys this condition as a kind of default principle, leading to much of the traditional

constituent structure. There is no doubt, however, that natural languages in general do not comply with condition (19). Nonprojective violations of the SF-PF-correspondence show up even inside lexical items, but especially in practically all domains of syntactic combination³². Obvious cases are the well known bracketing-paradoxes indicated in (21), and the intricate phenomena dealt with by different types of syntactic movement, illustrated in (22).

- (21) a. (un (happi er))
 | | |
 [NOT HAPPY] MORE]
 b. (auf (hör t e))
 \ / \ /
 STOP PAST
- (22) a. who do you want to talk to who
 ↑ |
 └────────────────────────────────┘
 b. der Lärm hörte dann auf hörte
 ↑ |
 └────────────────────────────────┘
 (then the noise stopped)

Without going into the vast literature dealing with the various types of problems involved, three remarks are to be made here. First, if one assumes that conventions establishing a symbolic relation must basically relate a signal to its object (or PF to SF, for that matter), then all the complexities involved in projective mapping and its extension derive from the conditions guiding the combination of symbols. It is an empirical issue to find out the extent to which they are inherent properties of the language faculty characterized by UG. Second, the fundamental operation creating complex symbols is to combine linguistic expressions according to their fixed properties, thereby creating the complex, but systematic mapping between PF and SF. A stimulating perspective on these matters arises from the distinction between internal and external Merge, proposed in Chomsky (2001). The external merging of two separate expressions would yield the basic projective correspondence, while the internal Merge, modifying this correspondence in systematically constrained ways, leads to nonprojective extensions. One might wonder why the faculty of language exploits the possibilities of nonprojective mapping, thereby complicating the more transparent projective mapping. One of the reasons might be the conflict between different preferences on ordering noted above (see Note 28). In any case, the faculty of language obviously provides the means for projective mapping as well as its nonprojective extension.³³ Finally, the projective mapping and especially its nonprojective extension are directly related to the nonconic nature of linguistic expressions, although the correspondence be-

tween form and meaning of complex expressions is motivated and predictable on the basis of their constituent parts³⁴.

6. The completeness of natural languages

It is possible now to go on and not just assert, but to explain the expressibility or completeness of natural languages. Two properties turn out to be decisive for two different aspects of completeness.

6.1. No limitation of domains and situations

The meaning of linguistic expressions is not restricted to particular domains of experience, nor is their use and content bound to specific situational settings. This is due to the symbolic nature of linguistic expressions, which do not depend, like indexicals, on limited conditions of use, nor like icons, on particular parts or aspects of external and internal reality to which they must be analogous or similar. This independence from situational conditions and structures of content follows directly from the nature of symbols, and it is possible only because of the abstract nature of form and meaning, more specifically of the interface representations PF and SF.

To make this point as plain as possible, one might contrast linguistic expressions with pictures, which too can represent an unlimited range of objects and situations independent of specific occasions or settings, but they are clearly restricted to the visible aspect of reality and cannot represent e.g., acoustic or abstract phenomena³⁵.

It is perhaps worth noticing that the arbitrariness of symbols underlying this aspect of expressibility is often underestimated, compared to the second aspect to be discussed immediately, viz. free and recursive combination of symbols, since it is only in the conventionality of symbols that allows the representation of meanings that are inaccessible to similarity or situational contiguity.

6.2. No closed, finite set of expressions

Given the free range of potential domains, the second indispensable condition is the disposal of an unlimited range of signals with identifiable meanings, which allows for distinctions of any intendable degree. It is only with respect to this potentially infinite distinctions expressible within each domain that the principle of expressibility can be taken seriously. This potential infinity is warranted in two quite different ways.

The prominent possibility is the free, rule-governed, recursive combination of basic symbols. The computational capacity on which it is based is language specific: it generates corresponding complex structures in two heteromorphic domains. No other biological system, human or nonhuman, seems to have this capacity. It is possible only because of the abstract, discrete character of the corresponding domains.

The less prominent, but perhaps no less important possibility relies on the capacity to build up and continuously extend complex lexical systems, that is arrays of conventionally fixed feature structures that serve as basic symbols. Without the capacity to organize and modify the inventory of basic symbols, the computational process would not get off the ground, and it there would, moreover, always remain lacunae of unexpressibility, if it would not be possible to implicitly introduce new symbols or to assign new meanings to existing ones. This is not just a matter of language change — which, of course, emerges from such modifications —, but of actual linguistic structure.

The two ways to extend the range of linguistic expressions — by adding or combining words, so to speak, — are of completely different character³⁶. But one might adumbrate the possibility that they are interdependent aspects of the language capacity. In any case, the introduction of new basic symbols, although a crucial condition of language acquisition, is not merely a matter of learning already fixed words, but an actual possibility to implicitly extend listed (properties of) lexical items.

It must finally be emphasized that in spite of strong reasons to acknowledge recursive combination of symbols as the core of the language capacity, recursion by itself does not automatically warrant expressibility. For trivial reasons, the system of natural numbers or the propositional calculus, although recursively generating infinite sets of expressions, cannot in any reasonable sense compete for Expressibility. The trivial reason arises from the fact that numbers and logical formulae deliberately avoid arbitrary conventionality as much as possible and thereby miss the diversity of domains that become accessible only by conventional symbols. In other words, neither the conventionality of symbols nor the combinatorial capacity alone can provide the expressibility of natural languages, but only their combination.

7. The unescapable limits of language

Why are natural languages nevertheless subject to essential limitation in the sense stated in (4)? It should be clear enough that what is at issue is not the lack of one or the other set of terms or lexical items which could be supplied and would in fact get into the stock of symbols, once the meaning to be expressed is identified. The problem is of a fundamentally different nature. The bounded-

ness in question cannot be overcome by language-internal means, and we are now ready to explain why.

The root of the limitation is the very property by which language attains the power of expressibility, namely the discrete infinity in the sense emphasized in Chomsky (2000), and more specifically, the symbolic and therefore abstract nature of language. Remember that the discrete character of both components of symbols, and therefore the abstractness of linguistic patterns with respect to continuous properties of the signal as well as the represented objects and situations had to be recognized as indispensable. The often important continuous properties of linguistic signals, representing e.g., emotional states or the personal identity of the speaker, are easily brought to mind. A more systematic account would have to sort out aspects that actually function as indexical signs, representing personal conditions of the particular speaker. What is even more important, though, is the fact that all continuous experience of whatever conscious or pre-conscious status cannot enter the meaning of linguistic expressions. One facet of the problem is covered by the term *qualia* in the sense of subjective experience which is not rendered by abstract patterns and therefore covered by only improper verbalization³⁷. The tension between perception and classification of color-distinctions is a well known case in point. Qualia can be compared by intersubjective standards, but they cannot be represented by linguistic expressions. For the domain of visual perception, Jackendoff (1997) observes that visual images contain both less and more than verbalized concepts: less, because visual percepts do not exhibit classificatory distinctions and corresponding generalizations, and more, because lots of relevant shades and nuances are part of visual perception, but impossible to verbalize.

To make these abstract considerations more concrete it is helpful to briefly look at two domains where the distance between experience and verbalization is completely obvious.

7.1. *Faces*

Within the domain of visual perception, the capacity to differentiate, recognize, identify, and remember human faces constitutes a highly specific subdomain, meeting obviously essential requirements and supported by special brain structures³⁸. Thus, the particular module underlying facial recognition is comparable to, although of course crucially different from, the systems in A-P. The point to be made here concerns the absolutely nonverbal character of this domain. Normal individuals are clearly capable to identify and recognize a large number of particular faces, under different conditions and perspectives, but there is no way to verbalize them in even remotely comparable detail and reliability. Faces can be characterized by general features like long nose, oval

shape, etc., but to sort out a particular face is easier by means of a phantom picture than by a detailed verbal description, and the actual click of identification is strictly bound to visual perception. As a matter of fact, the syndrome of prosopagnosia usually deprives patients of just the capacity to recognize the identity of faces, preserving the capacity to classify them by their general features.

A particular aspect to be noted here is due to the fact that, differing from speech perception and production, recognition of faces is usually restricted to perception, while reproduction requires the additional skills and capacities of painting or drawing. An artist, however, might be able to reproduce a recollected face, while other people can only remember it, describing it by insufficient, abstract means. But all observers are capable to judge the identity or similarity of a portrait, far beyond the possibilities of verbalization³⁹.

It is not easy to delimit the extent to which the operations involved in recognition and identification of faces are pre-conscious, involuntary and outside the range of cognitive control. It must be noted, though, that the decisive aspects of perception, representation, and (in case of artists) controlled activities for the domain under consideration clearly belong to the world of cognitive capacities and experiences, available to conscious inspection and cognitive activity, including modification of environmental conditions, inferences, abstraction, and evaluation, as any successful caricature demonstrates.

The difference to be highlighted should be clear enough: It is possible to talk about faces to any degree of precision within the range of discrete, classificatory features, but it is impossible to verbalize the pertinent experience, including the cognitive operations involved in caricature, idealization, etc. In other words, faces (and their pictorial representation), for one case, constitute a cognitive area of “my world” outside the boundaries of language.

It might be added that, even though faces are special in crucial respects, some of the characteristic observations apply to other fields of visual representation as well. Thus, the art of painting and sculpture in general lives on the fact that there are highly articulate, important mental experiences that can be visually expressed, but not verbalized.

7.2. *Music and gestures*

A completely different, but equally characteristic domain escaping symbolic, i.e., nonanalogous representation is the wealth of music and related mental activities. To be sure — the overwhelming phenomena of this domain can be touched here only rather superficially, but the point that is relevant in the present context is easily grasped: The meaning of music can not be verbalized.⁴⁰ Although music and language share the acoustic, time-dependent nature of

signals, the functional organization of music is radically different from that of language. The possibility to combine text and music in singing must not obscure the fact that a song is not a verbalization of music, but rather the integration of two very different types of representation, which do not only rely on different aspects of the signal, but — more importantly — link it to quite different mental domains.

An appropriate account of the characteristic conditions on which music is based would go far beyond the present limits. Lerdahl and Jackendoff (1983) have traced interesting analogies and distinctions in the organization of language and music, focusing on the common as well as the different properties in the organization of signals. In Jackendoff and Lerdahl (2006) they also take up the question of what musical signals represent, i.e., what sort of meaning is expressed by music. Two rather general points are to be made in this respect.

First, music is combinatorial, but it is not symbolic. Besides very particular cases like military or hunting signals with conventionally fixed functions, musical expressions do not convey any meaning that is not completely analogous to (or even identical with) the form of its acoustic signal. Neither the combination of single notes in themes or tunes nor to the combinatorial principles like repetition, grouping, inversion, etc. can represent anything that is structurally different from the signal. Whatever a piece of music conveys is determined by the structure of its acoustic signal. That includes cases of apparent or real referential meaning like the thunderstorm and birdsongs in Beethoven's 6th symphony or Honegger's "Pacific 234", based on the sounds of a steam locomotive, and so-called program music in general. In other words, even if something outside the music is referred to, the relation is based on analogy. The fundamental difference between the symbolic nature of language and the iconic character of music is highlighted by the role of negation: Every natural language has (usually several) means to indicate the negation of a semantic representation. There is absolutely no way to have a musical signal whose function corresponds to that of *not*, *un-*, *no*, *neither*, etc.⁴¹ In general then, musical expressions do have a rich combinatorial structure, which does not and cannot represent a structurally different, nonanalogous meaning.

Second, the so-called referential nature of program music is a special property, which most music doesn't exhibit. This leaves us with the question of meaning for musical expressions in general. One answer would be that if music can't have a meaning whose structure differs from that of the signal, then it has no meaning beyond the signal itself — actually the gist of Hanslick's famous dictum that music is just "tönend bewegte Form" (acoustically moving form). A less abstinent view would claim that music expresses emotions. This widely held opinion has much to be said in its favor, but it is in need of clarification, if the characteristic phenomena of musical form and their mental effect are to be captured. To mention just one problem to be cleared up: One and the same

musical structure can well come with different emotions or shades of mood, as borne out e.g., by the fact that in a song different verses rely on the same music accommodating different attitudes⁴², while on the other hand structural variants and modifications may well comply with one overall emotional bearing. With regard to observations of this type, Raffmann (1993) in a revealing attempt to elucidate the nonpropositional, ineffable nature of musical meaning carefully distinguished between emotion at large and “musical feeling”, arguing that it is just the latter that makes up the meaning of music, viz. the tension, expectation, relaxation, degrees and timing of beat, etc. in other words, experiences that clearly go with components and relations in musical structure. Taking for granted the reality of emotional responses to music, Raffmann considers emotions as the value of musical meaning, whose content is just the musical feeling. It is important to add that emotion and musical feeling, however they depend on each other, are both inherently tied to the basic, motoric activities, which the physical realization of music necessarily involves, as the rhythmical organization of music most clearly shows.

With these considerations in mind, I proposed in Bierwisch (2009) the meaning of music to be determined by gestural form, which corresponds and contrasts to the semantic form of linguistic meaning. While semantic form integrates the various mental domains propositional meaning has access to, gestural form integrates, in a very different guise, three aspects, which might be called the motoric, the affective, and the structural dimension. The motoric dimension relies on specific patterns of motor-activity involved in active and receptive musical and perhaps other, mainly rhythmical performance. The affective dimension relates this aspect to distinctions in basic emotional states as well as more subtle affective modifications. And the structural dimension, which closely corresponds to Raffmann’s musical feeling, connects all of this to the effects of specific configurations in musical form like cadence, upbeat, leading note, subdominant, etc. which belong to the framework within which the form of musical expressions is organized. An obvious and extensively studied example of such a framework is the system of European tonal music.⁴³ Thus, the gestural form draws on rhythmical and emotional processes that belong to the common background of experience, providing, moreover, a perspective towards intimately related mental structures, connecting music to dance, and other motoric activities, including the prosodic aspect of language and poetry.⁴⁴

Whatever the right account of meaning in music might be, two points should be clear enough. First, the gist of music, its moving spirit, emerges from a capacity, that is presumably no less fundamental than the faculty of language. For principled reasons, musical expressions can be accompanied by words, and they can be described by linguistic means, but they cannot be expressed by linguistic signs. Second, there can hardly be any doubt that the organization of

music belongs to the most intensely experienced mental and even intellectual domains, which one might call, following considerations of Ligeti and Neuwiler (2007), motor intelligence.

7.3. *Experience, expression, symbolization*

Returning to the distinction between experience and thought made in Section 1, the comparison of language, music, and faces suggests the following conclusions. Within the overall range of experiences or mental phenomena, i.e., the (largely pre-reflexive) consciousness⁴⁵, structures that may correspond to or are induced by linguistic expressions are to be distinguished from those that cannot be represented by linguistic means. Within the latter, percepts of faces constitute a characteristic and possibly biologically supported sub-domain belonging to the more general area of visual perception. Besides further modes of perception, nonverbal experiential domains comprise fundamental conditions of emotion and motor control.

Now, aspects of experiences that cannot be verbalized may nevertheless be accessible to expression, due to the crucially different type of iconic signs, manifested by corresponding visual or acoustic signals. The two types of expression, supporting symbolic and iconic signs, represent completely different facets of experience, even if they deal with the same mental phenomena. What iconic signs express is complementary to what symbolic signs express. In somewhat simplified terms: linguistic expressions say what they mean, iconic signs show it, where a signal is supposed to show something if it exhibits similarity to the properties to be expressed. As Wittgenstein (1922) put it in a different connection: what *can* be shown, *can* not be said.⁴⁶ The contrast does not exclude borderline cases, like onomatopoeia, or integration of the two types of signs, as in songs combining music and language, but the two principles are essentially distinct, representing different aspects, even if they relate to the same complex experience.

Iconic signs might express experiences based on external perception, as in pictures, pantomime, or music with referential meaning, or they might express strictly internal aspects of experience like attitudes, emotions, or mental movements, as in absolute music, dance, or abstract painting. In other words, iconic expressions are neither restricted to external nor to internal experience, but only to the condition that systematic similarity between form and meaning obtains.

It is important to notice, however, that experience and expression of experience must carefully be distinguished — even in cases of iconic signs with close similarity between the signal and its meaning. The difference between recognition and depiction of faces is an obvious case in point. Identifying a face is

independent of signs expressing this experience, while the creation and recognition of depicted faces involves signs and hence the representational difference between experience and expression⁴⁷.

The distinction between basic perceptual, emotional, or motoric experiences (the “qualia” in one of the senses of this term) on the one hand and their expression in terms of signs with corresponding external signals on the other has different consequences for different types of signs. As noted earlier, iconic signs are intrinsically limited to modalities which the similarity between signal and content can rely on. They are not limited, however, with respect to the degree of detail the structural analogy can exploit. Symbolic signs in contrast are not constrained with respect to domains or modalities, but they are constrained by the principled lack of similarity between signals and the experiential qualities to be represented, as noted with respect to faces and music. An even more elementary illustration of this point is the famous case of color terms. Indicating color perceptions through exemplars of e.g., color chips is limited by technical conditions at the most, their verbal expression, however, is systematically restricted through categorization by means of color terms. This categorization, which is determined by conventions and practical needs and hence notoriously different across languages, has nevertheless been shown by Berlin and Kay (1969) to not at all arbitrary, but channeled by basic and presumably universal conditions of perception and categorization, providing focal colors for verbal categories to rely on. There is, however, absolutely no similarity between relations among colors and relations among color terms.⁴⁸ Similar observations hold for other perceptual domains across the board, including shape, texture, motion, taste, or emotions and attitudes, as discussed in part by Miller and Johnson-Laird (1976).

It should be noted at this point, that thought and experience, as exemplified by color categories vs. color perception, are nevertheless tied together in the following sense: Whenever an experience of some sort — a color shade, a facial expression, an emotional attitude, a musical gesture, etc. — can be identified, then it is within the range of some category of thought, by which distinctions are made with respect to this range. In slightly more explicit terms:

- (23) For any experience *e* made by a speaker *S*, there are possible thoughts *X* and *Y* of *S*, such that *X*, but not *Y* covers *e*.

The condition ‘*X* covers *e*’ should be sufficiently clear, although it can be made more precise in various ways. The important point is that *e* is assumed to be classified, but not in principle identified by *X*, such that *e* is not necessarily distinguished from *e*’ by *X*, which may cover *e* and *e*’ alike, although *e*’ can be covered by some distinct category *X*’. By definition, *X*, *X*’, and *Y* may (but need not) belong to the semantic form of distinct expressions of a given language *L*.⁴⁹

7.4. *Similarity and coding*

These observations have critical consequences for the recurrent debate about the so-called Humboldt-Whorf-Hypothesis, according to which experience is shaped by the world view a given language incorporates. As usually construed, the issue concerns the constraints linguistic expressions are supposed to impose on perception and cognition, such that different expressions would lead to experiential differences that the lack of the different expressions would not allow for. The fact that we are not only able to recognize faces we cannot identify by verbal description, but can even identify a wide range of faces, far beyond the persons we know by name, is an easily ignored strong refutation of this tenet. In a systematic study of the more elementary domain of color discrimination, Brown and Lenneberg (1954) have shown that the structure of language does not determine color experience, but only what they called their codability, which is, roughly speaking, the effort needed to name a given color.⁵⁰ In other words, the structure of language does not decide which experiential distinctions are possible, but merely the expense required to express them, in case they can be verbalized at all, which is a quite different issue⁵¹.

It must be noted at this point that codability as just discussed is one of the crucial conditions which the sign relation of symbols is subject to, insofar as the conventions by which linguistic expressions are related to their meaning seem to comply with a kind of principle of least effort. More technically:

- (24) a. A given meaning tends to be assigned to the simplest possible expression that meets (b).
 b. A given expression tends to be assigned to the simplest possible meaning that meets (a).

Simplicity of an expression and of its meaning can tentatively be identified by means of the specifications in PF and SF, respectively. Further aspects, like standard expectations or stability under repetition, must be taken into account.⁵² In general, though, shorter or less marked expressions tend to have less complex meanings, and vice versa. Familiar cases in point are categories like singular or present tense, which have a simpler SF as well as PF than the more complex counterparts plural and past tense, or basic color terms like *red* or *blue* in contrast to nonbasic terms like *crimson*, *scarlet*, or *bluish*. These are instances of general tendencies with well known ramifications within lexical as well as morphosyntactic structures, which have led to the notion of iconicity as an important aspect of linguistic organization, according to which complexity of form tends to correspond to complexity of meaning, and vice versa. One might call this type of iconicity of coding efficiency.⁵³ It must not be confused, however, with the structural similarity on which iconic signs are based. Coding efficiency is not based on similarity between signal and object, as does e.g.,

onomatopoeia: there is no similarity between past tense morphology and the temporal relation it expresses. Coding efficiency cannot replace the conventionality of symbolic signs, it does in fact presuppose it, determining preferences among alternative options. It can be violated by sub-optimal choices in cases like third person singular of English verbs — the most “neutral” category with the most “expensive” Phonetic Form.⁵⁴ In general, then, coding efficiency and the iconicity it gives rise to might be in channeling the structure and use of linguistic expressions, it cannot abolish the essentially symbolic nature of language.

To sum up, mental structures that are systematically external to language, like music or faces, cannot be verbalized, just because language is symbolic — a property by which it has, however, access to all domains. This apparent paradox disappears if one recognizes the difference between experiences and thoughts, the latter capturing those aspects of experience that can be represented by linguistic expressions. This distinction does not restrict the domain of thoughts, but the aspects of experience that language can express. By its inherent character, language represents aspects of experience that do not depend on similarity requiring the signal to exhibit the properties and relations to be expressed. Language thus creates a boundary within the mental world, but it is not the boundary of experience. The area outside this boundary is not a field without, but with a different kind of mental activity, including inferences of the appropriate type.

8. Surplus value of the language capacity

There are two consequences emerging from symbol combination leading to the absolutely unique character and incomparable capacity of natural languages.

8.1. Metalanguage and reflection

A crucial effect of symbol combination is the fact that natural languages have access to any domain of the external and internal environment. One particular area of this unlimited field is language itself, more specifically the knowledge, structure, and use of linguistic expressions. By its very nature, language is in the range of phenomena with discrete structure and hence within the realm of objects that can be verbalized. This leads to basic symbols like *word*, *syllable*, *sentence*, *meaning*, *ask*, etc. which participate in the standard computational process generating complex expressions by means of their canonical structure. Furthermore, each linguistic expression *E* can by itself become the meaning of a linguistic expression *E'*, by using the signal, or rather the PF of *E*, as the

PF of *E'*. This is usually called mentioning *E* in contrast to using it. When *boy* is used, it means a male child, when it is mentioned, it means the word *boy*. In short, natural languages are inherently disposed to contain their own meta-language, which implies the possibility that this fact can in turn be dealt with and represented by the basic language — as in the present text.

By means of the schematic representation used earlier, the structure of meta-language can be indicated as follows:

- (25) a. Language: [PF \longleftrightarrow SF]
 b. Metalanguage [PF' \longleftrightarrow [PF \longleftrightarrow SF]]

In the case of metalinguistic use of an expression by mentioning it, PF' in (25) (b) is equal to PF, which now is, however, part of the structure of the meta-linguistic SF.

It can easily be seen, that the operation that leads from (25a) to (25b) can be repeated, creating meta-metalinguistic expressions, etc.

The upshot of this observation is the important fact that the structure of metalanguage, the representation of representation, is exactly the structure of reflection and the formal nature of self-consciousness. In other words, the nature of language implies the structure of reflexive thought: thoughts about thoughts.

Although this observation has far-reaching consequences, it does not imply that reflection and self-consciousness is restricted to language. Pictures containing pictures are of similar structure, and self-portraits are reflexive in yet another sense, which must be left aside here. More generally, whenever signs have signs as (part of) their meaning, the structure of (25b) arises, which means, that reflection is possible within different media.⁵⁵ The difference is obvious, though: Only symbolic signs can re-represent objects without being restricted to similarity. Hence mentioning signs has a rather special and strictly limited place in iconic systems.

8.2. Definitions and lexical extension

The other important consequence of symbol combination is to provide for definitions as a genuine possibility to introduce or change basic symbols. Definitions come in various forms, subject to fairly specific requirements according to context and purpose. Example (26) provides some standard examples with the term to be defined (the *definiendum*) and the defining expression (the *definiens*) marked by capitals and italics, respectively:

- (26) a. KILL means *cause to die*
 b. To DIE means to *become not alive*
 c. A BACHELOR is *an adult male person who never married*

- d. The *dog over there* is a COLLIE
- e. *This* is called PHOSPHORUS
- f. OCULIST means *eye-doctor*

Definitions are necessarily combinatorial, they must connect the definiens to the definiendum by linguistic means like *be*, *mean*, *call*, or others. The main point, viz. fixing the interpretation of an expression by that of another expression, requires both to be conventional. Hence definitions are possible only in systems of symbol combination.⁵⁶ They are, moreover, metalinguistic in a specific way: they affect the term to be defined by either confirming or changing its meaning, where change includes in particular the case of introducing new terms that have no meaning yet.⁵⁷ Ignoring a fair range of technical details, the upshot of these remarks is summarized in (27), where E_1 and E_2 represent the definiendum and definiens, respectively, $SF(E_i)$ identifies the meaning of E_i , and \leftarrow abbreviates the contribution of the different definitional schemata, notably the function of *mean*, *be*, *call* and other elements:

$$(27) \quad SF(E_1) \leftarrow SF(E_2)$$

Definitions are available in all languages, but their status for elucidating or introducing the meaning of natural language expressions is a matter of theoretical controversy. On the one side, standard lexicography as well as different approaches of decompositional semantics like Katz (1972), Miller and Johnson-Laird (1976), Jackendoff (1990, 2002), and many others take for granted the possibility to define basic linguistic expressions by means of their components. Fodor et al. (1980) on the other side deny this possibility, claiming lexical items to be largely primitive elements without internal semantic structure. Thus, cases like (28) show *kill* in definition (26a) to be by no means strictly synonymous with *cause to die*:

- (28) a. They caused the inhabitants to die (from/*by cancer).
- b. ?They killed the inhabitants (by/*from cancer).

However, McCawley (1978), Jackendoff (1990), and others have argued that cases like these can well be accounted for, if *kill* and *cause to die* have the same semantic form, but are subject to a general strategy like (29):

- (29) If a lexical item and its paraphrase have the same SF, the lexical item covers the simpler, more central or more direct instances.

This strategy, however, is a direct consequence of principle (24a), it requires (28b) to cover direct causation as less complex than the indirect causation in (28a).⁵⁸ In any case, definitions like (26) may clearly be appropriate in the pertinent context, and the vivid objections in Fodor (1981) can be left aside here, as they concern the nature, origin, and acquisition of semantic primes,

rather than their conventional mapping on linguistic expressions.⁵⁹ As a matter of fact, Fodor deals with the innate character of concepts, which is sort of opposite to their expression based on convention.⁶⁰

The crucial role of definitions relevant in the present context is the possibility to make conventions about basic symbols explicit, supplementing thereby the implicit mapping on which lexical items are primarily based. Two types of cases can be distinguished in this respect: First, new lexical items can be introduced either by paraphrase or by ostensive definition, in order to express distinctions or conditions not acknowledged so far, or to improve the repertoire with respect to codability. Second, the meaning of existing items can be modified, restricting or extending their interpretation by changing the semantic form, again covering new cases or improving the codability.

A number of circumstances might be observed. First, neither the introduction of new items nor the modification of existing ones needs to be arbitrary in the sense of being unmotivated. Definitions are completely conventional, but they may be supported by phonetic or semantic similarities in one way or the other, and they are constrained by the tendencies (24) regulating codability. Second, the definiendum necessarily meets the inherent formal conditions of the sign system to which it is added, while its conceptual aspect might be a new combination of familiar elements, but could also represent distinctions or entities unrecognized so far (but, of course, recognizable — in whatever way). And, perhaps most importantly, definienda might be conceptually interdependent, such that one term cannot be defined in isolation from others within a given array.⁶¹ All of this is just the explicit, metalinguistic, aspect of the inherent extendibility of the lexical system noted earlier.

As a natural consequence, any distinction that in the speaker/hearer's experience establishes a new kind, species, place, person, or whatever, can be associated with a phonetic form, and thus enter the expression of thought. In this sense, the warranty of completeness is an intrinsic condition of language as a system of combinatorial symbols. It is this inherent extendibility, indicated by the possibility-operator in (1), that eventually guaranties complete expressibility of natural languages.

9. Epilogue

The completeness of natural languages with respect to domains of thought and potential distinctions is based on the fact that combinatorial symbolic expressions are based on the conventional nature of basic expressions. This leads to apparently conflicting consequences.

On the one hand, members of the same species inherit the same biological properties and mental capacities, adapted to the same types of possible

environments, they are capable to acquire and elaborate linguistic systems that provide the same complete expressibility, which sets, moreover, the same type of limitation on experiences that can be verbalized.

On the other hand, the crucial condition of this completeness is the conventional nature of symbolic signs, which includes, of course, lexical items together with all morphosyntactic aspects that are subject to historical change. Now, conventions are necessarily based on socio-cultural conditions of particular language communities. As these communities, their experiences and conventions are anything but uniform, it is an empirical fact and a natural consequence of the contingency of conventions that natural languages differ wherever symbol combination allows for.

The tension between the universal language faculty and the overall uniformity of potential human experience on the one hand, and the diversity of cultural traditions and conventions with the actual diversity of experience on the other hand has shaped the philosophy of language and the history of linguistics over and over again. The most prominent and influential example is Humboldt's famous treatise *Über die Verschiedenheit des menschlichen Sprachbaus* [On the diversity of human language construction], which has been reclaimed for the ancestry of Universal Grammar in generative linguistics as well as for various positions of linguistic relativity.

It looks like a paradox, that the conventionality of symbols, on which the expressibility of language rests as a crucial aspect of its universality, is at the same time the reason of its dependence on accidental, parochial conventions. As a matter of fact, the universal, biological properties of individual human beings and the particular, socio-cultural conditions of the diverse language communities are not separate issues, but aspects of the same reality. The actual tension is bridged by at least two things.

First, the principle that "whatever can be meant can be said" must naturally be construed as relative to the range of thoughts in a given community. Different environmental conditions or technological standards give rise to different plans, intentions and thoughts — together with different linguistic means to express them. A speaker of some language L_a , say Tzeltal, may thus express a thought T that a speaker of L_b , say Eipo, could not express in his or her language, although both L_a and L_b meet the expressibility with regard to the thoughts their respective speakers could grasp. This relative completeness is called *local effability* in Katz (1972). If now for some reason a speaker of L_b may grasp the thought T and intend to express it, the inherent plasticity of the language faculty is to be invoked. This is the point where definitions (and their less formal surrogates) come in, extending L_b so that T can be expressed, actually an option continuously used in standard communication. Expressibility as fixed in (1) thus turns out to be the horizon or closure of local effability, which has no insurmountable limit below complete expressive power.

Second, even if some language L_b contains the means to eventually express the same thoughts as another language L_a , expressions of different complexity might be involved. Consequences of such differences can be observed in various respects. The crucial effects under controlled conditions have been shown to depend on codability, i.e., on more or less optimal solutions with respect to the principles mentioned in (24). It must be emphasized that codability does neither locally nor globally restrict the expressibility of language, but it still is by no means a side issue with minor relevance for the relation of language and thought. Convenient coding is not only a matter of efficiency with regard to recall and recognition, which also channels conventionalizing symbolic expressions, but by the same token sets preferences with regard to routines of thought and experience.

In any case, while the distinction between symbolic and iconic systems is a matter of principle, preferences due to codability and local effability are a matter of degree, the exploration of which is of interest far beyond the well-known cases of color terms.

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Notes

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- 1. The motivation of the possibility-operator in (1) will be taken up in Section 8 below. For the time being, the possibility is just to be taken for granted.
- 2. To give just one example, for Frege (1918) the thought Peter expresses by saying *I am sick* is different from the thought Paul might express by *Peter is sick*, (due to the different referential conditions of proper names and pronouns), even though Frege sharply distinguishes thoughts, which he assumes to be independent from individual speakers and their mental activities, and the mental states or processes involved in grasping a thought. I will return to this point shortly.
- 3. One has to be careful here with respect to the interpretation of (3), as Wittgenstein, even though he talks about words and sentences, does not, in fact, deal in the *Tractatus logico-philosophicus* with problems of natural language, but with the conditions of a logically perfect language. In the *Tractatus*, Wittgenstein does not even make a distinction between logic and language. In any case, the thesis quoted in (3) is frequently construed in the sense, in which it would be a consequence of the principle of Expressibility.
- 4. For further discussion of this distinction and the nature and properties of “abstract objects” like thoughts and languages see e.g., Higginbotham (1991).
- 5. As Dieter Wunderlich (personal communication) points out, one may read aloud the notes of a tune, thus, in a way, verbalizing the melody. This possibility relies, of course, on additional codification of the musical structure by means of notes or their names. The decisive point,

however, is the fact that only if you realize or at least imagine how the notes sound, you get the tune and what it expresses. But you might of course know the tune and what it means or expresses without knowing how it would be written. See Section 7 for further discussion.

6. A terminological remark might be indicated. The range of thoughts as envisaged in (1) and delimited in (4) consists of what is often assumed to be the domain of propositions and their constitutive parts. Things are not quite clear, however. According to standard views of speech act theory, for instance, utterances of (i), (ii), and (iii) express the same proposition, their different illocutionary force (assertion, question, request) clearly not being part of this proposition.

- (i) You are in time.
- (ii) Are you in time?
- (iii) Be in time!

But it is equally clear that the illocutionary force belongs to what the speaker means (in the sense of (1)). There is thus some kind of overlap between thoughts to be expressed and non-propositional content. This is even more obvious, if performative formulae like "I hereby ask you" are taken into account, which allow for explicit verbalization of the illocutionary force, as discussed e.g., by Austin (1962). Further terminological problems could easily be adduced, which do not interfere, however, with the fairly robust distinction to be discussed in the sequel, and may be left aside here.

7. The interpretant is not the interpreter in the sense of the actual sign-user, but rather the code due to which a signal stands for or is related to an object. In case of natural languages, the interpretant is most plausibly construed as the knowledge that guides processes of language production and comprehension. The general scheme (5) would cover, however, all kinds of nonhuman codes as well.
8. One might, of course, try to sort ought invariants by comparing recollections of different visitors by means of pictures, narrations, etc. This is, by the way, roughly the problem of Frege's distinction between a thought and the act of grasping a thought, discussed above.
9. The role of iconicity in lexical items, traditionally called sound-symbolism, according to which the signal of words like e.g., German *spitz* 'pointed' vs. *rund* 'round' display what they represent, has been emphasized e.g., by Jakobson (1978), particularly with regard to its function in poetry. See also Jakobson and Waugh (1979). The problem goes back to Plato's discussion in *Kratylos* about the origin of names as either *physei* (by nature) or *thesei* (by convention).
10. The incompleteness and overlap of the triple symbol, icon, index has been noted e.g., in Eco (1976), who, for a number of reasons, proposes a rather different typology of signs. As will be seen in what follows, the distinction between symbolic, iconic, and indexical aspects turns out to be fundamental and indispensable in several respects.
11. One might object that this is not really a constraint, since practically every dimension can be mapped on a corresponding analogous representation, as any schematic diagram easily demonstrates. But this is possible only by way of introducing a conventional, i.e., symbolic choice, by which e.g., the height of columns represents the size of populations or the average life-span of insects, or the salary of managers, etc. In other words, diagrams exploit the combination of symbolic and iconic aspects, mentioned above, and to that effect, they rely on crucial conditions of conventional signs.
12. Notice that the necessarily discrete character carries over to icons, in case they integrate symbolic elements, as e.g., the different hands for hours, minutes, and seconds in cases like analogous clocks or the symbolic ingredients used in various types of maps.
13. The property in question is self-embedding, which admits sequences like [a[b[a a]b]a], but excludes e.g., [a[b[a a]a]b]. Experimental evidence seems to show that nonhuman pri-

- mates cannot identify the “mirror-image” property of the first as opposed to the second sequence.
14. Chomsky (2004) assumes more specifically that the decisive combinatorial property of the language faculty is the operation Merge, which combines two elements A and B into the complex [AB], subject to rather specific conditions. I will return to this issue shortly.
 15. As traffic signs (except pure traffic lights) are made up from characteristic parts, using color, shape, and arrangement, there is some kind of combinatorial structure in the signal. But there is no inherent property according to which they combine into larger signs. The same holds for flags and coat of arms.
 16. The difference can, of course, be made explicit as in (i) and (ii), but that does not affect the claim with respect to the alternative structures assigned to (13).
 - (i) Mary remembers Paul just as well as Sue remembers him
 - (ii) Mary remembers Paul just as well as she remembers Sue
 17. The force of this claim depends, of course, to a large extent on the features and conditions the basic symbols bring to bear, and which general or language specific operations and consequences might depend on them. Most of the extensive discussions about Universal Grammar as a characterization of the Faculty of Language revolve around assumptions and evidence with respect to these features and operations. For a considerate survey, see e.g., Wunderlich (2007). Whatever conclusion might turn out to be correct in this respect, the fact that language combines symbols will not be affected.
 18. There are various other combinatorial symbol-systems, like numerals, logical calculi, or symbolic systems of technical and scientific domains, but they are clearly derivative on natural language. This holds also for the intriguing relation between language and numbers, which depends on the language capacity at least to the extent, to which numbers are expressed by numerals. For further discussion of these matters see e.g., Wiese (2003).
 19. SF corresponds in crucial respects to the Logical Form LF in Chomsky (2001 and related work), or the *conceptual structure* (CS) in Jackendoff (1997, 2002), but also to the *discourse representation structure* (DRS) of Kamp and Reyle (1993) and the *semantic representation* of Katz (1972). For some discussion of correspondences and differences see Jackendoff (2002) and Bierwisch (1997, 2007).
 20. This inclusion and autonomy applies, albeit in different ways, to spoken as well as signed language, referring to auditory and visual perception in much the same way as to articulation and signing. In derivative ways, it might apply even to written language.
 21. We will return to this issue in Section 8.
 22. This claim is not at variance with the well known fact that segments are simultaneous bundles of distinctive features, as these are just conditions on sequentially ordered slots. This remark applies also to the observations dealt with by means of tiers in three-dimensional phonology, as proposed in Halle and Vergnaud (1980). It might furthermore be worth emphasizing that hierarchical organization of PF, which plays an important role in metrical and prosodic structure, is just grouping imposed on the basically linear skeleton and cannot dispense with the essentially sequential nature of PF-units in all layers.
 23. For a fairly comprehensive exemplification see e.g., Wiese (2000).
 24. More technically, elements of SF must be assigned to types determining the type of arguments a functor applies to and the type emerging from admissible combinations. For details see e.g., Bierwisch (1997), or — for a somewhat different version — Jackendoff (1990), among many others.
 25. As a matter of fact, the notational choice used in Kamp and Reyle (1993) dispenses with linear arrangements in favor of two-dimensional dependencies. Other notational variants could easily be invented.

26. In addition to functor-argument-relations some kind of aggregation or cluster-formation might be indicated in SF, corresponding to the conjunction of simultaneous, but independent conceptual conditions, as assumed e.g., in Jackendoff (1990) for modificational structures, or the clusters of conditions in Kamp and Reyle (1993). But even if such combinations could not be reduced to standard functor-argument conditions, they would enrich the format, but not undermine the claims just made, since this sort of combination would also occur within and across lexical items.
27. The heteromorphy of PF and SF, which turns on the different organization of form and meaning, might remind one of the duality of patterning discussed by Hockett (1958) or the related notion of double articulation discussed by Jakobson and Waugh (1979), but it focusses on a rather different aspect of natural language. The duality of patterning distinguishes elements of signals without meaning (phonemes and their combination) from elements to which meanings are assigned (morphemes and their combination). Dual patterning thus deals with elements with and without meaning, while PF and SF identify different aspects of expressions with meaning.
28. The same holds for indices, but for a number of reasons they can be left aside here.
29. As Wunderlich (personal communication) points out, conditions like “Topic first” or “High pitch on Focus” and various others manifest a fair amount of nonarbitrary iconicity in syntax. Although there is no doubt about iconic motivation of such preferences, it is important to note that they are imposed on basically conventional regulations like “Head first” or “Head last”, as is obvious from different options in different languages, or even different categories of the same language. In fact, things are even more complicated, as different conditions — conventional or iconic — might collide, as e.g., the preference “Actor before Theme” against “Topic first”, in cases where the Theme is Topic. Conflicts of this type and their consequences are discussed in Klein and Perdue (1997). As a matter of fact, some of the violations of the principle of Projective Correspondence to be discussed below might be ways to reconcile conflicting conditions of this sort. Similar considerations apply to effects of iconicity in morphology like the condition that marked categories are phonetically more salient than unmarked categories.
30. It is worth noting that language — like mathematics — captures conceptual continuity by means of discrete, abstract structures, as shown by simple cases like *As time goes by*.
31. The possibility operator *P* in (1) above, Searle’s formulation of the principle of expressibility accounts for this very capacity to introduce lexical distinctions if necessary. It must be stressed that adjusting the repertoire of lexical items does not alter the range of thoughts for which an expression can be found, but provides the means of expressing them. We will return to this issue in Section 8.
32. On closer inspection, even simple cases like (20) do not strictly obey condition (19), as with respect to prosodic grouping the Determiner *an* can be construed as part of the sequence *an unhappy*, while its semantic content applies to the complex [[NOT HAPPY] FEMALE PERSON].
33. Discussing the rational of internal Merge, i.e., of nonprojective mapping, Chomsky (2001) suggests that the apparently suboptimal design of natural languages provides the optimal computational solution, given the interface conditions PF and SF must meet.
34. One might be tempted to consider projective mapping as a kind of iconicity, which mirrors conceptual connectedness by means of linear coherence, transposing merely the dimensionality, somewhat like perspective drawings which represent three-dimensional space by two-dimensional configurations. This analogy is misleading, however, since in perspective drawing relevant relations are all determined by iconic correspondence, while projective mapping involves essentially on noniconic ordering in PF, as even simple cases like *the faculty of language vs. the language faculty* or *an undecided issue vs. an issue that is not decided* readily show.

35. It could be claimed that it is the importance of great paintings like, say Rembrandt's portraits, to make things graspable that go beyond pure visual representation. This does not affect the point to be made here, though, just as great poems must be taken to convey more than the actual combination of words can express. In both cases, however, the additional effect is possible only by means and on the basis of the primary semiotic foundation. The analysis of such additional effects would have to deal with different conditions and aspects. See Bierwisch (2008) for some discussion of these problems.
36. Obviously, the actual expressions determined by these possibilities do not fall into strictly disjoint domains. Many cases of derivational morphology or compound formation are notorious borderline phenomena which exhibit properties of systematic combinatorial processes as well as particular, or even idiosyncratic, amendments characteristic of lexical elements. One must perhaps recognize two stages or aspects of combination in these cases — rule governed combinations and lexical amendments imposed on them. Such interactions do not blot the distinction between the two types of operation under discussion.
37. A related, but somewhat different concept of qualia structure is introduced in Pustejovsky (1995), where the term is used for irreducible, idiosyncratic components of lexical items.
38. For a revealing discussion of the cognitive and cerebral aspects of the capacity in question and its circumscribed disturbance in prosopagnosia — see the chapter on facial blindness in Sacks (2010)
39. To be explicit, it must be noted, that facial recognition is a matter of purely perceptual classification, while the inclusion of portraits and other representations of faces brings up a strictly iconic sign system. In case of paintings, two-dimensional signals are related by similarity to (the mental percepts of) three-dimensional objects.
40. Of course, music — like language — can be written by means of notational systems, which are intricate, essentially symbolic systems in themselves, the details of which cannot even be touched here. In any case, notational systems of music represent (essentially discrete) aspects of the acoustic form of music. They give access to the actual musical form and its content to the extent to which one knows the conventions of notation, which is, as noted in Note 4 above, as different from knowing the music as knowing the alphabet is different from knowing the language.
41. It should be clear that negation is just a particularly striking case of strictly symbolic representation. Equally unavailable to music are all sorts of quantification like *every*, *most*, *few*, etc., relations like *forget*, *possess* and an unlimited range of other concepts and operations.
42. The different occurrences of the chorale “O Haupt voll Blut und Wunden” in changing environments within Bach's Oratorios is a particularly famous case in point.
43. For further discussion of these matters, see Raffman (1993) and Jackendoff and Lerdahl (2006). It must be noted that the framework, on which the structural aspect of gestural form is based and which therefore is a crucial prerequisite for understanding music, is a matter of historical tradition. It is subject to modification and it is fixed by convention. If one is not acquainted with e.g., the Chinese or Indonesian tradition, one is hardly able to adequately understand the music of these cultures. In fact, music is not something everybody understands without presupposition. It is based on convention like many other systems of social coordination. It must be stressed, however, that the conventional framework of a given musical tradition concerns its formal structure, i.e., the tonal system, the temporal organization of the signal, etc., but it does not create a symbolic relation between signal and object. It might include regulations about the affective or emotional patterns expressed by certain formal means, as noted e.g., in the doctrine of affections of the 17th/18th century. But even though the structure of musical form is subject to conventional conditions, its interpretation remains strictly iconic.

44. For the sake of completeness, it might be added, that certain musical “Gestalts” can conventionally be linked to noniconic interpretation. For instance, a sequence of chromatically descending notes (the *passus duriusculus*) may — under appropriate conditions — represent the path of passion, as Wunderlich (p. c.) points out. Symbolic extensions of this kind are the counterpart to iconic motivation of symbols in onomatopoeia. Symbolic overload of a configuration must be compatible with the gestural form, however, if it is to be integrated into standard musical context. A rising major triad could hardly symbolize the death of a hero. A special case of this sort is Wagner’s use of “Leitmotivs”.
45. The intricate issues related to notion of consciousness, the delimitation of concepts like pre- and sub-consciousness and other aspects need not concern us here. All we need to rely on is the unquestionable fact that one is aware of what one experiences by way of perception, intention, imagination, emotion, whether or not these experiences are accessible to reflection and verbalization.
46. Wittgenstein’s entry 4.1212 of the *Tractatus logico-philosophicus* reads “Was gezeit werden kann, kann nicht gesagt werden.” It concerns the distinction between the logical form and the factual content of an ideal language, rather than the contrast between iconic and symbolic signs, but it provides a perfect formulation of the issue at hand.
47. It is worth pointing out in this regard that music and faces likewise illustrate phenomena that cannot be verbalized. But they differ crucially not only by contrast between the visual and the auditory/motoric modality, but particularly because recognition of faces is not primarily a matter of signs, while music is au fond a sign system, even though its content might come from independent sources, whether percepts of external sounds or patterns of emotions and gestures.
48. Relations between color terms are subject to general linguistic conditions, like markedness, typicality, syllable structure, etc., but not to perceptual relations between chromatic value, brightness, or saturation. Even the focal colors, whose organizational role for the field color terms Berlin and Kay (1969) identified, are not subject to any correspondence between relations among the Phonetic Form of color terms on the one side and relations within the color spectrum on the other.
49. For the sake of illustration, think of *e* as a color-percept that might be classified by *X* as *red*, but not by *Y* as *purple*, with percept *e*’ within the coverage of *X* distinguished from *e* by *X*’ as *crimson*.
50. Actually, codability as the relevant factor Brown and Lenneberg identified was characterized by several criteria, including expense in terms of syllables and words as well as stability of recognition and recall under repetition and across subjects.
51. As a matter of fact, the overwhelming phenomenon is not so much the fact that language indeed does not restrict our experience, in spite of the lack to verbalize certain aspects of it, but rather the way in which the formation and combination of symbols provided by the language faculty can support or enhance the creation of thoughts. To this point, we will return in the next section.
52. A framework within which these principles can be made more explicit is the Bidirectional Optimality Theory proposed in Blutner (2000), where close equivalents of (23)(a) and (b) are given as I-Principle and Q-Principle, respectively. — An important range of consequences of these principles makes up the theory of markedness, which systematically deals with properties of linguistic expressions emerging from the preference for neutral or default options over alternative possibilities. See Kean (1981) and Wurzel (1998) for overviews.
53. Wurzel (1998) for instance discusses this type of iconicity especially with respect to morphology and its intrinsic relation to principles of markedness.
54. Although coding efficiency is an overall boundary condition not only for language, it is not a principle like the linearity of PF or the functor-argument-organization of SF, principles that

- may be overlain, but not violated or replaced by the effect of other conditions, such as situational contiguity of indexical expressions like deictic pronouns.
55. Just as e.g., Watteau's famous Signboard of Gersaint is a painting that shows paintings, one might say that Mozart "quotes" his Marriage of Figaro during the dinner of the final act of Don Giovanni. (This sort of "quotation" must be distinguished, by the way, from the practice of parody e.g., in Baroque music, which does not mention the parodied composition, but uses it.) — Notice that "quotation" by means of indexical signs is impossible for principled reasons: mentioning necessarily alters the situation within which the relevant contiguity holds. Hence quotation is restricted to icons and symbols.
 56. Definitions are not restricted to natural languages, though. They play a central role in artificial languages and other symbolic systems, with types of definitions which natural languages allow for at best marginally. Definitions are indispensable, on the other hand, if the construction of artificial languages is at issue. — It might be noted, by the way, that there is no place for definitions in music, pictures, or other iconic systems: Instances of these systems may introduce new signs, but there is no way (and no need) to define them. (The legend of a picture is not its definition.)
 57. One easily notes that definitions are always metalinguistic, but not necessarily distinct from their nondefinitional use. (26d) for instance can occur as a so-called ostensive definition, providing (part of) the semantic content to be fixed by using nonlinguistic demonstration. But it can equally be a statement about nonlinguistic facts, if the meaning of *collie* is taken for granted.
 58. This is not a trivial assumption, since the more general causative relation, which includes both direct and indirect causation, might formally be simpler than direct causation, which explicitly excludes intervening steps. It seems, however, that the direct, more central, cases are also the simpler ones under various perspectives, such that not the exclusion, but the admission of intervening steps or departures from the central area normally has to count as more complex.
 59. This is obscured by the fact that Fodor (1981) practically identifies basic semantic elements with lexical items (which he takes to be indefinable), although there is no more reason to assume that semantic primes come out as lexical items than the primes of PF.
 60. It must be noted in this connection, that Fodor's argument against the definability of basic lexical items has nothing to do with the expressibility of natural languages, as suggested by an anonymous reviewer, who assumes Fodor's arguments show that there is another, in fact language-internal domain, where completeness in the sense discussed here is impossible. However, Fodor's point about innate, un-definable concepts does neither imply, that they are more limited in number or scope than definable concepts would be, nor that they cannot be assigned to phonetic forms. As a matter of fact, whatever can be conceptualized by means of either innate or learned concepts can also be verbalized. Even for Fodor, there is absolutely no reason, why innate concepts should impose any limitation on principle (1). To emphasize the point once again: we can identify an unlimited number of different people by individual concepts, whether innate or learned, and we can verbally identify them by attaching names, but we cannot verbalize their faces, although a gifted cartoonist could highlight characteristic properties by caricature. The limits of completeness are just not language-internal.
 61. Thus while for instance color terms, although belonging to a coherent frame of reference, can be introduced by independent (usually ostensive) definitions, terms of spatial orientation might well be interdependent with respect to a common frame of reference, such that e.g., *vertical* could not be introduced without the meaning of *horizontal* being available. For discussion of different systems of spatial orientation, relying on different arrays of interdependent terms, see e.g., Levinson (1996). Other types of interdependence obtain in many domains.

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