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HOW THE BRAIN WORKS WHEN WE SPEAK*

The idea that the brain only has to conceive a conceptual structure which is mapped onto a phonetic string in order to linguistically bridge the distance between speaker and hearer is an overt simplification. It appears that at least eight levels of information processing have to be passed in the construction of a sentence, some of which have wrongly been considered fully external to the process of speaking.

John, could you pass me the butter, please?

Three questions have to be answered if we want to define the activity of the brain when we utter the above sentence about John and the butter:

(a) what does the brain do with its proprietor and to what extent is it actively involved in the steering of the linguistic process;
(b) which levels of information processing are to be discerned;
(c) to what extent are activities that are not primarily linguistic involved and does the situation etc. play a part?

(In the rest of the paper the sentence under analysis will be abbreviated as SQ = question sentence.)

Two restrictions are to be made. We start from average, i.e. normal circumstances. The speaker is an adult and does not have hampering deficiencies such as blindness or other defects. At a purely linguistic level we do

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not go deeply into the difference between sentence and utterance. It will be acknowledged, but the phonetic realization, the utterance with all its technical implications, is only treated in its final result: the complexity of the vocal track will be left aside. Where it offers no difficulties, we will indiscriminately use the term 'sentence'.

The question sub (a) concentrates on a restricted field of mental activity. Speaking relates to animal communication in certain aspects and although it is typically human it is firmly based on universal principles of information processing. Moreover, other aspects of mental operations are involved; where this is the case, they appear to play an important part in what we call linguistic thinking: the interaction of cognition and communication. A whole series of levels are active in the process of speaking: we will treat the eight most essential, more particularly those, that result in the generation of the interrogative utterance SQ. Apart from the eight levels treated here, there are other aspects that may prove relevant in the communicative interaction of speech-participants; one may think of the context and of expressions preceding or following the particular utterance.

We will not enter into the operation of the brain-cells in their physical and electro-chemical activity, but simply adhere to St. Pinker's terse definition 'brain-cells fire in patterns'. This seems a sufficient delimitation for identifying brain and mind in the sense that the latter is no more than functioning of the brain-cells, as held by Searle [1]. Neuro-physiologic research of the last decennia has proved conclusively that Descartes' dualism, distinguishing a material aspect ('res extensa') and a mental aspect ('res cogitans') is to be abandoned once and for all [2]. If indeed brain and mind appear to be one and the same, there seems to be no fundamental difference between the structure and operating of the human and the animal brain. Exception to this kind of concurrence is the language capacity, operating with rules and concepts that are present in nuclear form in the animal at best. To give one example of the agreement: in animal communication just like in verbal communication of the human species there must be something like a message or conceptual structure, that is mapped onto something like a cry, a call or the like [3].

The latter rudimentary example sustains the thesis that there are good grounds for describing the whole linguistic processing as regulated in the brain or, to put it more bluntly, as a series of procedures that are of a cerebral nature without exception. It is within this domain that animal sign-giving and human language parallel each other in several respects. Apart from

the message and its expression in a signal, there are levels of processing such as our Orientation and contact within the species, that work in every form of communication, animal or human. At the other end of the process the distinction between utterance and sentence is paralleled in animal signalling as well, in that the same signal – a cry of warning, e.g. – may be uttered a hundred times or more: each time it differs from a former realization in time and in quality.

As regards the processing of sentences such as the question SQ, it should be emphasized that we here meet with a high form of thinking. In principle this goes for every full-size linguistic utterance, be it that we assume that simple commands, interjections and the like fall outside this category. They coincide with animal signals such as cries of warning, gestures, etc., which are not the result of logical consideration. The 'normal' statement and the interrogative sentence, contrarily, are intellectual exercises of a high quality in that they can be judged as to their truth value for a state of affairs in reality. In order to reach this high level of thinking an intricate interaction of cognition and communication is requested. This is not simply a matter of collaboration, but the one aspect cannot do without the other: no linguistic thought can be developed without the strong hold of fixed forms. It is like arithmetic where the treatment of numbers is impossible without the support of ciphers.

While the elaboration of thoughts needs the support of formal means of a communicative nature, there is no communication without a cognitive pattern as its base: communicating nothing is impossible, even in 'arte povera'. Therefore communication takes account of the ultimate realization, just like the cognitive process is developed in view of its formal expression. Intermediary in the speaking process is the lexicon with its two-sided items, combining a (linguistic) concept and a phonetic form. In this sense we interpret Saussure's linguistic sign: it is the lexical item that combines a conceptual and an acoustic image [4]. Its relation to an entity on the one hand and a name on the other hand is only realized at the level of language use; the entity, then, is the observable referent, the name is what can be seen or heard.

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The different levels of mental processing involved in the conception and realization of sentences – SQ among them – can be accommodated in three categories: extra-linguistic (I), pre-linguistic (II) and linguistic in its re-

stricted sense (III). However, all of them participate in the processing of language and every level has the former level as its precondition. This implies that the information of level *x* builds on that of level *x*-1. A comparison with contextual coherence will illustrate this relation. In a text, a concatenation of sentences, every sentence has the foregoing as a precondition; its contents not only proceeds on the contents of what has been stated, but incorporates it as part of its own message [5].

The extra-linguistic category I contains three levels, viz. the Setting (1), the Orientation (2) and the Personal contact (3). It should be emphasized from the start that they lay the foundations for the ultimate realization of the sentence, more particularly the phonetic form, and contribute in the mental processing of all linguistic levels following. The pre-linguistic category II contains the levels Visualization (4) and Conceptualization (5). They concentrate on those aspects that have an immediate influence upon what wants to be transferred between the interlocutors, without being linguistic in the narrow sense.

Within the strictly linguistic category III three levels are to be discerned, viz. Message structure (6), Verbalization (7) and Phonetic realization (8). As regards the latter level, as mentioned above we do not go into the complexities of phonetics in its broadest sense: no muscles, breath or vocal track are described. They come at the end of the information processing in the brain, but are not part of it, although they result from impulses sent out by the brain-cells. Every action in the vocal apparatus is prepared in patterns of neurons but as material execution they fall outside the device developed here.

Before entering upon the operation within the three categories, we think it useful to point out that the speaking process has its roots in more general qualities that can be found in animal as well as human species. Cognitive arrangements as well as communicative universals are fundamental properties of everything living in the animal world. Without a minimum of 'thinking' capacities – planning, remembering, making judgments, etc. [6] – it is impossible to distinguish between friend and foe, between food and poison. And without communicative interaction it would be impossible to recognize possible partners with whom to procreate. That cognitive and communicative qualities are connected – no communication without a minimum of content – has already been noticed. However, in animal signalling they are not interrelated as in language, in which the inner and the outer aspects not only presuppose each other but also influence and, to a certain extent, define each other. The real break between animal and human sign-giving and their think-

ing implications evolved where the human species developed more intricate means in the construction of signs, the outward forms. Elsewhere we have called this 'linguistic thinking' [7]. It is because of this thinking quality that we have made a distinction between statement and question on the one hand, and interjection, singular command and warning on the other hand. Only in the former two a property is accorded to a concept as in SQ; only in this way a meaning-bearing unity is constituted. This is the full-grown sentence, not only representing the world through its content, but also organizing it. Since Aristotle the thought implied in the sentence is captured in the formula ((subject)predicate) [8]. Structures of this kind truthfully represent reality, whereas interjections and the like do not; they fall in the same class as animal signals such as cries and songs.

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We will now define the different levels of linguistic information processing, arguing that they all participate in what ultimately results, viz. a phonetic form as the carrier of a specific thought. Apparently none of the eight levels can be omitted or eliminated: this not only goes for our SQ but also for neutral texts such as a scientific treatise.

The first level, that of the Setting, is not objectively given as a world on its own. It is that part of the world the speaker considers relevant for his communicative contact. He is conscious, moreover, that he shares this restricted field with the hearer who has to know in what theatre the conversation takes place. In that theatre only the stage is illuminated, as a strictly limited part of the auditorium. Discussing flowers, e.g., it must be clear that the flowers on the table, not those in the garden or in a nursery are considered. It is not reality that defines where the borders of the setting are to be drawn, but it is the understanding about the place of action that the speaker assumes to be comprehended by his interlocutor as well. The setting, therefore, is the scene where the play is performed, while the theatre itself with the entry doors, the chairs, even the other visitors do not play a part: it is the stage and the stage alone that defines where the discussion takes place and to what subjects it is restricted. The setting is created from the moment the curtains are drawn, and it is within its strict boundaries that a new world is opened. Choosing the Setting does not have to be done consciously, but neither is the Message structure (6), to give an example. It is a necessary background, however, of which the speaker knows that the hearer acknowl-

edges it just like it is intended. Misunderstanding can only be avoided where the Setting is shared or is assumed to be shared.

A restriction to a well-defined domain is also necessary for a clear understanding of level (2), the Orientation. In SQ the orientation is on the table, not on the door, the windows, the floor or the like. The mind is a camera, focussing upon a central theme and excluding what does not play a part in the ultimate evocation. It is like the eye that concentrates on the bird in the tree top: even the immediate surroundings of branches and leaves become no more than peripheral decoration. In the case of SQ the orientation is concrete and visually encapsulated. However, where more abstract subjects are treated, say in defining a notion such as *freedom*, the orientation focuses upon something that is mentally conceived and finds no support of the eye. Now it becomes particularly clear how important also the setting is. The interlocutors may enter, for instance, a setting that is philosophical in nature; within that setting the orientation is directed towards a field of related but abstract ideas. Therefore it is the setting that delimits the relevant part of the world in which the orientation then focuses upon the object or objects in the field. In SQ the Orientation (2) is drawn to a concrete centre in which the light is on the table and the ritual of the breakfast. From a different point of view it can be argued that the Setting (1) is a negative process, eliminating what is irrelevant for the scene the Orientation (2) wants to concentrate on.

As regards level (3), that of the Personal contact, this concentrates on the hearer, in this case the other person at the breakfast table. We have placed it within the more comprising framework of (1) and (2), but it should be conceived in a less delimited sense. Rather, it has a function that permeates the different levels following, since every next phase reckons with the understanding of the interlocutor. If, for instance, the relation between the speech-participants is cool and formal, the choice of concepts and of the lexical items will be more distant as well. The Personal contact (3) thus is involved in the preparation of the message and the final realization: it is the underlying awareness that there are two players in the game, rather than a speaker in an isolated position. Even in a scientific paper the interlocutor plays his part. What is being expressed is directed at an audience of scientists, moving in a comparable domain as the sender. In general it can be said that level (3) is an audience-directed pre-programming of what it to be transferred. It is the understanding that speaker and hearer share or rather, what the speaker assumes that they share.

The three levels, Setting, Orientation and Personal contact have set the mental computer in action and have prepared the ground for the transition to

the ultimate linguistic processing. However, there is still another set of procedures to be passed, subsumed under the pre-linguistic category. Visualization (4) and Conceptualization (5) are not yet linguistic in the technical sense, but they are directed at the final technicalities. Visualization should be interpreted in a large sense. It is a matter of focusing the attention on the objects and properties that must play a central role in what is to be expressed. In SQ, to be precise, they are things, relations, persons at the breakfast-table. Again, attention may also be concentrated on objects and qualities of a more abstract nature. In defence of our term we can say that it is 'the mind's eye' that evokes objects etc. and places them in the centre of mental processing.

In a sense we have already made a first step from level (4) to level (5), in that it is not the objects themselves but their neuronal reflexes the brain operates with. Thus what has been observed – visually or mentally – is catalogued and translated into concepts. These concepts are of a general nature, not yet lexicalized: to underline their proper character we could compare them to the concepts animals operate with – they must be clearly distinguished from linguistic concepts as we will meet them on the next level. The concept reflecting the yellow bread-spread thus is different from the linguistically conceived representation "butter". We therefore subscribe to the thesis that conceptualizations "are strictly pre-linguistic and only later mapped onto linguistic expressions" [9]. Concepts of the level (5) may be visual, auditory or purely mental. Conceptualization, consequently, may be an event that we remember, a plan that is not yet expressed with linguistic means. It is possible to recognize a flower as a tulip, without any interference of a linguistic concept: it may even be the case that the name as well as the lexical item is absent. It is also possible that we are planning to gather a bouquet of flowers, without translating that plan into words or a sentence. Indeed, there all kind of conceptualizations that stop at this 'ideological' level. Being in the world, walking or driving in it, implies a permanent delimiting of our position and a necessary reaction upon other actions by other participants. We thus remain in the domain of non-linguistic cognition and there is no link to communication. It is a process of ongoing adaptation to the surroundings we move in, and expressing our actions by means of verbal representation is not necessary. It is only when we want to communicate our experiences as they are fixed in pre-linguistic cognition, that we make the step to the following levels: those of linguistics proper.

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The last category with its three levels is traditionally considered the field of language and language use. As to the manner in which the brain processes this kind of information, we will follow Levelt (1989): which does not imply that we want to do away with the former categories as necessary and integral parts of the speaking process. Levelt argues that there are different types of information processing in the brain and different systems in which this takes place. He calls them 'languages of thought'. Apart from a spatial code and a kinaesthetic code he distinguishes, among others, a propositional representational system. It is possible to go from one mode of representation to another, for instance when we jump away from a threatening lorry: from vision to action. And what we see can be translated into a verbal action or the other way around. "If, however, the intention is to speak, then the code must eventually be propositional in nature" [10]. The output of the propositional system is a semantic representation or preverbal message. In order to become a sentence the message has to pass through a so-called formulator, responsible for the ultimate phonetic form.

In our system Conceptualization (5) does not coincide with Message structure (6), the output of Levelt's propositional component. We hold that (5) is typically pre-linguistic, operating with general concepts, while (6) is linguistic in the restricted sense, operating with concepts that are intended to play a role in the communicative process. To that end the general conceptual structures are to be mapped onto messages, just like the general concepts are mapped onto 'meanings'. The output of level (6) are propositions, constructed in accordance with propositional rules that integrate linguistic concepts. In stead of 'proposition' we will use the term 'thought'. In our view there are all kinds of thinking processes, but if a semantic structure results, this can only be considered a thought. Thoughts, in other words, are the contents of sentences, not yet verbalized but conceived in such a way that they can be mapped onto structures of the next level, the Verbalization (7).

We want to use the term 'thought' for a semantic pattern for more than one reason. First of all, it is only in language and language use that thoughts can be developed. There are many human accomplishments of a high quality: in building, designing, research, etc., but they cannot be considered thoughts, although thoughts are usually at their base. Thoughts can be judged as to their truth; and truth is a semantic category. The Aristotelian concept of truth implies a correspondence between propositions (= thoughts) of a given language and a state of affairs, i.e. what the world has to offer [11]. In conformity with Aristotle's definition, we therefore hold that thoughts are structures of a sub-

ject and a predicate, the former referring to an entity, the latter to a property. The formula ((subject)predicate) represents a situation in the world and only if the formula covers what it represents may this be considered true.

Thoughts operate with linguistic concepts and linguistic rules. We assume that they have universal validity. The problem of every linguist, philosopher, neuroscientist is that they have no means of representing the abstract structures of concepts without recourse to the elements of the next level, viz. that of Verbalization (7). Therefore we present thoughts in a rudimentary form to express their abstract character, using brackets and inverted commas. Thus the thought underlying the sentence *She is sixteen years old* can be represented in a propositional formula in which the concepts, "…", are represented within the brackets of a thought structure: (("girl") "16 years").

It is in the subject-predicate structure of the thought that we meet with the most basic procedure to escape the purely representational function of the signal. Signals as uttered by animals are singular and unstructured. Therefore they can never be judged as to their truth value: a cry nor a warning or other singular concept can analyze and organize reality – therefore we need at least two concepts which give, yes or no, a correct picture of the structure of reality. There are indeed good scientific grounds for regarding the "class of subject-predicate propositions as the basic or fundamental class of (…) propositions" [12]. It is in this structured representation that human language has left the two-dimensional surface in order to reach for a third dimension, leading to unrestricted creativity.

The question may be posed whether a reduction of (6) and (7) into one level could be defended. This would imply that semantic conceptualization (= message structure) would operate with words and syntactic rules. The answer must be negative. A thought is not a sentence but the contents of a sentence, a linguistic concept is not a word but the value of a word. Just as it is possible to make conceptual structures that are not yet linguistic in nature, it is possible to have thoughts that are not connected directly with a sequence of words. This is the reason why we often know what we want to express, but that we hesitate in our choice of the most fitting word: *freedom* or *liberty*, *hope* or *expectation*, *working* or *processing*, etc. Semantic concepts do not have the strict and unique form their corresponding words have; rather they are fields whose borders are set by other conceptual fields: "good" stops where "moderate" or "excellent" begins [13].

Intermediary between the thought and its verbal expression (7) is the lexicon. It is a list of items, combining an abstract form (*butter*) and a linguistic

concept ("butter"), the latter ranging from "grease" to "package", etc. Lexical items, [*butter*/"butter"], are values, values for words and concepts, but neither the one nor the other. They do not function on a semantic or a verbal level, but have no other quality than coupling inside and outside, i.e. mapping of a concept onto a word or, the other way around, of a word onto a concept.

The sentence is to be regarded as the minimal unit of meaning. By means of the thought it contains reality can be represented (and organized) in a truthful manner. In logical semantics meaning and truth are even identified, which proves that it is not words but sentences that have meaning. Apart from the lexicon with its two-sided items, there are the syntactic rules, exerting a comparable function. Thus there is a rule relating a propositional subject-predicate structure to a so-called surface structure. The latter is the (ordered) sequence of words from which it can be derived what is subject and what is predicate on the semantic level. Syntactic rules are language-specific as lexical items are. On sentence level, where English uses two elements to express the subject-predicate structure, Latin can do with a morphological structured but nonetheless singular term: *veni* in stead of *I came*, while Japanese brings the subject function to the surface with the help of a postposition *na* or *ga*.

On the level of Verbalization (7) we are still operating within the constraints of the brain: abstract, fixed in patterns of brain-cells, not yet uttered in a palpable form. It is therefore that a sentence can be realized in innumerable ways, on different moments of time and multiplied, again indefinitely, by radio or television. Only where the sentence is mapped onto an utterance do we reach level (8), that of Realization. The utterance is unique, even where it is broadcasted, since at least the place differs. Although the actual realization is executed by a complex connection of muscles – vocal track, mouth, lips, etc. – the processing of the final phase is also executed in the brain and fixed in a series of related patterns. It is on the base of these patterns that instructions are sent to the vocal apparatus: as a result the sentence is mapped on its phonetic correspondent along the linear axis of the breath.

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Before showing the relation of the different forms of processing and the way they cooperate in realizing a complete product, the following should be stressed once more. From level (1) to level (8) every mental activity participates in the realization of an utterance. Even the processes within the Setting (1) and following levels, although categorized as non-linguistic, are fixed in

neuronal patterns in a way comparable to the patterns involved in the generation of (6) through (8). From the very start, the speaker must delimit the field of action and he does so with the eye upon the interpretative capacities of the audience. Thus the Setting, although drafted by the speaker, takes the attitude of the hearer into account: in this manner the foundation is laid for common understanding. It is as if the speaker isolates a particular corner of the vast landscape both parties find themselves in. A certain acquaintance with this corner of the person spoken to must be assumed in order to arrive, ultimately, at a shared form of information. It is within this geographical field – geographical in a metaphorical sense – that the attention of the speaker as well as the hearer can focus upon more specific objects and characteristics. They may be concrete and visible in the surrounding reality or of an abstract nature. Impulses starting activity in the brain, specifically those concerning the process of speaking, may come from the outside world – as is the case in SQ – or from preceding internal representations. If, e.g., the speaker wants to start a political discussion or express some form of empathy, dislike or whatever, it may be external but also internal ideas that cause a logical continuation of a linguistic nature.

We have argued that linguistic thinking characteristically implies the intricate collaboration of cognitive and communicative processes. Communication functions as the means to transfer what has been developed cognitively, but on the other hand it influences the delimitation of cognitive patterns. Even if it is accepted that the communicative function is secondary to what is cognitively organized, the latter does not operate in full independence. Definition of abstract notions, for instance, requires the support of a well-defined form in order not to get lost in vagueness.

Before explaining how the different types of information processing operate in the generation of our example SQ, we have to analyze its semantic structure. To that end we sketch a device of its stratification. We will do this on the level of the Message structure (6), since on this level the interference and mutual dependence of cognition and communication is most visible. It is for this reason that we operate with linguistic concepts [“…”] and their propositional relations [((…)…)]:

I		[“you (“(pass the butter) to me”)]			cognitive kernel
II	[“could you”	“Q”	“please”]		communicative frame
III	[	“John”		]	communicative signal

In the three layers distinguished here the first is embedded in the second and the two are embedded in the third. As regards their content we may call I: rationality, II: modality, and III: social contact.

The most central layer is the cognitive kernel. It may also be defined as the layer of rationality, since on this level the message in its most restricted sense is presented. Rational implies that there is no more than a propositional structure of subject and predicate in which a (complex) property is applied to the person involved. This relation is not yet encapsulated in a framework, i.e. a statement or a question. It is the raw material, sitting at the core of the sentence meaning. What is expressed in layer I is nothing but a subject-predicate structure containing semantic concepts. This may be considered sufficient for the intended act of passing something, but what is missing is the embedding framework that gives the rational kernel the character of a communicative act.

It is the latter, the communicative frame II, that defines how the semantic content is to be interpreted by the hearer: question, statement, order. We use the term 'modality' since it indicates the mode of interpretation. At least three concrete elements contribute in the modal encompassing, viz. the typically modal verb *could*, the inverted order of finite verb and subject combined with an interrogative melody and the modal adverb *please*. The combination of these concepts – once more, prepared in patterns of brain-cells – offer a profuse set of indications as to how the semantic nucleus I is to be interpreted. They could be considered as designing a complex map pointing out to the interlocutor which way to follow.

It is interesting to refer here to a discussion started by Searle with Chomsky. The latter holds that "language is 'essentially' a system for expression of thought" [14]. Searle, contrarily, argues that the function of language is communication in the same manner the function of the heart is the pumping around of blood [15]. Although one must agree that one of the functions of language is communication, it should also be acknowledged that there must be 'something' which is communicated. Since we do not discuss thinking in a general sense, it is a (linguistic) thought that is expressed. It is possible to argue that both scientists are right in that communication and cognition meet, but only Chomsky appears to combine the two: 'expression' as the communicative and 'thought' as the cognitive aspect.

Our third layer, III, accounts for the social contact. In the case of SQ it is only loosely related to the former two layers: in a sense it is a pointing finger, indicating the person for whom the question is meant. Here we meet with a particular use of the proper name. Proper names are common nouns

that can function in an NP, a noun phrase, just like other nouns. In stead of *John is there* it is possible to say *Your brother is there* or *The neighbour*, etc. In the statement *John passed me the butter* the proper name functions as subject of the thought, to which the predicate is added as a qualification. In SQ, however, *John*, although a 'rigid designator' [16], uniquely defines one referent, but it does not participate in the construction of the rational thought. We will therefore hold that it is used as an independent sentence. It is cognate to the cry of an animal, reason why we will call it: vocative use.

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Returning to the eight levels of brain activity, we will demonstrate how and to what extent this has led to the interrogative sentence SQ. All eight of them participate in the encompassing structure language and language use rest upon: the intricate tissue of cognition and communication. As regards their interrelation and mutual dependence, we may indeed hold that language pursues to communicate what has been developed through cognition. In order to guarantee a correct mapping the cognitive structure is developed in function of communication. In short, linguistic cognition has the format of a thought or proposition in order to be correctly mapped onto a sentence. It is the subject-predicate structure of the thought, in which concept and property are ordered along a time axis, that forms the ideal base for realization on the surface. On that level the words are also realized one after the other as the channel of the breath causes the words to be concatenated in a linear order.

Within this bipolar framework of a universal nature, the eight levels of processing are the technical means with which the brain works in order to arrive at its ultimate goal, the utterance that is interpreted by the hearer as intended by the speaker. The eight technical procedures generating the SQ *John, could you pass me the butter, please?* have their specific domain each. They operate on the output of the former level or levels, thus narrowing the large road to the one point focused upon. We will now define them more specifically in relation to our interrogative SQ.

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(1) SETTING. The dining room with the table in the middle. In general, the setting rather than focusing on objects or actions intends to exclude the rest of the world. Once more: it is the brain that demarcates the playing

field, thus designing the borders of the field where the actions themselves are executed at the lower levels. What will be said and communicated with the hearer is like a text spoken in a restricted part of a theatre: let us say on the stage. The theatre itself – here the room outside the table as well as the walls, door, windows – falls outside the setting. By delimiting the stage the brain creates a temporary reality within which the two interlocutors can develop their dialogue. The speech-act that results, our SQ, remains within the confines of the theatrical playground, whereas the rest of the world is no more than the side-wings of the stage.

(2) ORIENTATION. The speaker is in the act of having breakfast, an act that is in several respects directed by the brain. Within the negatively delimited setting a positive attitude is now developing. The attention is on those things that are relevant to taking breakfast: those things that usually play a role in having a meal of some kind. The orientation is not on the birds outside but neither on cutlery, breakfast-set or even the bread that is already on the plate. Something is missing and it is that what the attention is drawn to. A spotlight is in search of an essential part and strays about the table.

(3) PERSONAL CONTACT. With the search started on level (2), the means how to reach the intended object must be investigated. It is now that the creation of verbal interaction can be contemplated, since there is another person at the table. Given the situation established on the former level, the possibility is investigated whether and how to involve the other in some way. Thus the individual concentration of the (future) speaker on the breakfast is broadened to consciousness of a kind of plurality: the necessary base for a dialogue. The intention to speak will arise. Although our schematic analysis obliges us to locate the personal contact and the intention to communicate between the levels (2) and (4), the role of the other person is not restricted to one area. Since the possibility of verbal contact opens itself, the consciousness of his presence permeates several other levels of information processing. At the level of semantic structuring (6), for example, the choice of concepts also depends on the social relation between the interlocutors.

(4) VISUALIZATION. Breakfast as it is taking place here implies all kinds of activities such as using a knife, taking a slice of bread and the like. They are prepared in the brain and performed under the influence of the mental patterns. However, although visual activity covers a large area, visuali-

zation plays a specific role. It is through the latter that attention is focused upon the particular object, viz. the butter, that the appetite craves after. At the same time its distance from the actor is experienced as unbridgeable. The other person, rather than being noticed as just present, now enters the calculation. His distance from the desired object is measured and an imagined line between the butter and the two persons is drawn. They are visually connected and the step from vision to cognitive action can be made.

(5) CONCEPTUALIZATION. The mental arithmetic started here transforms the visual image into a structure of related concepts. The same goes in a way for the other person at the table: in order to be related to the object wished-for there must be an image of that person, some kind of conceptual imprint, in order to make him participate in the intended action. To that end some action concept is evoked, viz. that of handling the object 'butter'. Now a real conceptualization can be designed in which the person and the butter or rather their concepts are related. The second person thus becomes instrumental in order to complete the picture of what the speaker wishes. A still pre-linguistic pattern is conceived that can be represented as something like 'person-action-butter'.

It should be emphasized once more that the pattern is a structure of concepts, not to be identified with a thought, i.e. a linguistic conceptualization using linguistic concepts. Only the latter are written as "butter" and "pass" and "please", whereas their structural relation is that of subject and (complex) predicate. It is at this level also that the notions "John" and "you" are introduced: the notions, not the words.

(6) MESSAGE-STRUCTURE. In (5) the rational elements and structure are activated, but what is missing is the personal attitude of the speaker: that is the bed in which the kernel of the central wish is accommodated. Only by this act a message comes to life. In SQ that is a question rather than a statement or an order.

It is on this level that the brain conceives a proposition , that is to say a thought that is linguistic in the classical sense. In the underlying subject-predicate structure the concepts "you" etc. are inserted. They indeed have meaning potential and contribute to the meaning that will be mapped onto the sentence. In Levelt's terminology it is a pre-verbal message, but in our device there is more to it. The wish relevant for the conceptualization now becomes a kind of operator mechanism, viz. Q for Question. We thus make the step to the layer II, that of Modality. The 'rigid designator' "John" is

excluded from this qualification since it is not part of the question in its strict sense: rather it is an independent pre-sentence. As such it certainly has a function, establishing a relation of confidentiality between the interlocutors, but as appears from the intonation pattern on level (8) it is an expression on its own. It could be argued, therefore, that our example SQ consists of two sentences: an SV (for V = vocative) and an SQ. However, the SV does more than asking for the other person's attention: it preludes on the function he is expected to fulfil in the sentence following.

The distinction made before, viz. of the three layers Rationality, Modality and Social contact suggests that our eight-level information processing could easily have been enlarged by splitting up Conceptualization and Message-structure, entering the three layers into the processing row. However, we think that the brain operates with more than one type of pattern to arrive at the last phase. Thus concepts are connected in order to be mapped onto thoughts, but this process is executed in a modal way. The aspect of wishing something is not added as an after-thought, but the rational idea is conceived in a modal wrapping.

(7) VERBALIZATION. In order to become a sentence composed of words, two sets of grammatical mechanisms are activated. The syntactic rules offer the mechanisms to relate the subject-predicate structure to a surface pattern. This may be the pattern kernel-attribute, but also, e.g., a dependent NP relating to the semantic object. The syntax, therefore, should be conceived in a comparable way to the lexicon. The latter is a collection of lexical items such as ["butter"/*butter*], ["pass"/*pass*]. They are auxiliary expedients, not operating on the levels (6) and (7), but connecting the concepts of (6) with the words of (7). In the same way the syntactic rules only intermediate. As a consequence the structural relations 'thought' on level (6) get a correct expression on the level (7). In our example the result is a complex sentence consisting of two parts: the SV and the SQ: *(John) – ((could you pass me the butter) please?)*. We have kept the brackets in place to indicate that this is an S, an abstract chain of words that can be made audible on the last level.

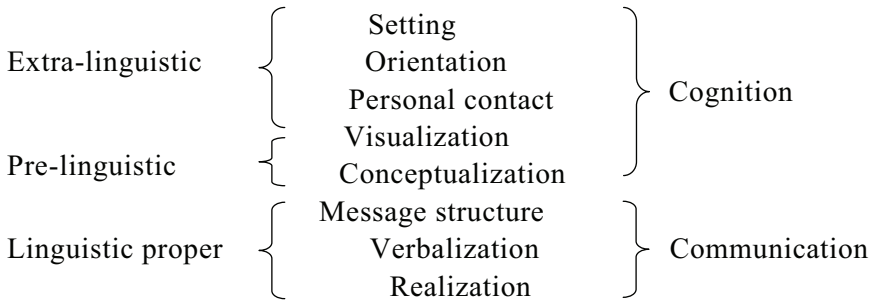
(8) REALIZATION. When the sentence is realized according to the multiple instructions sent by the brain to the relevant muscles, *an* utterance is born. This process of mapping from abstract structure onto concrete structure is scrupulously and minutely prepared by the brain-cells. It implies that no two utterances of the same sentence are identical. They are distinct in time, but also in all kind of audible respects: they differ as the

sighs of a tormented soul, expressing the same emotion in ever changing variability. That our example *John, could you pass me the butter, please?* is an utterance rather than a sentence, is proved by the fact that it can be eliminated, while the sentence is still present in the mind.

*

We have argued that the brain preparing and organizing utterances operates on a complex series of levels. Processing information and bringing it to the surface (audible, readable) happens in a series of neuronal activities, that interact and blend into an intricate continuum. Together they exert a combined function of communication and cognition, so-called linguistic thinking. Rather than extending the design of 8 levels by intercalating, e.g., Modality, we consider the latter as well as Rationality categories of mood. They operate on the utterances rather than participate in constituting them.

What has been left aside is the feed-back and feed-forward between the different levels, as if each of them operates in full independence. As we have suggested, the next level cannot operate without the former and some mental actions can exert their influence upon calculations that follow. All this requires a far more elaborated theory than we have sketched in some simple lines. The following device, therefore, points out a direction, without delimiting the field in a precise way:



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CO DZIEJE SIĘ W MÓZGU, GDY MÓWIMY

S t r e s z c z e n i e

Istnieje błędny pogląd, że mózg może pokonać przepaść między mówcą a słuchaczem poprzez rozwój konceptualnej struktury, którą można odtworzyć jako łańcuch fonetyczny. Okazuje się, że należy pokonać co najmniej osiem warstw opracowania informacji, aby móc zdefiniować zdanie czy wyrażenie. Niektóre z tych warstw postrzega się niesłusznie jako usytuowane poza procesem mowy. Podczas opracowania i strukturyzacji wypowiedzi językowych, takich jak „Janie, czy możesz mi, proszę, podać masło", mózg funkcjonuje na następujących płaszczyznach: 1) struktura ramowa, 2) orientacja, 3) kontakt osobisty, 4) wizualizacja, 5) konceptualizacja, 6) przesłanie, 7) werbalizacja, 8) realizacja. Zwroty językowe jak zdania czy teksty rozwijają się więc w mózgu na podstawie ścisłej współpracy między sferą kognitywną a komunikatywną.

Przełożyła Marzena Górecka

Key words: brain, cognition, communication, conceptualization, message, message structure, modality, orientation, operation of the brain, phonetic realization, pre-linguistic, sentence, setting, ((subject)predicate), thinking (animal & human), utterance, verbalization, visualization.

Słowa kluczowe: mózg, poznanie, komunikacja, konceptualizacja, wiadomości, struktura wiadomości, modalność, orientacja, działanie mózgu, realizacja fonetyczna, prelingwistyczny, zdanie, ustawienia ((temat) predykat), myślenie (zwierząt i ludzi), wypowiedź, werbalizacja, wizualizacja.