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ON SOME PROBLEMS IN CULTURAL SEMIOTICS

A detailed discussion, one which would not only differentiate between individual approaches but would also include the evolution of the views of West European scholars within cultural semiotics, is beyond the capacities of a paper this short.

Thus, I must confine my discussion to the state of research concerned with problems which I consider central to, and representative of, current studies in cultural semiotics by articulating a few general ideas of my choice without referring to specific works unless they provide particularly illustrative examples.

I shall present the situation starting from the second half of the 1960s, when research procedures for cultural semiotics changed significantly.

In the brief history of contemporary semiotics, which derives from a generalization of linguistic research methods viewed as a model for all studies on systems in humanities, there was a period when the seemingly predominating view — among scholars studying communication systems other than the natural langue — was that a classification of social practices in a community (usually done according to different criteria for different types of practices) solves the problem of the classification of semiotic systems, which are typical, as with the practices, of the community's culture. Hence the ideas of creating separate languages for individual practices which are often coupled with a single-minded and utopian pursuit of double articulations specific to these languages, thus, discrete units were also attempted to be distinguished in imitation of phonemes: e.g. the term 'gusteme' in a national

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culinary system. There were also attempts to create languages for painting, film, theatre, the etiquette and other behaviors.

Today, however, it is generally accepted in semiotic studies that individual social practices, including communication practices, all use within their limits not one but many different semiotic systems. Moreover, some of these systems are specific to a given practice, while others are used more broadly — in many different types of practices of a given community.

These problems were reflected in the studies on the semiotic typology of cultures, initiated by Yuri Lotman, which attempted to further differentiate primary modeling semiotic systems, such as natural languages, from secondary modeling systems, which are built upon language, such as literature and other ideological systems. As a result, the very concept of world modeling in semiotics systems had to be refined. The primary system of natural language started to be treated as if it was a "forging" device, useful in structuralizing all orders of culture. It was yet another limitation placed upon the inspirational Sapir—Whorf hypothesis. Whereas secondary systems started to be divided into systems which program human behavior under the supervision of a community (that is, world modeling systems), into those which operate on basic axioms, such as mathematics, and into those which operate in a more complex way, such as religion. The central question at that point was what kind of semiotic systems function in a particular culture of a given community and how do they relate to one another? A need arose to analyze semiotically as many diverse cultural phenomena as possible and culture itself as a typologically recognizable whole. Thus formulated hypotheses presupposed, in keeping with Mauss, that when we are studying a culture we are dealing with "a world of symbolic relationships." Mauss's thesis, however, was overly broad and a little too strong when he claimed that "the social is only real when integrated in a system." Not all that is social is also systematic. Moreover, we know now that it is precisely some secondary modeling systems, which play such a major role in cultures, that do not have all the necessary attributes defining systems as such. Even the model system of a natural language is not, for example, closed, so it does not meet this particular criterion of full systematicity. Nevertheless, culture understood as the whole of communication processes of a given community in a given time, may indeed be tentatively described as a set of texts which are realizations of semiotic systems characteristic of this particular culture. Three major issues illustrate the state and the development trends of hereby discussed cultural semiotics.

Firstly, how are the texts of a particular culture given to us? To what

extent should we take into account the role of the media which transmit these texts and the cultural functions of this media in comparison with the semiotic functions of the texts themselves. Can we e.g. analyze the semiotic functions of individual texts included in the programs of national television systems or should we take into account the cultural role of a TV channel, broadly understood as a medium with a specific technology, and the role of everything that makes it possible for a message to be meaningful, decodable as a representation of something else or someone's speech etc.? Should we take into account the anthropological influence of a message and its power to condition and modify semiotic functions of texts? Should we take into account the impact of the physical aspect of the technology itself, of the medium, the channel, that is, of the entire technology behind a TV system while analyzing the meanings of these texts?

Secondly, given what was said above, how should we study aspects while analyzing a text semiotically? Can we infer a pragmatic relationship between a sender/receiver and a text from the results of an analysis of the syntactic and semantic aspects of the text, supposing that a different syntax or semantics imply a different function and a different pragmatics? Or perhaps an analysis of the pragmatic aspect ought to be carried out separately and on a different level than the analysis of syntactic and semantic aspects?

Finally, what conclusions can be drawn from this discussion in relation to the problem of typologies of cultures?

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In their well-known dissertation, Lotman and Piatigorsky claim:

The concept of text is defined in accordance with an article by A. M. Piatigorsky [Piatigorsky 1962: 145 and passim]. Particular attention is given to such features of a text as its expression ['vyrazhennost'] in a given system of signs — its "fixation" — and its capacity to perform in a certain relationship (in the system of signals functioning in a community) "as an elementary concept." The function of a text is defined as its social role, its capacity to serve certain demands of the community which creates the text. Thus, function is the mutual relationship among the system, its realization, and the addresser-addressee of the text. (Lotman, Piatigorsky 1978: 233)

As the research developed, other clarifications were introduced, like the concept of a multidimensional text (Zaliznjak, Ivanov, Toporov 1962: 134—143), when the signs of a natural language are used to code the signs of a mythological system and then the latter are used to code the meanings of

a religious system. Texts are not only multidimensional, but also organized by multiple codes. It so happens that we decode a certain text with the use of not one but many codes.

Finally, texts appear to be multi-systemic. If we wish to claim that every text is a realization of only one system of signs, it will be merely a convention. In that case we would have to introduce some principal concept that would define the textual realization of more than one semiotic system and moreover, the realization would have to make signs of all the realized systems functionally and structurally interdependent. It seems, however, that it is more convenient to speak of possibly multidimensional texts and typologically distinguish one-dimensional texts from multidimensional ones. It is more convenient to treat a poster in a magazine as a realization of a certain system of iconic signs and, simultaneously, on the level of inscriptions, a realization of a natural language system. It is more convenient since that way we single out such a poster as an individual, complete text within a defined and recognizable practice in a given culture: the practice of advertising. If we stood by the thesis that each individual text realizes only one semiotic system, we would have to use the initial, elementary data — the text — which would then be distanced from socio-cultural reality and would often turn into an *n*-degree abstraction.

How are texts actually given to us? To what extent these elementary initial data are indeed abstracted? What relationship do they have with social practices and their classifications?

According to Lotman, what is characteristic of a text is that it is fixed with the use of particular signs, it is demarcated (that is, it is opposed to all materially fixed signs which are not included in this text) and finally, a text is structured, in other words, it is not a simple, linear sequence of signs, but it is internally organized (Lotman 1970b).

A fixed (either in time and space or only in time), demarcated and structured text with its meanings — both in terms of the signifying (*signifiant*) and the signified (*signifié*) — cannot do without a specific material object-medium. What is meant here is a physical material which as such is neutral in terms of meaning — it may be e.g. an acoustic material or a material in the proper sense, e.g. the fabric of which clothes are made in such a way that, in the context of a particular folk culture, it allows us to distinguish an unmarried woman. Hence, such an object performs a semiotic and textual function, but also the medium itself, which is inseparable from the text, performs an objective function — it covers the body and protects it from the influence of the natural environment. I believe that this media,

as well as the texts themselves, may be called semiotic objects and qualified as semiotic components of the interpreted culture, the latter being understood as a set of processes and functions of social communication.[1] It seems necessary, given the close relationship between the semiotic, the textual and the objective functions of semiotic objects and their force of impact, to modify semiotic functions through objective functions, which are always co-present to one another and which influence both senders and receivers in communication processes, but which are never anthropologically neutral.

The hereby discussed cultural semioticians seem to assume in their more detailed analyses (e.g. Toporov 1973) that all texts, except a few liminal cases, are the realization of numerous systems. Texts are usually multi-systemic due to their multidimensional and multi-semiotic character (or sometimes both), the latter being a result of a cooperation of different systems which are simultaneously at play. The same analyses carried out in the late 1960s indicate show the abandonment of the thesis that social practices and separate languages or semiotic systems characteristic of a given practice supposedly correspond with one another. Classifications of systems and practices are separate. The classification of texts, as well as the demarcation of each and every one of them, are secondary to both of the previous classifications, provided that it is our priority to classify practices and to distinguish them as processual entities of different degrees depending on the theory of a given practice. Hence, we speak of the texts of e.g. ritualistic behaviors, ludic behaviors (carnival-like), as well as literary, mythological, film or poster texts and diverse texts of the JW program etc. The procedures of distinguishing practices as semiotic objects, media for texts and texts themselves are dialectically co-dependent.

Therefore, texts can be classified in two ways: first, by referring to the criteria of distinguishing social practices, second, by referring to the criteria used to distinguish, within a culture, semiotic systems and their functional relationships, when realized in multi-systemic texts such as films. The criteria derived from these theories of classification of different types and degrees of social practices are incomparable. Technological characteristics of different types of practices are the least comparable, while their social characteristics are easier to compare. The latter, however, are very hard to define in an unambiguous fashion without a semiotic analysis. Therefore, only the classifications of cultural texts which refer to the criteria of distinguishing

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[1]These problems, although slightly differently understood, were the preoccupation of A. J. Greimas (1968) and J. Kristeva (1968). We should also consider more detailed discussions by the contributors of 10th issue of *Langages*.

semiotic systems realized in these texts, according to the rules of their internal organization, are truly comparable.

By confirming their fixation, demarcation and internal organization, a semiotic analysis and a classification of texts allow us to verify hypotheses on classifications which refer to the often ambiguous criteria of distinguishing different types and degrees of social practices and their realizations in the form of semiotic objects.

A semiotic object carries the text which makes a given practice comprehensible and meaningful to people. It is text, the entire text, that is the elementary data. Isolated signs, sometimes meaningful on their own, are so only after they have been abstracted from a text. A semiotic object as a complete component of a culture is distinguished only if it is a medium for some text. Yet, these types of texts are determined by the classification of objective functions of semiotic objects.

A realization of some pattern of a certain social practice, fixed in a closed process or in time and space, is what we call a semiotic object. Its objective function are the anthropological consequences it has for an individual or a collective body, consequences which always arise when a social practice is realized.

Semiotic objects, due to their role of fixing and carrying texts, perform not only the objective, but, as we know, also semiotic functions. We have already said that e.g. a folk outfit can be considered a semiotic object. Its objective function — to dress a human and to protect him/her from the cold — is the basis which allows us to single out the text of folk clothes typical of many cultures. While the text, carrying the shape of that outfit which, as Bogatyriev claims, informs us about the gender, age, social and economic status, the magical and erotic intentions etc. of the person wearing it, allows us to determine which object with a co-dependent objective and semiotic function is an outfit and which no longer is one. Only in liminal cases the medium and the text appear to be materially identical. Usually, many material characteristics of the medium have no semiotic valence and only some of them are semiotized (e.g. colors can be meaningful, but textures or kinds of fabric cannot, at least at a given stage of the analysis). But the overall complex of relationships between meaningful units demarcates a certain semiotic object as both a medium and a text. For example, a meaningful decorative pattern on an outfit which can be read allows us to ascertain that the ornaments belong to this or that outfit, even though, in many other aspects, the outfit only covers the body and does not inform us about anything else with these aspects. Thus, in the proposed interpretation

of a culture, demarcation of a text serves to demarcate semiotic objects.

Semiotic objects, as well as their objective functions, are very much heterogeneous and they have clear time and space specifications: certain objects appear in some cultures but not others. Determining if particular objects appear in a given culture requires empirical descriptive research.

What is common to these heterogeneous classes of semiotic objects is their textuality and texts, as realizations of sign systems, are always homogenous because of the common metalanguage used to analyze them. They can be described with one language, the language of semiotic analysis. A typology of texts is based on the same kind of criteria: the rules for realizing communication processes, the result of a text analysis which includes all three aspects: syntax, semantics and pragmatics. A semiotic analysis can be used to interpret the functions of all texts. Therefore, it allows us to specify the functions of semiotic objects, and consequently, the functions of social practices in terms of their meaning for people and their value for both individuals and collective bodies to which these communicating individuals belong. Since for a scholar, in his attempt to fully interpret a certain culture, the development patterns, technologies and objective functions of social techniques are as important as the meanings these practices have for individual human beings. For the latter determines the hierarchization of techniques, their fixed equivalents as values. In this respect, a semiotic analysis acts a fundamental role. In a community, every human chooses and hierarchizes values as the participant of communication processes, a sender or receiver of messages (texts) in different situations, such as in the conflict situation of a strike, during a mass, while reading a book, bragging about the newest car and exercising one's "know-how" skills in the creation process.

But if the semiotic functions of a text in question and the text itself are given to us from the particular aspect of a semiotic object, inseparable from its objective aspect and objective functions, what is the correlation between these objective and semiotic functions?

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These problems *expressis verbis* are discussed mainly in Polish cultural semiotic (Żółkiewski 1972, 1973, 1974), but they are inspired by detailed Soviet analyses, among which Ivanov's generalizations, Lotman's more systematic research, as well as Piatigorsky's and Uspiensky's attempts play a major role (esp. Lotman 1970a: 105, 1973b: 94; Ivanov 1973: 206—236, 1965: 75—90).

The ability to distinguish between social techniques requires theoretical knowledge that supersedes all semiotic research. Such knowledge also helps us to formulate hypotheses on distinctions between semiotic objects, which may, in a particular culture, be media for texts characterized by fixedness, demarcation and internal organization of a structural nature. This proper, theoretically organized knowledge of the history and technology of social practices in a specific community and in a specific time allows us to distinguish e.g. an entire folk outfit instead of bits and pieces of fabrics or a book as opposed to a newspaper instead of scraps of paper. These hypotheses must be verified and, if need be, revised, depending on the semiotic analysis of the semantic functions of a text, whose medium is the semiotic object that we have distinguished. Distinguishing that object is determined above all by the answer to the following question: does this object, if distinguished as proposed, participate in a given culture and does it indeed participate in the communication processes of that culture? Only after having analyzed the semiotic function of the textual aspect of this object can we confirm our hypothesis on classifications and determine the required characteristics of the semiotic organization of this particular text, which is carried by this very object.

Defining the relationships between objective functions of a given semiotic object and its semiotic functions is an empirical question, which depends on the way a particular object functions in the communication process of a given community in a given culture.

Yet, there are at least three types of basic, invariant relations between these functions. If the semiotic function of a text depends primarily on its internal organization, on the type of semiotic system (or systems) and on the number of levels the next realizes itself, then it is the objective function of a semiotic object that has the power to modify the controlling power of the semiotic function.

Objective functions of a semiotic object may, first of all, ACCOMPANY semiotic functions on a metonymic basis.

Secondly, they may TRANSMIT semiotic functions on the basis of both metonymic and metaphoric organization at the same time. Thirdly, they may BE INTERPRETED through semiotic functions on the basis of a metaphoric organization. For example, in terms of the first case, the objective aspect of a folk outfit and its objective functions co-occur in one semiotic object — the very outfit — along with the semiotic aspect, the textual aspect and its functions. An outfit covers the body but at the same time it means something — it distinguishes the wearer in terms of gender,

matrimonial and social status etc. This objective function is susceptible to the modifications brought about by the semiotic function. The nature of this influence constitutes yet another empirical problem and we could possibly notice numerous types and tendencies of such modifications in a given culture. From a theoretical standpoint, it is vital that such influences occur and that while analyzing a text we should always bear in mind the properties of its medium. With the metonymic organization discussed in this example such influence is not considerable. In this case, semiotic functions have a high degree of autonomy. Nevertheless, the very fact that the objective and semiotic functions constantly co-occur results in a "familiarization" of the latter (in a particular culture, obviously). Their co-occurrence is marked by permanence which has a great semiotic valence. This leads to specific connotations. It would be shameful and ridiculous to ignore e.g. the semiotic attributes of an outfit which designate gender. But when (in a different culture of this community) this distinction ceases to be permanently connected with objective functions such as covering the body, e.g. when women are allowed to wear trousers, then this change is a semiotic expression with a considerable social function to perform, since it contributes to the processes of gender equality. An observer who watches these phenomena occur in morally conservative peasant countries which are undergoing a social revolution and experiencing all of its consequences knows the importance of such supposedly insignificant phenomena.

In the same way, we can analyze a different example of such a metonymic organization. For example, the Christmas Eve supper follows a certain order of serving meals. Its objective function is, among others, to feed the hungry. But people who participate in it can decode its text so that when a visitor arrives and sees sweet pasta with poppy seeds being served, he knows that the supper is almost over and that he is grossly late. The fact that the goal of the feast is to satisfy hunger and that the physiology of the process is accounted for, causes the semiotic aspect — the order of the supper — to become "naturalized." Especially, since the custom of serving a sweet desert as the last meal is common in our culture, although not in all cultures. This purely conventional act tends to be regarded as justifiable in the light of the physiology of hunger. Sweets are to be eaten only after a fat meal, not before, although we know that the human organism can tolerate even that "wrong" order.

The second correlation between the objective and the semiotic functions of semiotic objects is by far more important for its formation through information due to the strong link between information and social practice,

which manifests itself in the form of particular semiotic objects. McLuhan was the first to describe these phenomena so vividly, yet at the same time with one-sided exaggeration. Through the linear, printing technique proposed by Gutenberg, a copy of a book transmits information contained in the text of that book. But the social practices preserved in the physical copy, or in fact in many copies of the same text, are not anthropologically neutral in communication processes. The objective function of the transmission of this text in numerous printed copies accompanies its semiotic functions. It does so not only on the basis of metonymy, but the metonymic relationship that occurs here is of crucial importance. The possibility of printing a large number of copies thanks to modern printing techniques turns some texts and their codes into the public property of many receivers — these texts become a common repertoire of information available to a particular community and the appropriate codes become so well-known that they impose themselves onto the minds of receivers and they usually have great chances of dominating the hierarchy of possible codes. Hence, in literary communication, the cultural habit of the receivers accustomed to the poetics of 19th century critical realist novels accounts for the popularity, intelligibility and "easiness" of texts which follow this code, but also offers an opportunity of decoding other texts which the sender intentionally reorganized so that they resembled the critical realist poetics. Another face of the homogenization of reading experiences in mass literary communication, such as the reading of Faulkner's *Sanctuary* as a crime novel, can be easily explained by the influence of the objective functions of the semiotic object (the medium for the text) on the semiotic functions of the text: it suffices to publish and sell *Sanctuary* as part of a crime series with other novels of the genre, adding a proper cover and a symbol of police romances, to impose such a hierarchy of codes that will make the reader decode Faulkner's book as crime fiction. In cases when the objective function of the medium is mainly (or, in extreme cases, merely) to TRANSMIT information, when the medium is nothing more than an actual information medium, the distinction between the medium and the text, the objective and the semiotic function seems artificial. But it is not. Obviously, in our example, the design and the symbols used to mark detective fiction perform semiotic functions, such as implying that the content of the book falls into the criminal romance genre. But that is only on the level of a single copy. Meanwhile, from a social perspective, it is the number of copies that also plays a role — the number of copies of this book as well as the number of analogous (or pseudo-analogous) titles in the entire series. Only the objective function of the MEDIUM OF "SERIALITY" of a particular

type of texts, a medium with many copies and many titles, has the power to modify, as it has already been described, the semiotic functions of an individual text which is atypical of a given series and to impose on readers a certain hierarchy of codes, which in our example is represented by the dominance of the action code.

The quantitative aspect, which is decisive in this case, is not important in itself. It is a manifestation of the objective function of TRANSMISSION with social parameters allowing it to neutralize, at least to some extent, the controlling power of the internal properties of the text of the abovementioned *Sanctuary,* provided that it is not only labeled with symbols of seriality, but also distributed along with many other seemingly analogous titles labeled in such a way that they fulfil the quantitative conditions of seriality in the mass culture of a given community.

But, as it was already said, that is not what is important. For, in this example, there is also a metaphoric relationship between the objective and semiotic function. Let us consider two semiotic objects which represent two different social practices of passing on information: a printed book and an entire television system of a given region broadcasting respective entertainment programs. The meaning of a text contained in a book as well as the world model implied in this text as a realization of a particular semiotic system are also a metaphoric interpretation of these attributes of the transmission medium determined by the very technology of communication. These attributes, metaphorically interpreted, act as limiting frames setting the tone for the way in which the text models the world. Hence, they have their share in determining the organization of this model. Print bombards different receptors than television: for example, given the linearity and cause-effect presentation of events characteristic of print, this medium favors a significantly different type of modeling than television which attacks the entire human central nervous system, but also stimulates the imagination which is needed to fill in the gaps in a TV "worldview" caused by the specific nature of TV technology and its limited, in comparison with cinema, capacities to transmit iconic images. This does not explain the final interpretation of the famous aphorism that the medium is the message, but this fact is valent enough to prevent an isolated analysis of semiotic functions of an abstracted text without taking into account its unbreakable relationship with the semiotic object and the unbreakable relationship between semiotic and objective functions, that is, the technological properties of the objective function of the very act of transmitting or of using a certain channel.

Finally, the third type of relationship between these two functions is

called metaphoric. This is an organization in which the semiotic function is only an interpretation of the objective function. I believe this category mainly includes the texts of behaviors which we cannot segment "naturally." However, they are not the orders of behaviors (such as rituals) which simply transmit encoded information (e.g. myths).[2] In the latter case we are dealing with a variation of the above analyzed organization. It seems that the third category is about texts which are realizations of the various classification systems of particular global and fragmentary social practices. For example, we may become familiarized with the artisanal practice of making horseshoes through our own competence in this craft, through observation of relevant behaviors or, indirectly, though descriptions encoded in natural language signs. We are able to understand production practices and treat these usually processual phenomena as semiotic objects. Their objective function is to produce, while the semiotic function answers the question: produce what and how? If we can refer particular factors and elements of the manufacturing process to classes of certain activities and to classes of elements, and then if we can adequately classify the relationships between these components as well as classify their functions in the analyzed process, the semiotic aspect of an object may be recognized. This is because a classification is *de facto* an interpretation of objective functions through semiotic ones, but it should be detailed enough to correspond with the point of view of the usually fragmentary practice. For example, a hammer is a tool and a tool of this kind is used in many practices. When interpreting (that is, classifying) the particular hammer in a particular process of manufacturing horseshoes we identify it as a sledgehammer for making horseshoes. On the other hand, as to the classification of the processes of a particular practice as a whole, that is, of its higher degrees, we have to distinguish between e.g. a craft product from an assembly-line product and, to go further, between capitalist and socialist methods of production or between other, theoretically more general classes used to organize a practice. Generally speaking, in this example we are interpreting the stylistic features of social practices, features which relate to certain stylistic orders and specify the manner of executing these practices along with the attributes that determine their quality and meanings (Kluckhohn 1962: 37f; Żółkiewski 1965: 183—200). I have referred in this example to the classification of practices from the perspective of the theory of production, but many more classifications could be used: for example, the approach proposed by personality theories, as is done in the well-known

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[2]Some scholars negate the communicational functions of a ritual (Greimas 1968: 26). However, I stand in favor of a contrary interpretation by Yu. Lotman (1973a).

study by Piatigorsky and Uspensky (Piatigorsky, Uspiensky 1967).

In our typology, we have always said that objective and semiotic functions accompany one another in a metonymic fashion, that semiotic functions are transmitted by objective functions in a metonymic and metaphoric fashion, and that objective functions are interpreted metaphorically through semiotic functions. In other words, we speak of types of relationships between dominating functions (on the side of the objective and semiotic ones) in reference to the analyzed semiotic object. Objective functions ACCOMPANYING the semiotic ones in the foreground of a social practice, may, in the background, TRANSMIT information and perform other functions if we look even deeper. For example, a folk outfit above all protects and covers, which is what objectively dominates the practice of wearing an outfit dominated, but after all it is the outfit (or its certain elements) that BRINGS us information related to its semiotic aspects.

When the objective functions of information TRANSMISSION are dominating, as it is the case with e.g. ritual dance or the entire practice of using mass media, then certain secondary objective functions, such as those of information electronic equipment, may only accompany the semiotic functions, like some socially (prestige-wise) functional physical properties of the casing of a single receiver.

Finally, in the third case, the interpretative relationship dominates over, for example, manufacturing practices and their pre-established correlates. But even then the relationships between objective and semiotic functions may be richer, although manufacturing practices usually lack informative intention, which they compensate with clear productive intention.

I realize that my simplified analysis does not explicitly state that a classification of social practices, which precedes a semiotic analysis, shares all epistemological difficulties and problems of major cultural theories. A semiotic analysis does not free us from cultural theories. Semiotics cannot replace a worldview. Nevertheless, I am convinced that a semiotic analysis allows us to specify the interpretation of signs and meanings and to make respective hypotheses REJECTABLE. Yet, a Marxist would still use the results of a semiotic analysis differently than a phenomenologist or a neo-positivist.

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The thing is that we should accept the rigors of describing the initial data: the rigors of texts and the rigors related to ordering the initial documentation of cultural phenomena and processes. At the same time, we should adopt

such rigors which would prove the most productive from the point of view of reconstructing the semiotic systems realized in texts along with their world models.

The semiotic analysis of a text has essentially three aspects: it refers to syntax (the internal organization of a text), to semantics (the approach of a text to that what shapes the image of the world external to the text itself) and finally, pragmatics (the relationship between the sender or the receiver to the text and to the adequate sign system. The results of such a triple analysis allow us to establish the function of a text and its social role.

There are two options: either to treat culture as a collection of texts, or as a set of functions. In the first case, a function determined through reference to a particular text acts as the meta-text. While in the second case, a text is derived from a function.

The function and the text may be analyzed at the same level or at two different levels. The one-level analysis of the text and its functions is in fact a syntactic and semantic analysis. In that case, the pragmatics of the text are deduced only from syntactic and semantic determinants. We assume that the change of syntax and semantics of a text modifies its pragmatics, as well as the sender's/receiver's approach towards it, and consequently, the very functions of the text. Therefore, we attribute a special controlling power to syntactic and semantic signals over behaviors connected with sending and receiving information. It is essentially a utopian, quasi-linguistic theory, as it attributes such a controlling power that only natural language systems could have to different cultural systems realized in a text.

As a result, this quasi-linguistic theory assumes a special status of the sender and the receiver as intra-textual facts. There are signals in a text, which incorporate not really its sender, but rather its addresser, or, the intra-textual "image of the author," as Vinogradov would say. On the other hand, the text contains signals which determine the intra-textual concept of the addressee (rather than the receiver), in other words, the virtual receiver. Only surrendering to the controlling power of signals which incorporate the virtual receiver can a real, "correctly" reacting receiver be formed. I believe, however, that both the receiver and the sender actually operate outside the text.

Both approaches appear in the semiotic studies analyzed here. These studies include descriptive works which treat culture as a collection of texts, as well as those which treat it as a set of functions. There are also such works which examine only the syntax and the semantics of a text, drawing conclusions about its pragmatics only on the basis of these two analyses.

But there are also works which carry out the pragmatic analysis separately, at a different level than the syntactic and semantic analyses. Therefore, they operate in two types of research: on the one hand, the approach which treats the addresser and the addressee as intra-textual constructs and on the other hand, the one which considers the sender and the receiver part of the communication process taking place outside the text itself. A classic example of the latter approach to text, sender and receiver is e.g. Toporov's study *On the Cosmological Origins of Early Historical Descriptions*.

The superiority of empirical descriptions clearly speaks in favor of the second view: culture as a set of texts and the sender and receiver as operating outside a text. Such a conclusion is also supported by everything that was said above: about how texts are given to us, about the existence of the strong connection between a text and its medium and about the dependence of the semiotic functions on the objective functions of a semiotic object —that is, a social practice. All of the above mentioned relationships and phenomena require separate pragmatic analysis, as the objective functions of semiotic objects modify, as it was proven in this discussion, the semiotic functions of texts primarily in their pragmatic aspect.[3] These modifications are based on the varying hierarchy of codes (dependent upon the objective functions of text media) used to decode a text, on a varying hierarchy of text levels and on a similar hierarchy of systems realized in all complex texts. This is what was discussed in our examples.

Changing hierarchies of codes in different epochs are the reason why the seventeenth-century satirical reading of *Don Quixote* is so different from the romantic reading, which emphasizes mostly the conflict between an authentic individuality and a conformist society. And, after all, the hierarchy is established on the basis of the sender's/receiver's attitude towards texts. Of course, the pragmatic approach is not independent of the internal, syntactic and semantic structure of a text — the signals sent by the latter certainly have controlling power, it is, however, historically variable within certain limits. Especially, e.g. in terms of literature, within textual phenomena of the *longue durée*, as Braudel claims. For example, until the 18th century the controlling power of the literary generic code could not be ignored by the receiver while he was hierarchizing the codes of a given text. Thus, it is necessary to choose between the two possibilities — to treat culture as

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[3]This is how the functions of a semiotic analysis of non-verbal cultural texts were perceived by P. G. Bogatyriev already in his research from the 1930s (1971 — e.g., see an article from this book written in 1937: *Funktsii natsionalnogo kostyuma w Moravskoy Slovakii*, p. 297—366).

either a collection of texts, or as a set of functions. The hereby discussed analytical practice seems to favor the approach to culture as a set of texts. In that case the intra-textual concepts of addresser and addressee, as well as the extra-textual concepts of receiver and sender, can be as I regarded as complementary.

However, while searching for answers to the question about the social functions of a text, we should put an emphasis on the sender /receiver operating outside the text, since the social functions of a text are determined by the hierarchization of codes.

We said, for example, that the functions of a semiotic object, such as an outfit protecting its wearer against the cold, affect the semiotic functions of the outfit as a text — marking the gender of the user. The every-day, metonymic relationship between the objective and the semiotic functions of a constantly worn outfit leads to a "familiarization" of the latter. Consequently, a violation of the semiotic functions — despite the fact that a women's outfit may just as well be worn by a man from the objective point of view — becomes highly semiotically marked. A man in a woman's outfit is usually a masquerader; hence, when observing such a phenomenon in any cultural text (a text of behaviors, a literary text, a film etc.), we refer to the code of a carnival, which we treat as the dominant, at the top of the hierarchy. This hierarchization obviously determines our decoding of the function and the social role of this text.

The said scholars believe that starting out with the attempts to classify heterogeneous cultural phenomena, social practices and semiotic objects creates enormous difficulties in terms of hypotheses which point out the differences and similarities of cultures in time and space. Although it seems that no study of cultures can do without hypotheses which theoretically justify the initial classification of social practices specific to a particular study, but it can be scientifically controlled by distinguishing semiotic types of cultures. The latter procedure allows us to separate ourselves (already in the initial phase of research) from the heterogeneity of phenomena, practices and semiotic objects. It allows for the characterizing of these objects from the perspective of what they have in common, their textuality. It also allows for the grounding of the initial hypothesis of classification in the identified similarities and differences of the semiotic functions of these objects. For example, B. Uspensky's research — which proves that semiotic objects, as different as a literary work and a painting, despite clear semiotic differences, share some important features which allow us to classify them both as works of art — follows this pattern. Hence the possibility to test the

hypothesis on the homology range of social, literary and painting practices as artistic practices of a given culture or of many cultures (Uspiensky 1970, especially the final chapter). Even more important is Bakhtin's discovery of the homologies between carnival customs and a carnivalesque model of literature, in other words, a special literary practice and a corresponding practice of ludic behaviors.

Within the works on cultural semiotics discussed in this article we may identify the following major typologies of cultures. The first typological proposal distinguishes the features of the sets of text or of the functions of a culture which are expressible with the language of typology, starting out with the basic opposition between that what is within the scope of a given culture, that what is beyond it. The second typology distinguishes types of cultures according to the criterion of the dominant code in relation to auto-model texts of a given culture (texts, in which a culture interprets itself as a whole), which leads to distinguishing the following types: semantic ("symbolic"), syntactic, a-semantic and a-syntactic at the same time, and, finally, both semantic and syntactic. The third proposal refers to the criteria for defining what qualifies as a text in a given culture and what does not. It also refers to the criteria adopted in a particular culture for varying the degree of cultural authoritativeness of its texts. Finally, the fourth proposal takes into account the types of pragmatic approaches of senders/receivers to the signs of a given culture. The latter is divided into two types: it either explores the pragmatic approach by drawing conclusions from a syntactic and semantic analysis of a text structure and of changes within this structure, or — as it was already mentioned — it treats the pragmatic aspect of a text separately, at a different level than the syntactic and semantic aspects.

The first proposal out of those listed above (to be clear: the typological one) seems to lead to a dependent classifications, complementary to other methods of classification. The second (the criterion of the dominant code) presupposes a utopian harmony and unity of a culture under discussion, and consequently, the dominance of one type of text structure, that is, it allows only one possible auto-model of a given culture. This assumption is challenged by the empirical results of the studies of different cultures and an observation of their internal contradictions. The third proposal (the criterion for determining what qualifies as a text and what does not) fails to sufficiently differentiate between the concept of a text as an element of the metalanguage of a semiotic analysis and that of a text as an element of an object language. Consequently, the concept of a text is always relativized to the uses of an object language, to culture-specific meanings. This results either in an

argumentative vicious circle or in the fact that such a classification can be used only to describe auto-models of cultures. For when coming up with a typology of cultures we must know what does and what does not qualify as a text, regardless of how these concepts are used in object languages of different cultures, but rather according to the rules of using these terms in the metalanguage of the classifier who wishes to observe, instead of participating in the studied cultures.

Finally, the fourth proposal in its first variant, the one which treats culture as a set of functions, has already been criticized above. What is left is the second variant of the fourth proposal, which refers to the presupposition that it is possible to tentatively describe culture as a set of texts. I believe that most of the elaborate works by the abovementioned semioticians assume precisely that second variant of the fourth proposal (the fourth in this classification) as the basis for their research procedure. A classic example of that is the previously cited *On the Cosmological Origins of Early Historical Descriptions* by Toporov (1973). In this study, the ideological, and, therefore, pragmatic attitude of the sender/receiver to the sign system of cosmological description and a different system of historical description is the criterion for the typologies of cultures in which these various systems function. According to Toporov, these two cultures are divided by the social, political and religious crisis which determines the abandonment of one type of description — the cosmological one — and the creation of a new sign system — the historical system for describing cultural phenomena. The functions of the second type of description, the one expressing human meanings of the crisis, determine the approach of the sender/receiver to the new type of historical texts. A pragmatic approach of the sender/receiver to the systems of cosmological and historical descriptions does not depend only on the semiotic function of these descriptions already verbalized in earlier sources. It also depends on the objective function of the most ancient media of cosmological descriptions, media such as rituals, whose objective function consisted in the participation in timeless, mythological processes of "creating cosmos" or conquering chaos. Objective functions which changed under the influence of new and foreign traditions penetrating a culture with its rituals modified also the semiotic functions of a cosmological system, deprived it of its original meaning and made it insufficient for the new historical communicational situation. Similarly, in Bakhtin's works, a reconstructed approach of the sender/receiver to a text determined whether a given text should be qualified as part of the folk culture, in which the primary function is fulfilled by a sign system capable of realizing the model of a "world turned

upside down," or, on the contrary, a text should be treated as part of the official culture, in which the main role is performed by the ruling system realizing the model of a hierarchical world based on the order of the class system (Bakhtin 1965, passim).

We may conclude — from these examples and this entire discussion — that the results of semiotic analyses help verify many hypotheses formed in the process of studying cultures, especially those initial hypotheses which aim to classify social practices. Descriptions and semiotic analyses are useful in theoretical and historical cultural research, which studies the dynamics and patterns of cultural shifts, but they can never replace the latter research and its methods.

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Olgierd Adrian Wojtasiewicz
A FORMAL SEMANTIC INTERPRETATION OF VERBS

The aim of the present article is to offer a description of verbs that would emphasise their semantic functions within deep structures, disregard surface syntactic phenomena and refer to certain functors regarded as primary concepts. Attempts at introducing a certain set of elementary (primary) semantic concepts (semantic primitives) are currently a common trend in linguistic studies encompassing semantic analysis (Apresyan, Melchuk and others in the USSR, Katz and others in the USA, Wierzbicka in Poland). These said attempts consist in defining the elements of natural languages using simpler terms, treated as constituent concepts and combined in appropriate ways. The methods of combining them range from relatively intuitive verbal descriptions to attempts at a formal notation. Works of this kind include e.g. O. A. Wojtasiewicz's study of Polish conjunctions in sentences.

The formal apparatus employed in the present work is functional calculus (also known as predicate calculus) with elements of set theory and Boolean algebra. The constants shall, apart from the constants appearing in these formalisms, incorporate the functors mentioned in the first paragraph, regarded as primary concepts of the system and equivalent to certain elementary semantic notions. Each functor will be introduced in a meta-systemic manner by determining its semantic interpretation and the number of its arguments. The syntactic category of each argument will also be identified; only two categories are accepted, namely a proper name and a sentence. It is also assumed that in the case of functors that take more than one argument the order of the said arguments is fixed and has a syntactic function (and,

indirectly, also a semantic one, as the position of a given argument is related to its semantic role stemming from the interpretation of the functor).

Furthermore, it is assumed that each functor along with its specific arguments (i.e. the correct number of arguments, each of which belongs to the syntactic category appropriate for a given case) has the syntactic category of a sentence and therefore (in a more complex expression) may become an argument of a functor of one type or another in cases where the rules of syntax stipulate the use of an argument having the syntactic category of a sentence. In the introductory meta-systemic description the arguments will be represented with initial letters of the Latin alphabet; in the analysis of verbs they will be represented by the final letters of the alphabet.

Some functors will, out of necessity, have the nature of variables, not constants. This choice stems from the need to identify certain semantic facts in the analysis without developing an overly large (at least for the current phase of the analysis) repertoire of semantic constants. Various formal operations will be used, however, to reduce the number of variable functors as far as possible.

Another aspect that needs to be taken into account in a description of the meaning of verbs is time. What is meant here is not the category of grammatical tense included in many natural languages, but the temporal relations arising from the meaning of the verb itself. To forestall future interpretations, an example might be in order: the verb *dziwić się* ('to wonder') indicates that a person has at a certain moment learnt about some occurrence (or fact) that they had at some EARLIER moment considered at least unlikely. The relation of previousness is embedded in the very meaning of the verb; it may be treated as a relative chronology, independent of the grammatical tense in which the verb is being used. The technicalities related to this understanding of temporal relations are provided in a further section of the article.

The author of the present study wished to present a semantic description of verbs that would be as dependent on the grammatical properties of the analysed verbs as possible. Such a description could then be used to construct a so-called intermediary language for machine translation, i.e. a form of an artificial language that retains the meaning but is independent of the grammatical structure of both the source and the target language.

The present study focuses on examples from the Polish language, in some cases comparing them with English verbs or words in other languages. The analysis of the Polish example verbs introduces certain methods that

make it possible to specify that some purely surface elements will not be taken into consideration; on the other hand these methods may, if need be, indicate whether in the given case the variable included in the example is understood as a sentence or as a proper name (this allows the surface structures to be taken into account to some degree, yet appears necessary; it makes it possible to choose such an interpretation for a different language that will be appropriate even if the surface structure of the language differs in a given aspect from the surface structure of the Polish language; it must be remembered that the analysis must start from examples in a specific language, which forces the scholar to deviate from the initial theoretical premise of disregarding surface structures). If the need arises, the analysis will include pragmatic elements incorporated in the verbs under consideration; as the meaning of some verbs hint at the attitude of the speaker towards the content of the utterance.

As it turns out, the meaning of at least some verbs is connected to the meaning of other elements in the sentence (if the verb is regarded as defining a certain relation, what is meant is the meaning of at least some elements of this relation). For this reason, the present study cannot be regarded as an analysis of verbs as purely lexical components interpreted out of context. Due to the fact that the meaning of verbs depends on the context the analysis needs to be extended to include certain other elements of the sentence in which the verb appears. Thus, the present article contains semantic analysis of certain utterances understood intuitively as minimal sentences, i.e. containing only the components necessary for the purpose of analysing a given phenomenon. A proper definition of a minimal sentence is very complicated and shall not be discussed.

In symbolic notation the temporal aspect will be represented in the form of subscripts to the right of the symbol of the sentence (when the symbol is singular) or to the right of the functor (when the sentence is represented by more than one symbol); if other subscripts appear (which is possible, especially if the notation of the given sentence includes a functor), they will be separated with commas.

In the formula the model of the sentence under analysis will be presented on the left side, whereas the right side shall contain its equivalent in a detailed symbolic notation. The colon dividing the two parts ought to be interpreted as the symbol of definitional equivalence.

To avoid overly complex symbolic notation to the right side of the formula, in some cases a previously described verb included in the symbolic interpretation shall be repeated in English; in a full notation it would have

to be replaced with its previously presented notational form. The symbols of functors and certain other terms are also given in English or in a form referring to certain words in the English language.

The following section contains a description of the terminological apparatus and the forms of symbolic notation that shall be used throughout the present analysis.

(1) $L(a,b)$,

where L represents the relation of spatial location, a is a proper name or a sentence and defines the item or occurrence which is being localised, and b is the name defining the localising item (the localiser). This relation is transitive (all relations analysed in the present work are treated as non-reflexive and asymmetrical — the latter property results from associating the positions of arguments with semantic roles; a given relation is transitive only if it is explicitly stated in its description).

(2) $T(a,b)$,

where T represents the relation of temporal localisation, a is a proper name or a sentence and defines an occurrence which is being localised, and b is a name or a sentence defining the localising occurrence (the understanding of the term 'occurrence' incorporates also complex and long-lasting processes that are not referred to as occurrences in colloquial language). The relation is transitive.

To add to the complexity of the problem, in many natural languages occurrences which ought to be described with sentences are expressed as proper names, such as *wypadek* (an accident), *pożar* (a fire), *wojna* (a war). The same is true in relation to conventional chronological terms: *Jan Sobieski żył w wieku siedemnastym* (Jan Sobieski lived in the seventeenth century) has the meaning of *Jan Sobieski żył wtedy, kiedy był wiek siedemnasty* (Jan Sobieski lived when it was seventeenth century). Many languages include elements which have, within the framework of reism, been labelled 'apparent names'; this linguistic custom shall be taken into account in the present analysis. It could be argued that a denotation of an occurrence is always a sentence from a semantic point of view, yet in terms of syntax it is not always so — the discrepancies are observable even within a single language, let alone between various languages.

(3) $Ex(a)$,

where Ex is a predicate signifying material existence, a is a proper name denoting a material object (or a complex one colloquially not referred to as an object). The predicate Ex should not be regarded as signifying continuing life in the cases where a denotes a living organism; thus, the transition

from existence to non-existence (the relations of transition from one state to another shall be discussed below) ought not to be interpreted as the death of a living being. This reservation may be insignificant in many cases, yet for some may prove crucial: for example from the point of view of forensic medicine a corpse is an existing material object which would only cease to exist e.g. if burned, etc.

It must be emphasised that the functor *Ex* cannot be identified with a quantifier of existence. The functor clearly determines the ontological status of its argument as material (or intentionally material) existence, whereas a quantifier of existence indicates only that a certain object may be identified in some way, without defining the ontological status of the said object. For example, if we say that there exists such an x that x is an even primary number, we are only stating that we are able to identify an object that would comply with certain requirements. We are not in any way commenting on the ontological status of natural numbers.

(4) *Trans*(a,b),

where *Trans* represents a relation signifying the transition from one state to another, a and b are sentences denoting the two states (even if in colloquial speech a given state is described by a proper name, semantically speaking the denotation of a state needs to be expressed by a sentence). The relation is transitive.

(5) $Trans(a,b) \rightarrow \bigvee_{t,t'}$, $Trans(a_t,b_{t'}) \wedge (t < t')$,

where t, t' are (relative) denotations of time, the less-than sign appearing between the denotations of time should be interpreted as the relation of previousness. As regards the arguments of the functor *Trans*, the state represented by a always precedes the state represented by b, therefore the subscripts indicating the relative denotations of time will be disregarded in the case of *Trans*(a,b) as providing no new information. Due to the transitive nature of the relation of previousness, the inclusion of the denotations of time is not at variance with the transitiveness of the relation of *Trans*.

(6) *Ag*(a,b),

where *Ag* represents the relation between the agent and the result of its actions, a is the proper name denoting the agent, and b is the sentence describing the result of the action. The agent is invariably understood as a material object (if it is an intentional object, it is understood as intentionally material).

Theoretically, this notation could take the form of a relation of causality, represented e.g. as *Caus*(a,b) with arguments belonging to the

same syntactic categories as the arguments of *Ag*. The decision for introducing the *Ag* symbol was dictated by the wish to be free (at least with regard to wording and associations) of the notion of causality and source. The notions are firmly embedded in philosophy and its tradition often bordering on the metaphysical.

It must also be noted that the relation of *Ag* is interpreted purely in terms of result, not intention, i.e. in the sense that "*a* acts SO THAT *b*" and not "*a* acts SO AS TO *b*." In simpler terms, in the official interpretation the agent does not have to be a human being. It may very well be a mechanical device or a manifestation of the forces of nature, e.g. the wind or an avalanche, i.e. objects that are not associated with the intention to produce a given result.

The present analysis will also employ the following formulas:

(7) $Ag(a,b) \rightarrow \bigvee_{t}, t' \, Ag(a_t, b_{t'}) \wedge (t \leqslant t')$.

(8) $B(a,b)$,

where B represents the relation existing between an entity nurturing a certain belief and the said belief; a is a proper name (of the entity who holds the belief), whereas b is a sentence (describing the belief). The selection limitations for a are as follows: human beings (individuals or groups) and objects intentionally regarded as anthropomorphic. Specifying any selection limitations for b does not seem possible, because — as may be surmised — anything may become the subject of a belief.

The relation B shall be governed by the following (axiomatic) principle:

(9) $B_t(a, \neg b) \rightarrow \neg B_t(a,b)$,

which is indubitably in accordance with all intuition. It must, however, be added that the opposite implication does NOT occur. The axiom is made in the spirit of intuitionism (as an approach to the study of the foundations of mathematics) at least in the sense that it postulates that a negative statement cannot be the foundation of a positive conclusion. This assumption is in accord with our experience, at least with regard to the relation under consideration: if somebody is convinced that an even primary number does not exist, then this person is not convinced that an even primary number exists (this is an example of using formula (9) in practice); however, if somebody is not convinced that an even primary number exists, it does NOT implicate that this person is convinced that an even primary number does not exist — the person may simply not know the term 'primary number' etc. Including an implication opposite to (9) would therefore be an error.

(10) $S(a,b)$,

where S signifies the relation between the sender of an information and the piece of information conveyed; a is the proper name denoting the sender, while b is a sentence describing the piece of information. The sender of the information is understood very broadly: the notion incorporates senders that may be associated with the wish to convey information (i.e. human beings and objects intentionally interpreted as anthropomorphic) as well as instruments of conveying information (mathematical devices, thermometers, thermographs, barometers, barographs, manometers, etc.) to which such an intention is not ascribed. The differentiation between a human sender and a device may — if needed — be introduced by referring to the relation B connected to holding a belief. As it has been mentioned above, the ability to hold beliefs is ascribed only to humans (or anthropomorphic beings — this emendation is general in character and shall not be mentioned further in the course of the present analysis). The notion of the sender does not include such sources of information as indexical signs (to use Peirce's terminology) emerging in a purely natural fashion without the participation of man-made information devices. Thus, growth rings on a tree trunk which may — to certain people and in certain circumstances — be a source of information regarding the life of a given tree, shall not be included in the category of senders of information employed in the present article.

The relation S shall be governed by the following (axiomatic) principle, analogous to (9):

(11) $S_t(a, \neg b) \rightarrow \neg S_t(a,b)$.

The opposite implication does not occur, which seems even more apparent than in the case of the relation B: if somebody is informing that not-b, they are also not informing that b; however, the fact that somebody is not informing that b cannot imply that they are informing that not-b, since the sender may simply not be conveying any information at the time.

The relation S shall additionally be governed by another axiomatic principle, which is slightly more complex and, for the sake of clarity, includes the subscripts signifying temporal relations:

(12) $S_t(a, \neg b) \rightarrow \bigvee_c Ex_t(c) \wedge R_1^3(c,b)$.

The above formula is an explication of the notion of the relation S rather than its definition: the right side of the equation does not feature the symbol S, yet — as will soon become apparent — the interpretation of the relation R_1^3 refers to the concept of information. Thus, from a semantic point of view there is no new input. The formula (12) should be interpreted as follows: if someone sends a piece of information, then at the same time there exists a

certain object which is the material carrier of this piece of information. The relation on the right side of the equation shall be explained in detailed in a later section; the entire formula is presented mainly for interpretational purposes. The necessity (or lack thereof) to include the formula in the system of the analysed formalised notation of the meaning of verbs is hard to assess, at least at the present stage.

(13) $Exp(a,b)$,

where Exp signifies the relation between the entity experiencing a sensation and the sensation itself; a represents the experiencing entity, whereas b is a sentence describing the sensation. The term 'experiencing entity' is also used in a relatively broad understanding: it may also be an instrument capable of receiving information (and therefore also of reacting to new data), i.e. an object which cannot be described as conscious. The method for specifying that the entity is a conscious being shall be discussed in a later section of the present analysis. Imposing more restrictive selection requirements on a when necessary will make it possible to create varying interpretations of the relation Exp. It should also be remembered that received information may also appear within the experiencing entity and pertain e.g. to its internal condition. The relation S refers to (sending) sign-based information; Exp, in turn, may also pertain to (receiving) information in the so-called sensation codes (the term was introduced by Henryk Greniewski).

The relation Exp shall be governed by the analogous axiomatic principle:

(14) $Exp_t(\ a, \neg\ b) \rightarrow\ \neg\ Exp_t(a,b)$.

(15) $M\ (a,b,c)$,

where M is the (tripartite) relation of ascribing a given measure to something by someone or something; a is the proper name of the measuring entity (a human being or a device), b signifies the proper name of the subject of measuring and c is the name of the measure ascribed to subject b by a as a result of measuring.

(16) $V\ (a,b,c)$,

where V is the (tripartite) relation of ascribing a given value to something by someone; a signifies the proper name of the human being (individual or group) that ascribes the value, b is a sentence describing the evaluated occurrence, while c is the name of the value being ascribed to occurrence b by a.

Despite the considerable similarity between the relations M and V, these two differ in some significant aspects; the difference consists not only in the semantic interpretation of the designates of the name c (in the first

case it is a numerical measure, including the so-called fundamental units; in the latter case it is a quasi-measure which cannot be expressed in numbers), but also in purely syntactic considerations: in the case of *M*, *b* is a name-type argument, whereas in the case of *V* *b* is a sentence-type argument. This is because we are able to ascribe value only to states, situations or, generally speaking, occurrences, i.e. phenomena that may only be described using sentences.

Another method of comparing measures is the less-than sign ($<$). It may also be applied to comparing values, provided that values are portrayed on a scale with a conventional zero point, so that for all values *c*, if $c > 0$, the value ascribed is positive; and if $c < 0$, the value is negative. Zero points — on appropriate scales — may also be adapted in the case of measures, yet it appears that in practice it would be redundant for the present analysis.

(17) *Prob*(*a*, [*i,j*]),

where *Prob* represents the relation between a certain occurrence and the subjective probability ascribed to it, *a* is the proper name denoting the occurrence and [*i,j*] is a closed interval constituting the measure of probability ascribed to the occurrence designated by *a*. Furthermore, *i*, *j* needs to comply with the (obvious) conditions:

(18) $(0 \leqslant i \leqslant j \leqslant 1)$.

In cases when $i = j$ the probability is defined by a single point; such instances do not seem to have any significant role in the present analysis. It is much more important to note that assuming prerequisites such as: $j = 0$, $j > 0$, $i = 1$ allows us to define respectively: impossibility, possibility and inevitability. This, in turn, enables us to describe certain modal verbs and such hypothetical cases in which the meaning of the verb implies modal concepts.

In most cases the probability will be subjective — because verbs referring to some notion of probability usually imply subjectivity. For this reason, the notation equivalent to formula (17) shall appear as the second argument of the functor *B* or as an element of the second argument of the said functor. Thus, the analysis shall contain formulas such as *B*(..., *Prob*(*a*, [*i,j*]), ...), where the first '...' symbol will be substituted with the (obligatory) argument of the functor *B* denoting the subject of a given belief, while the second '...' will be substituted with the (optional) second element of the argument detailing the content of the belief.

The following section shall present the part of the apparatus that may in many cases be considered the least specific and might result in the solutions proposed in the analysis being called ineffective. The allegation,

at least to a certain degree, pertains mostly to our manner of speaking; in cases when it applies to the stipulations of the analysis it must be noted that limiting the range of extra-logical concepts introduced to the present work was a necessity: if the repertoire of such concepts would be extended to a greater degree, all the non-definiteness characteristic for natural languages which formal notation tries to eliminate (as much as it is possible) would be reintroduced, so to speak, through the back door, under the guise of an overly large set of extra-logical concepts assumed to be primary and therefore remaining undefined. As far as possible, the present article shall introduce formal measures intended to make the proposed solutions less ineffective. Perhaps further study may result in limiting the number of ineffective suggestions to the minimum; but that will probably be feasible only much later.

Let us introduce the concept of a single-argument functor playing the role of a predicate and represented generally as:

(19) $P_i(a)$,

where a signifies the proper name of a material object, while i is a certain indicator defining the place of the predicate in a given case and in the hypothetical future list of such predicates. For the time being, in individual cases i shall be introduced into the *definiens* as a variable bound to the quantifier of existence; the binding is necessary, since the variable i shall not appear in the *definiendum*. If a given notation will contain more than one predicate, they will be supplemented with varying subscripts; owing to this general assumption it will not be necessary to supplement each individual case with the provision that $i \neq j$, etc.

Where possible, the subscript i may be substituted with a variable that is free in the *definiendum* and, as such, does not require to be bound to a quantifier. The details shall become clearer as we move on to discussing specific examples.

The formula (19) should be interpreted as: "a is in the state of P_i;" as in the case of the functor *Ag*, the interpretation is something of a verbal trick: the predicates define characteristics, but it is our intention to (a) avoid using the term 'characteristic' and the philosophical connotations it evokes and (b) to adjust the terminology to the discourse used in automata theory, system theory etc. These frameworks often mention the state of certain systems and the transition of a system from one state to another. Incidentally, the latter phrase is directly related to the interpretation of the functor *Trans*.

Another concept that needs to be introduced is the marked predicate P_0 interpreted as a constant; represented as:

(20) $P_0(a)$

which ought to be interpreted as: "*a* is in a state atypical for itself." This statement requires some further explanation. The interpretation assumed for this formula is intuitive, meaning that e.g. a given person is in a state typical for themselves if they are healthy and do not exhibit any anatomical anomaly. Naturally, it might be argued that the boundary between the norm and pathological anomaly is difficult to ascertain; the boundary between health and illness even more so. It seems, however, that the risk of error is smaller than one would expect, especially since the formula is designed to interpret the meaning of certain verbs implying the notion of a typical state, and not for solving problems e.g. of a medical nature. By saying *Kowalski choruje* (Kowalski is ill) we are expressing the view that he is not well, and thus — in accordance with the terminology presented above — he is not in his typical state. The fact whether Kowalski's state would be called an illness from a medical point of view is irrelevant for the interpretation of the above sentence. In the case of mechanical devices etc. the standard state is one in which they are able to function as intended.

Let us also introduce bipartite and tripartite relations of the R_n^m type, each supplemented with subscripts and superscripts. In practice, the superscript will always contain a natural number, specifying the syntactic type of relation (i.e. the number of arguments and their semantic categories). As in the case of predicates, the subscript may contain a bound variable or a variable which appears in the *definiendum* as free. If a given formula includes more than one relation with a subscript bound to a quantifier, it shall be assumed that the different subscripts signify different relations. For the time being, four syntactic types of relations need to be introduced:

(21) $R_i^1(a, b)$,

where a and b are proper names;

(22) $R_i^2(a, b, c)$,

where a, b, c are proper names;

(23) $R_i^3(a, b)$,

where a is a proper name and b is a sentence;

(24) $R_i^4(a, b)$,

where a and b are predicates.

The formula (24) requires additional explanation. From a syntactic point of view, the role of arguments of the functors have been taken, thus far, only by proper names and sentences. A predicate functioning as an argument needs to be introduced explicitly; this solution is well known from categorial grammar, where 'proper name' and 'sentence' are treated as basic

concepts, whereas other syntactic categories are defined with the use of these two concepts. Our predicates have the syntactic category of s/n and after a proper name (n) is added on the right side, they become sentences (s).

What is more, in order to limit the ineffectiveness of the formulas, certain relations shall be introduced as constant; their interpretations may be somewhat general, yet referring to them appears advisable:

(25) $R_1^1(a,\ b)$.

The formula represents the relation of possession (a possesses b; where the term 'possession' is understood very broadly and includes ownership, possession *sensu stricto*, governing, etc., and is always interpreted as a legal relationship);

(26) $R_2^1(a,\ b)$.

The formula represents the relation of a physical or sensory contact of a with b;

(27) $R_3^1(a,\ b)$.

The formula represents the relation of a purely mental (notional) contact that a has with b;

(28) $R_4^1(a,\ b)$.

The formula represents the relation of a social (or, broadly speaking, legal) contact of a and b;

(29) $R_5^1(a,\ b)$.

The formula represents the relation of domination of a over b in a certain aspect;

(30) $R_6^1(a,\ b)$.

The formula represents the relation of equivalence (similarity) of a and b in a certain aspect;

(31) $R_7^1(a,\ b)$.

The formula represents the relation of a having b in his/her/its memory, where a may be a human being, an animal or an electronic device equipped with a memory;

(32) $R_1^2(a,\ b,\ c)$.

The formula represents the relation of a using b upon c, where b is a tool or an auxiliary substance (further explanation shall be provided during the analysis of specific examples).

(33) $R_2^2(a,\ b,\ c)$.

The formula represents the relation of a lying between b and c (purely geometrically or in a given scale);

(34) $R_1^3(a,\ b)$.

The formula represents the relation between the carrier of information *a* and the content of the piece of data *b*.

As mentioned in the introduction, in the analysed examples the variables appearing as the arguments of the verb (regarded as a functor) shall be represented with the final letters of the alphabet, namely *x*, *y*, *z*, *u*, *v*, *w*; the letter *t* (with optional apostrophes) is reserved for indicating temporal relations. In particular cases certain variables from the *x* to *w* series will have to be introduced into the *definiens* as bound; it will be so in the instances when the meaning of the *definiendum* suggests that the implication pertains to an implicit element not expressed in the surface structure, yet crucial for explaining the meaning of the *definiendum* (typical examples include sentences in the passive voice that do not mention the agent, e.g. *list został wysłany w piątek* — the letter was sent on Friday — which implies that somebody sent the letter; the role of this person, though not mentioned explicitly, needs to be specified in the *definiens* that constitutes the semantic interpretation of the sentence).

Furthermore, in cases when the sentence implies a certain view of the speaker or a situation they are in, in the *definiens* the speaker shall be represented by the symbol *s* regarded as a constant and, as such, not bound by any quantifier; it could also be assumed that this is a variable introduced to the *definiens* for the purpose of semantic interpretation, in which case *s* ought to be bound to a quantifier — yet this is a matter of convention; the present article adapts the convention of *s* as a constant, as it reduces the number of bound variables.

In order to interpret certain cases of the application of the model xV_ky (where *x* is a proper name, V_k represents a verb and *y* represents a sentence; details shall be provided for particular examples), it has to be noted that the sentence *y* is semantically bound to *x* as its element (e.g. *x* may be the subject of sentence *y*, not expressed in the surface structure); in such cases the *definiens* should include the notation: $y = y(x)$, which specifies that sentence *y* refers to *x* in a certain way.

Individual variables will often require categorisation, i.e. their selection requirements will have to be specified. This may also pertain to variables that appear (as bound) only in the *definiens*. Such categorisation will be represented in accordance with set theory; the names of the sets shall be introduced gradually as the need arises and explicated as soon as they appear. The understanding of these concepts is based on rather colloquial meanings; the risk of ambiguity and vagueness is reduced due to the fact that the interpretation of these concepts is only indirectly dependent on

understanding the meaning of the individual verbs; as before, the aim was to reduce the names of sets of arguments and the sets whose elements may include variables appearing only in the *definiens*.

A more detailed and specific categorisation shall be developed later, for a future version of the present analysis. A preliminary investigation of this issue suggests that certain problems may arise with regard to the specialised meaning of certain verbs (e.g. *kopać* in the meaning of 'striking something with one's leg'), which may require the inclusion of certain categories of arguments with a very broad scope. On the other hand, it must be remembered that even at the present stage of study certain general categorisations of at least some of the arguments stem from the characteristic of such arguments as *Ag*, *B*, *S*, etc., specified when they were first introduced. Moreover, in some cases the meaning of verbs is extended — sometimes the set of their arguments (this often happens to the argument which, in the surface structure of the Polish language, acts as the subject) starts to include objects that did not use to assume this role. This phenomenon can be observed e.g. in the case of information tools (e.g. *Zegar wskazuje godzinę X* — the clock indicates hour X); the set of such instruments is rapidly expanding. In the last few decades calculating machines have started to be mentioned as the agents of actions previously associated only with human beings.

Additionally, we need to introduce the concept of the relation of being a part of something, i.e. Boolean or mereological relation, represented with $\subset^{\text{o}}$.

The examples analysed in the present study are mostly sentences in the present tense, in third person singular. The grammatical person was chosen due to the fact that such sentences tend to be semantically unmarked; sentences in first and second person cause additional difficulties that shall perhaps be discussed later. The choice of the present tense was dictated by similar reasons: in many cases sentences in the future tense touch on the issue of their logical value (which may be unspecified); in some cases it will be necessary to present examples in the past tense — namely in the instances when the meaning of the verb entails describing an occurrence that had already taken place.

One further reservation must also be made with regard to the indication of temporal relations represented in the form of subscripts; in the present version of the analysis the proviso is formulated in a rather intuitive manner. If a complex formal notation contains elements with subscripts indicating temporal relations, and we want to substitute (at least) one of

these elements with a previously introduced formula which includes its own subscripts related to temporality, the subscripts in the added formula need to be adjusted, so that they differ from the ones appearing in the remaining parts of the notation.

The analysis shall proceed in the following order: first we will present selected uses of the verbs *być* (to be) and *mieć* (to have; the two verbs appear very frequently in the surface structures of many natural languages, as well as in clearly idiomatic structures; the specificity of the uses of these verbs in various languages is evidenced in the series of books issued by Mouton); the analysis will be limited to certain basic uses typical for Indo-European languages. Later we shall discuss verbs whose semantic interpretation contains references to the predicate P_0. Further on we will analyse verbs that — from the perspective of the methods of interpretation adapted in the present study — may be divided into certain groups. Lastly, verbs treated individually or categorised into relatively small groups shall be analysed.

(35) x JEST y : $P_y(x)$.

[x IS y : $P_y(x)$.]

Interpretation: x is in the state defined by y. This represents a copulative use of the verb 'to be' typical for many languages (or at least many Indo-European ones), in which y is a noun (or is semantically interpreted as a noun).

(36) x JEST y-*owy* : $P_y(x)$.

[x IS y-*ish* : $P_y(x)$.]

The interpretation is analogous to (35), but here y is interpreted as an adjective. The difference between (35) and (36) is apparent only in the surface structure, since in both cases the sentence states that x is an element of a certain set. To keep the interpretation uniform, the concept of belonging to a set shall be represented by identifying the predicate that defines this affinity, and not by set membership (i.e. $x \in y$).

(37) x JEST y-*em* z-a : $R_y^1(z, x)$.

[x IS y of z : $R_y^1(z, x)$].

Interpretation: a relation (of a given syntactic type) determined by y exists between x and z. For example, the sentence *Warszawa jest stolicą Polski* (Warsaw is the capital of Poland) would be presented as: $R^1{}_{stolica}(Warszawa, Polska)$ [$R^1{}_{capital}(Warsaw, Poland)$].

(38) x JEST y-*em* w z : $P_y(x) \wedge L(x, z)$.

[x IS y in z : $P_y(x) \wedge L(x, z)$].

Interpretation: x is in a state determined by y and x is located with regard

to *z*. E.g. *Warszawa jest miastem w Polsce* [Warsaw is a city in Poland]: $P_{miasto}(Warszawa) \land L(Warszawa, Polska)$ [$P_{city}(Warsaw) \land L(Warsaw, Poland)$].

Some difficulties, or at least complications, arise in cases such as *Warszawa jest największym miastem w Polsce* (Warsaw is the largest city in Poland) or *Maria jest drugą żoną Kowalskiego* (Maria is Kowalski's second wife). It must, however, be noted that these obstacles arise in connection not with the verb itself, but with the description of certain elements in the sentence that are not verbs. The first example is relatively easy to interpret, due to the mathematical nature of the relation: Warsaw is a city in Poland and for all *u* that is a city in Poland, Warsaw is greater than or equal to *u*. The formal notation for this example would be as follows:

(39) $P_y(x) \land L(x, z) \land \bigvee_{v,w} \bigwedge_{u} (P_y(u) \land L(u, z)) \rightarrow (M(s, x, v) \land M(s, u, w) \land (v \geqslant w))$.

This interpretation may seem complicated, but is merely the formal notation of the verbal formula presented above: the state of *x* is determined by *y*, *x* is located in *z* and there exist certain *v* and *w* that for every *u* that complies with the same requirements as *x*, the speaker associates *x* with a measure equal or greater than that ascribed to *u*.

The second example poses more difficulty, as it requires referring to more complex situations: Maria is currently Kowalski's wife, and in the past there existed exactly one object other than Maria that was Kowalski's wife. The suggested formula:

(40) $\bigvee_{t}, t' \bigvee^1 u \; R^1_{y,t}(x, z) \land (u \neq x) \land R^1_{y,t'}(u, z) \land (t' < t)$,

where $\bigvee^1$ is a definitional abbreviation standing for "there exists exactly one such item that." As noted above, the complications in symbolic notation are not directly related to the description of the verb *być* (to be).

(41) x MA $y : R^1_1(x, y)$.
     [x HAS $y : R^1_1(x, y)$].

where *mieć* (to be) is used in the loosely legal sense of possession and R^1_1 is the constant discussed above (cf. (25)).

(42) x MA y-*owe* $z : (z \subset^o x) \land P_y(z)$.
     [x HAS y-*ish* $z : (z \subset^o x) \land P_y(z)$].

The formula pertains to cases of the so-called inalienable possession, i.e. utterances pertaining most typically to the features of a person's body; describing such features is semantically necessary, since stating simply that *Zosia ma oczy* (Zosia has eyes) introduces no new information; as opposed to the sentence *Zosia ma niebieskie oczy* (Zosia has blue eyes). If this statement

is evaluative in nature, its interpretation is different:

(43) x MA y-*owe* $z : (z \subset^{\circ} x) \wedge V(s, z, y)$.
        [x HAS y-*ish* $z : (z \subset^{\circ} x) \wedge V(s, z, y)$].

In Indo-European languages the verb 'to have' is relatively often used in sentences of the following type: *Kowalski ma zapalenie płuc* [Kowalski has pneumonia]. In such cases it should be interpreted as:

(44) x MA $y : P_y(x) \wedge (y \in Dis)$,
        [x HAS $y : P_y(x) \wedge (y \in Dis)$],

where *Dis* represents the set of medical conditions.

In this case it is also possible to use the notion of a typical state and formulate an interpretation that differs in terms of notation, but is semantically equivalent:

(45) x MA $y : P_y(x) \wedge \bigwedge\limits_{z}(P_y(z) \rightarrow \neg P_0(z))$.
        [x HAS $y : P_y(x) \wedge \bigwedge\limits_{z}(P_y(z) \rightarrow \neg P_0(z))$].

Interpretation: x is in a state determined by y and all that are in such a state are in an atypical state. The above notation employs the typical state marked with P_0. More examples of using this concept will be presented in the interpretation of other verbs.

(46) x JEST ZDROWY $: P_0(x) \wedge (x \in Anim)$.
        [x IS HEALTHY $: P_0(x) \wedge (x \in Anim)$].

Interpretation: x is in a state typical for x and x belongs to the set of living creatures.

The concept of P_0 proves particularly useful for interpreting expressions such as *człowiek ma dwie nogi* (A human has two legs), *pająki mają po osiem nóg* (spiders have eight legs) etc., where *człowiek*, *pająki* (or the singular form *pająk*, with the necessary changes in the sentence) signify a species or a category. It appears that interpretation based on quantifiers proves inaccurate for such cases: the use a general quantifier ("for every x, if x is a human, then x has two legs") results in false sentences, whereas the quantifier of existence ("for a certain x, if x is a human being, then x has two legs") produces sentences that are veritable, but intuitively perceived as distinctly inadequate. By referring to the concept of the state P_0 we are able to formulate an interpretation that is consistent with our intuition:

(47) x MA k y-*ów* $: P_0(x) \rightarrow ((y \subset^{\circ} x) \wedge M(s, y, k))$.
        [x has k $ys : P_0(x) \rightarrow ((y \subset^{\circ} x) \wedge M(s, y, k))$].
(48) y CHORUJE $: \neg P_0(x) \wedge (x \in Anim)$.
        [y IS ILL $: \neg P_0(x) \wedge (x \in Anim)$].
(49) x ZDROWIEJE $: Trans(\neg P_0(x), P_0(x)) \wedge (x \in Anim)$.

[x IS RECOVERING : $Trans(\neg\, P_0(x),\, P_0(x)) \wedge (x \in\, Anim)$].

(50) x ZACHOROWAŁ : $Trans(P_0(x),\, \neg\, P_0(x)) \wedge (x \in\, Anim)$.

[x WAS TAKEN ILL : $Trans(P_0(x),\, \neg\, P_0(x)) \wedge (x \in Anim)$.]

The formula (50) refers to a verb in the past tense, as the present-tense form *zachorowuje* (analogous to *zdrowieje*) is not in use. This does not seem to be a peculiarity observable only in the Polish language: the English equivalent 'is being taken ill' does not seem correct either. It may therefore be surmised that the core of the issue lies in semantics: we do say that someone 'is recovering' (*powraca do zdrowia*), but use the perfective form when reporting that somebody 'has fallen ill' (*zapadł na zdrowiu*) — except in cases when e.g. 'Kowalski often falls ill (*Kowalski często zapada na zdrowiu*).

(51) x CIERPI : $\bigvee_{y} Exp(x,\, \neg\, P_0(x)) \wedge V(x,\, \neg\, P_0(x),\, y) \wedge (y < 0)$.

[x SUFFERS : $\bigvee_{y} Exp(x,\, \neg\, P_0(x)) \wedge V(x,\, \neg\, P_0(x),\, y) \wedge (y < 0)$.]

Interpretation: x is experiencing that x is in a non-standard state and ascribes a negative value to this state. The use of the functor *Exp* implies that x belongs to a category of objects associated with the ability to experience.

(52) x PSUJE SIĘ: $Trans(P_0(x),\, \neg\, P_0(x))$,

[x BREAKS DOWN: $Trans(P_0(x),\, \neg\, P_0(x))$,]

This interpretation could also pertain to verbs such as *niszczeć* (to decay), *gnić* (to rot), *butwieć* (to moulder); in the latter two cases it might be necessary to add a selection limitation: $x \in\, Org$ (x is an organic substance).

(53) x PSUJE y : $Ag(x,\, Trans\,(P_0(y),\, \neg\, P_0(y))$.

[x DAMAGES y : $Ag(x,\, Trans\,(P_0(y),\, \neg\, P_0(y)))$.]

Interpretation: x acts so that y goes from a typical to an atypical state. The same formula may be used for the verb *uszkadzać* (to impair).

(54) x naprawia y : $Ag(x,\, Trans\,(\neg\, P_0(y),\, P_0(y)) \wedge (x \in\, Hum)$.

[x repairs y : $Ag(x,\, Trans\,(\neg\, P_0(y),\, P_0(y)) \wedge (x \in\, Hum)$].

The first part of the formula may be considered the opposite of (53) — the arguments of the functor *Trans* are reversed. The second part of the formula introduces the categorisation of x as a human being (damage may be done by forces of nature, yet in practice only a human being is capable of repairing something); this categorisation should perhaps be expanded to include automata ($x \in\, Hum \cup Aut$).

(55) x LECZY[1] y : $Ag(x,\, Trans(\neg\, P_0(y),\, P_0(y)) \wedge (x \in\, Hum) \wedge (y \in\, Anim)$.

[x CURES[1] y : $Ag(x,\, Trans(\neg\, P_0(y),\, P_0(y)) \wedge (x \in\, Hum) \wedge (y \in Anim)$.]

The formula describes one of the possible meanings of the verb *leczyć*, which pertains to actions performed by a human being upon a human being, an animal, etc. A very different formal notation would be needed to represent another meaning of the same verb exemplified in sentences such as: *Penicylina leczy zapalenie płuc* (penicillin cures pneumonia). The issue is made even more complex by the fact that even though (55) pertains to a singular x and y (with the assumption that the healing or treatment is effective), i.e. to sentences such as *Kowalski leczy Kozłowskiego* (Kowalski cures Kozłowski), the other meaning of the verb *leczyć* appears in more general sentences. It is not possible, however, to use a general quantifier ("for all z, if z has pneumonia, then...”), as this would result in false statements. Instead, it may be necessary to refer to the notion of probability; the sentence: *Penicylina leczy zapalenie płuc* (penicillin cures pneumonia) signifies that "if someone has pneumonia, it is very probable that penicillin will cure it.”

Thus, we arrive at:

(56) x LECZY^2 y : $\bigwedge\limits_{z} \bigvee\limits_{i,j} P_y(z) \rightarrow$ *Prob* $(Ag\ (x,\ Trans\ (P_y(z),\ P_0(z))),$ $[i, j]) \wedge large\ (i) \wedge (x \in Med) \wedge (y \in Dis) \wedge (z \in Anim),$

[x CURES^2 y: $\bigwedge\limits_{z} \bigvee\limits_{i,j} P_y(z) \rightarrow$ *Prob* $(Ag\ (x,\ Trans\ (P_y(z),\ P_0(z))),\ [i,$ $j]) \wedge large\ (i) \wedge (x \in Med) \wedge (y \in Dis) \wedge (z \in Anim)$],

where *Med* is the set of medical substances. It is possible to avoid introducing the notion of the set *Dis* into the notation, if the part of the consequent in which it appears is substituted with $(P_y(z) \rightarrow \neg P_0(z))$ (the formula clarifies that the state P_y is an atypical state).

It may also be added that it would perhaps be more advisable to present a past-tense version of (55) — i.e. *x wyleczył y* (*x* cured *y*) — as it would imply that the action is assumed to be successful. If *x leczy y* is understood as: *x stara się o to, żeby y wyzdrowiał* (*x* makes an effort for *y* to recover), it needs to be interpreted as *x dąży do zrobienia tak, żeby y wyzdrowiał* (*x* aims at making *y* recover). Such an interpretation will be discussed in a later section, after the interpretation of the verb *dążyć* (to aim; understood as: to aim at achieving a specific result of one’s actions) will be introduced.

(57) x SAMOREGULUJE SIĘ : $Trans_t(P_0\ (x),\ \neg P_0\ (x)) \rightarrow Ag_{t'}(x,\ Trans$ $(\neg P_0\ (x),\ P_0(x))) \wedge (t < t’).$

[x SELF-ADJUSTS : $Trans_t(P_0\ (x),\ \neg P_0\ (x)) \rightarrow Ag_{t'}(x,\ Trans\ (\neg P_0$ $(x),\ P_0(x))) \wedge (t < t’).$]

The interpretation of this formula requires some explanation in relation to the previously made remark on the changing of subscripts signifying

temporality. In the description of the functor *Trans* we have specified that its arguments signify states subsequent in time; in (57) the transition from one state to another appears over a specific (relative) period of time *t*. This leads to a problematic question of how this period of *t* relates to the temporal periods associated with the two states. The same problem arises in the case of interpreting the consequent of the implication, where a specific period of time *t'* (subsequent to *t*) is ascribed to the main functor *Ag*; the second argument of this functor is a sentence that involves the functor *Trans*, whose arguments, according to (5), are also associated with specific periods of time. To resolve this problem, the following interpretation is suggested: in this case (and other similar ones) it shall be assumed that the period of time *t* encompasses specific periods t_1 and t_2 ascribed to the arguments of the functor *Trans* in the antecedent of the implication in (57); similarly, the period of time *t'* encompasses specific periods of t'_1 and t'_2 ascribed to the arguments of the functor *Trans* in the consequent of the mentioned implication (here the functor *Trans* is an element of the functor *Ag*). Another suggestion is to stop marking the time periods t_1, t_2, etc., as this would make the notation rather unwieldy (the formula would look as follows: $Trans_t$ (P_0 (x), $\neg P_0 (x)$) $\wedge$ ($t_1 \subset^0 t$) $\wedge$ ($t_2 \subset^0 t$); the fact that ($t_1 < t_2$) is implied in (5) and does not require stating, but even without it the formula would swell considerably) and to treat such an abbreviated notation as a convention.

The analyses presented above lead us to the following conclusions. Firstly, a comparison of (55) and (56) confirms the previously made remark that the meaning of a specific verb is, at least in some cases, heavily dependent on its arguments (if deeper semantic analysis is applied; such differences may go unnoticed if only the surface structure is analysed). Secondly, in the case of (57) the apparatus used throughout the study makes it possible to present the semantic interpretation of such new concepts as self-adjustment, which appears to be a proof of the considerable degree of universality of the mentioned apparatus.

The following section contains the analysis of verbs with an embedded argument of an instrument or an auxiliary substance. Such verbs are relatively numerous, and from the linguistic point of view there is no difference between an instrument and an auxiliary substance. The former group includes such verbs as *heblować* (to plane), *bronować* (to harrow), *kosić* (to scythe), *piłować* (to saw); the latter contains e.g. *lakierować* (to varnish), *politurować* (to cover with French polish). The English language abounds in such verbs, due to the phenomenon of 'conversion', related to the fact that in modern English the morphological boundaries between various parts of speech become

increasingly blurred (at least when it comes to basic forms). Conversion is, however, a broader phenomenon than the one under analysis. Moreover, the embedding of arguments is tackled differently in various languages: e.g. in Polish there are pairs such as *szczotka — szczotkować* (a brush — to brush), but a similar pair in the English language: 'a comb — to comb' is rendered into Polish as *grzebień — czesać* (the argument of instrument is not embedded in the verb); other examples include *pług — orać* (a plough — to plough). Conversely, the Polish *wiosło — wiosłować* becomes 'an oar — to row' in English. The issue may cause two major problems. The first is connected to identifying the SEMANTIC transitiveness of such verbs: *heblować* indubitably means 'to use a plane (a tool) on a given object', whereas *wiosłować* signifies 'to use an oar', with no direct reference to any other object. The assumption than the latter verb always refers to a boat being set in motion by the movement of oars is erroneous. Firstly, the use of a plane results in the modification of the object on which the tool is used — in the case of oars it is not so. Nor does the verb imply setting a boat in motion — in the case of the verbs *wiosłować* and *pedałować* (to pedal) one may easily find examples of training devices in which the motion of oars or pedals does not result in the translocation of the entire device or the training individual. Thus, it must be surmised that some of these verbs are semantically transitive, while others are not.

Another problematic issue is related to whether the formal notation of verbs such as *czesać* (to comb) or 'to row' should indicate that, semantically speaking, such verbs have arguments embedded in them, even though this is not apparent from the form of a given verb. It seems that various solutions may be adapted, depending on the possible practical needs.

Semantically transitive verbs with an embedded argument of an instrument or an auxiliary substance shall be represented with the following general formula:

(58) $xV_zy : Ag(x, R_1^2(x, z, y) \land Ag\ (x, P_z(y))$,

where the subscript z in V_z signifies an argument embedded in the verb, and V represents the verb; in the given case V_z represents the entire group of verbs under analysis. Interpretation: x acts so that there emerges a tripartite relation if using an instrument or an auxiliary substance; the relation exists between the agent x, the instrument or the auxiliary substance z and the object y towards which the action undertaken by x is directed; at the same time x acts so that the state of y is defined by z (in the sense that the object becomes polished, planed, etc.).

If we agreed to adopt a similar solution for the cases when the

argument is not embedded in the verb morphologically, but only semantically, such verbs would be represented by the following formula:

(59) $xV_{(z)}y : Ag(x, R_1^2(x, z, y) \wedge Ag(x, P_z(y))$.

The notation is very similar to (58) — the only difference consists in the addition of brackets around the subscript z in the *definiendum*.

For semantically intransitive verbs such as *wiosłować* (to row), the following notation may be used:

(60) $xV_z : Ag\ (x, R_z^1(z, x))$.

For verbs with an embedded argument of a different type, other solutions need to be adapted. For example, the verb *matkować* (to mother) may be represented as:

(61) xV_z y-*owi*: $Ag(x, R_z^1(x, y))$.
  $[xV_z\ y{:}\ Ag(x, R_z^1(x, y))]$.

The interpretation is obvious: x acts so that between x and y there exists a relation determined by z.

The English verbs 'to coffin', 'to shelve' could be represented as:

(62) $xV_z\ y : Ag(x, R_z^1(z, y))$.

The notation states that as a result of the actions of x there exists a relation between y and z, determined by z. As mentioned in a previous section of the present study, the analysis pertains to non-metaphorical uses of verbs; the fact whether a given use is metaphoric or not often depends on the argument used in the expression — e.g. the phrase 'to shelve a proposal' exemplifies a metaphorical use of the verb 'to shelve'.

The English verb 'to knight' may be represented as:

(63) $xV_z\ y : Ag\ (x, P(y))$.

Interpretation: x acts so that the state of y is defined by z.

The English verb 'to ford' may be represented as:

(64) $xV_z\ y : Ag\ (x, R_z^1(x, y) \wedge (y \in\ Inland\ Waters)$.

Interpretation: x acts so that a relation determined by z begins to exist between x and y, where y belongs to the set of inland waters. The verb 'to ford' can also be described using a more complex formula, which illustrates the meaning more precisely:

(65) $xV_z\ y :$ V $u,\ wL(z, y) \wedge R_2^2(z, u, w) \wedge Ag\ (x, R_2^1(x, z) \wedge Ag\ (x,$ *Trans*$(L(x, u), L(x, w)))$.

Interpretation: there exist such u and w that z is localised by y and that z lies between u and w, while x acts so that a physical contact between x and z is initiated, and x acts so that x moves from u to w (literally: acts so that its state determined by its location with regard to u is transformed into its state determined by its location with regard to w).

The above interpretation is certainly correct (it may also be extended to include the categorisation of y, i.e. a second element of the conjunction in the *definiens* of (64)), yet it is doubtful that it could be used for other semantically complex verbs with an embedded argument. In many cases it will definitely be necessary to discard the relatively schematic interpretations featured in formulas (58) — (64), especially since even in the case of the mentioned formulas the interpretations (although similar) are not strictly analogous. This hypothesis may be confirmed by further examples. The verb *prątkować* (meaning: 'to be capable of infecting others with *Mycobacteria*') may be represented as:

(66) $xV_z : P_z(x),$

or, to be more precise:

(67) $xV_z : P_z(x) \wedge \neg\, P_0(x).$

The verb *odprątkować* (meaning: 'to apply treatment that causes the patient to lose the ability to infect others with *Mycobacteria*; the verb is syntactically and semantically transitive) may be represented by the following formula, which takes into account not only the embedded argument, but also the prefix with a very definite meaning:

(68) $x\ deV_z\ y$: $Ag(x,\ Trans(\ P_z(y),\ \neg\ P_z(y))).$

The verb *przeliterować* (meaning: to spell, to present the spelling of a word by pronouncing the letters in order) may be represented as:

(69) $xV_z\ y : \mathrm{S}(x,\ P_z(y)\ ) \wedge (y \in\ Inscription).$

The English verb 'to dial' (a telephone number, etc.) may be represented as:

(70) $xV_z\ y : Ag(x,\ R_2^1(x,\ z)\ ) \wedge Ag\ (x,\ P_y(z)) \wedge (y \in\ code\ number).$

Interpretation: x acts so that a physical contact is initiated between x and z and so that the state of z is determined by y. The situation in this case is exceptional, because as opposed to previous examples, it is the state of the instrument that is being determined (in the other examples the state of the object of the action was determined by the instrument). The above interpretation may, however, be considered questionable. Is it correct to state that the state of the telephone dial is determined by the number dialled by the person making the call? It appears so, with the proviso that the mentioned state is temporary, as opposed e.g. to the state of a wooden board determined by the action of covering it with varnish. Yet, given the fact that this issue is not reflected in the linguistic layer, but connected to our extra-linguistic knowledge, it does not seem necessary to include such considerations in linguistic semantic descriptions. It may be surmised that the differences in interpretation presented from formula (58) onwards is

sufficient for the purposes of linguistic descriptions. In the case of English, expressions such as 'to ford a river', 'to can food', 'to dial a number' are not varied in terms of syntax, i.e. do not contain purely linguistic differentiating data. As a result, it may be more advisable to substitute (70) with the following formula:

(71) $xV_z : Ag(x, R_z^1(z, x))$.

The emendations seem justified.

Another issue that requires attention is the need to differentiate between e.g. *Kowalski telefonuje*) and *Kowalski telefonuje, że...*The first expression conveys the message that Kowalski is busy speaking on the phone, while the second signifies that Kowalski is passing some information via telephone. In formal notation the two cases would be represented, respectively, as:

(72) $xV_z : Ag(x, R_z^1(z, x))$,

and

(73) xV_z (że) $y: Ag(x, R_z^1(z, x)) \land S(x, y)$.

  $[xV_z$ (that) $y: Ag(x, R_z^1(z, x)) \land S(x, y)]$.

In this case one may also argue that even though in the case of *telefonować* the action is performed directly by the agent, with the verb *telegrafować* (to telegraph; in the sense of conveying messages, i.e. in the meaning expressed in (73)) the action itself is most often performed by somebody else, and thus *Kowalski telegrafuje* literally means 'Kowalski is causing someone to use the telegraph and (by means of this device) pass the information that... Again, however, it's a question of extra-linguistic knowledge. This claim is corroborated by the fact that if Kowalski himself is a telegrapher and sends his messages himself, the linguistic form of the expression used does not change.

Naturally, presenting a full description of all verbs is a task for the future; it would require a careful analysis of the entire list of verbs. It must also be remembered that various languages differ greatly in this respect, not only with regard to morphology. For example in the case of Polish and English the nouns *woda* and 'water' are lexically (and semantically) equivalent to one another, but the Polish verb *wodować* does not have a single Equivalent in English. Its various meanings can be rendered into English as 'to launch' (as in: to float a newly constructed ship), 'to alight on water' (of e.g. seaplanes) and 'to splash down' (of spacecrafts). In Polish the nominal argument is embedded in the verb, yet in English it is not so. The meaning of English verb 'to water', in turn, is rendered into Polish by two verbs, namely *podlewać* (to water a plant) and *poić* (to water a living creature). Thus, in

different languages the (approximate) semantic equivalents of verbs with embedded arguments may differ in terms of morphology and word-formation.

In many cases the nuances of meaning may result in interpretations that would be even more difficult to represent using the formal apparatus employed in the present analysis. E.g. the English expression 'to clock a person' (i.e. to measure the time in which a person is performing a given activity; often used to describe the actions of a coach with regard to a sportsperson) might be represented as:

(74) $xV_z\ y$: $\bigvee\limits_u \bigvee\limits_w Ag(y,\ u) \wedge (u = u(y)) \wedge Ag(x,\ R_z^1(z,\ x)) \wedge S(z,\ M(z,\ u,\ w))$.

Interpretation: y performs a certain activity u, x uses z and z indicates what measure w is determined for u.

The formulas may be even more complex in the case of such verbs as 'to time' and 'to space', where the embedded argument does not refer to a material object. Such problems shall be discussed in the future; their analysis may require revising or expanding some of the theoretical assumptions of the apparatus.

Verbs that may be characterised as creative are also problematic, especially since these verbs are used both in a creative and in a non-creative sense, depending on the structure of the sentence, and, most of all, depending on the category of the argument that in Indo-European languages appears as a direct object. One typical example is the verb *malować* (to paint) in such uses as *malować obraz* (to paint a painting) and *malować sufit* (to paint the ceiling). In the first case the action is creative, since the process of painting results in the emergence of a work of art. The latter case exemplifies a non-creative use — the ceiling was not made in the process of painting, but existed before. The two meanings can be represented using the following formulas which accentuate the differences by means of superscripts:

(75) x MALUJE^1 y : $Ag(x,\ Trans(\neg\ Ex(y),\ Ex(y)))$.
    [x PAINTS^1 y : $Ag(x,\ Trans(\neg\ Ex(y),\ Ex(y)))$].
(76) x MALUJE^2 y : $VzAg(x,\ R_1^2(x,\ z,\ y)) \wedge Ag(x,\ P_z(\text{y}))$.
    [x PAINTS^2 y : $VzAg(x,\ R_1^2(x,\ z,\ y)) \wedge Ag(x,\ P_z(\text{y}))$].

In the latter case, as with the verb *czesać* (to comb), we are assuming that the argument — referring to an auxiliary substance, not an instrument — is semantically embedded in the verb *malować* (this is very apparent in the English equivalent 'to paint'), which determines the details of the notation. The semantic differences between the two meanings of the Polish verb find confirmation in word-building; the perfective form of the verb may either be *namalować* or *pomalować*, depending on which meaning is implied.

The reflexive verb *malować się* also has at least two basic meanings: to cover one's body or a part of it with paint (used in relation to makeup, markings on the skin made by warriors before a battle, etc.) or to be visible as (a) an element of the landscape or (b) as a reflection of an emotion on a person's face. The latter meaning shall not be discussed in the present analysis; it is a near equivalent of the meaning of the verb *widnieć* = 'to be visible to somebody' and requires a locative identification.

(77) x MALUJE SIĘ^1: $\bigvee_{z} \bigvee_{x'} (x' \subset^o x) \wedge Ag(x, R_1^2(x, z, x')) \wedge Ag(x, P_z(x'))$.

[x PAINTS ITSELF^1: $\bigvee_{z} \bigvee_{x'} (x' \subset^o x) \wedge Ag(x, R_1^2(x, z, x')) \wedge Ag(x, P_z(x'))$.]

This notation is almost identical with *maluje^2*, the only difference being the substitution of y with x' (signifying a part of x). The Polish language accentuates the differences in the meanings of this verb in word formation: the perfective form of the verb *malować się* in the discussed meaning is *umalować się* (though in the case of warriors painting their bodies *pomalować się* also seems acceptable; yet such uses are rare in Polish and refer to situations alien to our culture). The verb *malować się^2* used in the meaning (a) practically never appears in a perfective form, but in the case of the meaning (b) the appropriate form is also different — *odmalować*. (These remarks on word formation pertain to the Polish language and, as such, diverge from the basic premise of the present work, yet it seems justified to include them, since they confirm the existence of semantic differences between the various uses of the verb under analysis).

As for the verb *budować*, the present analysis shall disregard the expression *budować coś na czymś* (to build something on something) in its metaphorical uses such as *Kowalski buduje swoje nadzieje na tym, że ma ustosunkowanego przyjaciela* (Kowalski is building his hopes on the fact that he has a well-connected friend), since the author of the present work considers this to be an example of the use of the verb *budować na* (to build on), where the preposition *na* is a crucial element of the verb in the discussed meaning. In its basic meaning the verb may be represented analogously to *malować^1*:

(78) x BUDUJE y : $Ag(x, Trans(\neg\ Ex(y),\ Ex(y)))$.

[x BUILDS y : $Ag(x, Trans(\neg\ Ex(y),\ Ex(y)))$].

The verb *budować się* has at least two meanings: *budować się^1* = to be built; *budować się^2* = to be building (e.g. a house) for oneself.

(79) x BUDUJE SIĘ^1: $\bigvee_{y}$ textit$Ag(y, Trans(\neg\ Ex(x),\ Ex(x)))$.

[x IS BEING BUILT: $\bigvee_{y} Ag(y, Trans(\neg\ Ex(x),\ Ex(x)))$.]

Incidentally, the fact whether this constitutes a correct minimal sentence is a matter of discussion: it appears that an additional element (specifying the location, the number, etc.) may be necessary both in Polish and in other languages.

(80) x BUDUJE SIĘ^2 : $\bigvee\limits_{y} Ag(x,\ Trans(\neg\ Ex(y),\ Ex(y))) \wedge Ag(x,\ R_1^1(x,\ y))$.

[x IS BUILDING STH FOR ONESELF : $\bigvee\limits_{y} Ag(x,\ Trans(\neg\ Ex(y),\ Ex(y))) \wedge Ag(x,\ R_1^1(x,\ y))$.]

In this case x is building y and at the same time acts so that a relation of ownership is created between x and y. Thus, the verb *budować* appears to be semantically rich. In the Polish language, if the object being built is mentioned in the sentence, the verb takes the form *budować sobie*, e.g. *Kowalski buduje sobie willę nad zalewem* (Kowalski is building himself a villa by the reservoir). This example is even more complex, as it specifies the location of the building. In formal notation it could be represented as follows:

(81) x BUDUJE SOBIE y (w) z : $Ag(x,\ Trans(\neg\ Ex(y),\ Ex(y))) \wedge Ag(x,\ R_1^1(x,\ y)) \wedge L(y,\ z)$.

[x IS BUILDING THEMSELVES y (in) z : $Ag(x,\ Trans(\neg\ Ex(y),\ Ex(y))) \wedge Ag(x,\ R_1^1(x,\ y)) \wedge L(y,\ z)$.]

In the abovementioned Polish example "(w)" represents the entire class of locative prepositions. As the rules of description adhered to in the present study suggest, the final element of the conjugation in formula (81) should be semantically interpreted as identifying location; the surface structure of the component is irrelevant (in some cases and/or languages the expression may not contain a preposition at all).

Verbs with a creative meaning such as *malować*[1] (to paint) or *pisać* (to write) may also be used in the so-called absolute sense, e.g. *Kowalski maluje* as in: "Kowalski is busy painting." In such cases the speaker is referring to the state Kowalski is in, therefore it would theoretically be possible to interpret the verb as follows:

(82) x MALUJE^1 : $\bigvee\limits_{i} P_i(x)$.

[x PAINTS^1 : $\bigvee\limits_{i} P_i(x)$.]

On the other hand, the action results in the creation of an object, so the following interpretation is also acceptable:

(83) x MALUJE^1 : $\bigvee\limits_{y} Ag(x,\ Trans(\neg\ Ex(y),\ Ex(y)))$.

[x PAINTS^1 : $\bigvee\limits_{y} Ag(x,\ Trans(\neg\ Ex(y),\ Ex(y)))$.]

This formula features the typical variable y bound to the quantifier of existence, indicating that y, i.e. the object created as a result of the given activity, is not explicitly mentioned in the sentence. Since there are languages which have a tendency to avoid such absolute uses and mention the result of any given action (in modern Chinese the tendency has entered into the realm of lexicalising processes) even if the use resembles our absolute uses, the latter of the abovementioned interpretations appears more accurate, especially given the fact that it indicates the creative nature of the activity performed by x.

The difficulties of semantic analysis may be illustrated using the (digressive) example of the elements traditional grammar dubs 'adverbials of manner'. Let us consider the following two sentence: *Kowalski ładnie maluje* (Kowalski paints nicely) and *Kowalski szybko maluje* (Kowalski paints fast). Despite all appearances, the "adverbials of manner" used in the sentences (*ładnie* and *szybko*) differ in terms of semantic interpretation. The former constitutes an evaluation of the result of an activity, whereas the latter refers to the evaluation or a measurement of the process itself. The first example sentence may be interpreted as follows:

(84) x ładnie MALUJE^1 : $\bigvee_y \bigvee_i \bigvee_z Ag(x, Trans(\neg\, Ex(y), Ex(y)) \rightarrow$
$(P_i(y) \wedge V(s, P_i(y), z) \wedge (z > 0) \wedge (z \in\ Aesth))$.

[x PAINTS^1 nicely : $\bigvee_y \bigvee_i \bigvee_z Ag(x, Trans(\neg\, Ex(y), Ex(y)) \rightarrow (P_i(y) \wedge V(s, P_i(y), z) \wedge (z > 0) \wedge (z \in\ Aesth))$].

Interpretation: if x paints something (in the creative sense), then the product of this activity is positively evaluated by the speaker, and the evaluation is aesthetic in character (it belongs to the realm of aesthetic evaluation). The *definiens* is represented as an implication, because sentences of this type are frequently uttered when discussing someone's skill without making references to the activities the person is currently engaging in.

The latter example (*Kowalski szybko maluje*) is much more difficult to interpret, yet it is apparent that the meaning of the phrase is different than in the previous example: in this case the speaker is evaluating or measuring the time that elapses between the start and the end of a given action (the speaker may mean two different things: (a) the speed of the action, or, if the action cannot be performed at one stroke, (b) the fact that the breaks between the successive stages of the activity are relatively short). To represent the example in formal notation, the apparatus would have to be extended to include at least the definitions of starting and finishing an activity. As we said before, the above considerations are merely a digression,

since the problem concerns not verbs as such, but adverbials.

The verb *pisać* may be interpreted analogously to *malować*[1]. *Pisać się* proves much more problematic, as this reflexive verb has acquired many meanings in the Polish language. We shall disregard the expression *pisać się na coś*, since it is semantically equivalent to *mieć na coś ochotę* (to have a fancy for something) and is a stylistic variation of the phrase *chcieć coś posiąść* (to wish to own something) or *chcieć się znaleźć w określonej sytuacji* (to wish to be in a given situation). Moreover, in the Polish language *pisać się na* may be considered a compound phrase, i.e. a different verb. The specific use of the reflexive form in third person singular, as in the sentence: *Kowalskiemu dobrze się pisze* (perhaps more frequent in first person singular, in sentences such as *dobrze mi się pisze*) is unique to the Polish language; there is no exact equivalent of this surface structure in other languages. For this reason, it often cannot be translated into a concise phrase. The meaning of the expression is also difficult to capture. Usually the phrase *Kowalskiemu dobrze się pisze* signifies that (a) Kowalski is satisfied with the effects (results) of his writing, or that (b) he is satisfied with the circumstances in which he is writing. Such phrases usually appear in a more complex form — the sentence also specifies the time frame or location, e.g. *dobrze mi się dziś pisze* (I am satisfied with my writing today), *dobrze mi się tutaj pisze* (roughly translatable as: I am satisfied with my writing here), etc. A formal interpretation would have to take all the abovementioned semantic nuances into account — it shall not be discussed in the present analysis due to its spatial constraints.

The verb *pisać się* in its meta-linguistic meaning (i.e. signifying: to be subject to certain rules of spelling) is also a specialised one. The Polish sentence *analizuje pisze się przez u* is equivalent e.g. to the English 'analyse is spelled with a y' — an expression containing a semantically specialised verb 'to spell'. In both cases the semantic interpretation of the example sentence would be as follows:

(85) x PISZE SIĘ (przez) $y : P_0(x) \rightarrow ((y \subset^o x) \wedge (x \in \ Writ) \wedge (y \in \ Writ)$.

[x IS SPELLED (with) $y : P_0(x) \rightarrow ((y \subset^o x) \wedge (x \in \ Writ) \wedge (y \in \ Writ)$].

Interpretation: if x is in its standard state, then y is a part of it, and both x and y are elements of a given graphic code or sub-code.

The expression *pisać się* used in its vernacular meaning, e.g. in such sentences as *on się pisze Kowalski* signifies that in official documents a given person is referred to as 'Kowalski' (even though in everyday life he is called

something else). It may be represented by the following formula:

(86) x PISZE SIĘ y: $R_1^1(x, y) \wedge (x \in Human) \wedge (y \in Name)$.

[x IS REFERRED TO AS y: $R_1^1(x, y) \wedge (x \in Human) \wedge (y \in Name)$].

In this case the relation of possession is limited with additional categorial conditions placed on its arguments: x needs to be a person (and not e.g. a legal entity) and y must be a name.

Unexpectedly, perhaps, the verb *czytać* (to read) is not easy to interpret. The verb is decidedly polysemantic. It has metaphorical uses, in which *czytać* signifies 'to guess, to speculate, to interpret', e.g. in: *czytać czyjeś myśli* or *czytać w czyichś myślach* (both meaning: to read somebody's mind), *czytać coś w czyjejś twarzy* (to read something in somebody's face), etc. Other frequent uses include phrases like *czytam, ale nie rozumiem* (i can read this but I don't understand). Thus, the verb *czytać* may mean: to guess, to interpret, to see (to look at) a given text, to see a text and identify its elements, to see a text and understand it (interpret it semantically), or — which is a new meaning referring to electronic devices — to identify the elements of a given text with the use of mechanisms imitating sight. The understanding of a text is not the *sine qua non* condition of reading: if it was so, the verb *czytać* could not be used in reference to electronic devices, nor would we be able to say *czytam, ale nic z tego nie rozumiem* (I am reading this, but can't understand a word from it). To complicate matters even more, the verb *czytać* may also be used in reference to blind people decoding texts written in the Braille alphabet — thus, sensory or even quasi-sensory (electronic scanners) reception of visual (or quasi-visual) nature cannot be considered a necessary condition. The suggested interpretation is therefore very general, yet convenient, as it appears to cover all the meanings of the verb *czytać* listed above:

(87) x CZYTA y : $\bigvee_z R_2^1(x, y) \wedge Exp(x, R_6^1(y, z)) \wedge (y \in Writ) \wedge R_7^1(x, z)$.

[x READS y : $\bigvee_z R_2^1(x, y) \wedge Exp(x, R_6^1(y, z)) \wedge (y \in Writ) \wedge R_7^1(x, z)$.]

By disregarding the requirement that $(y \in Writ)$, we arrive at the interpretation of the verb *czytać* in at least some of its metaphorical uses.

Verbs referring to sensations may be represented using the following model:

(88) x V_{sens}(że) y : $Exp(x, y)$.

[x V_{sens}(that) y : $Exp(x, y)$].

The model utilises the functor *Exp* (cf. formula (13)). This is, however, only the most basic formula, which may be modified depending on specific

needs. Firstly, the functor *Exp* is defined in a such a way that its second argument is a sentence (hence the inclusion of the element *że/that* in the *definiendum* of (88)). This may require emendation in cases where the sensation is expressed with a proper name — such surface structures are very common, at least in Indo-European languages. Secondly, some verbs referring to sensations clearly indicate the organ involved. Different languages tackle this issue differently. Polish distinguishes between *widzieć* (to see) and *słyszeć* (to hear), whereas Italian and Ukrainian contain equivalents only for the former verb. The English language contains specific verbs such as 'to see', 'to hear', 'to smell' and 'to taste'; only the verb 'to feel' (which encompasses tactile sensations, but is not limited to this sense) is not specific and resembles the Polish *czuć*. It seems justified to mark any indication of the organ involved in the formula whenever it is implied in the meaning of the verb.

Verbs indicating the sensory organ may be represented as:

(89) $x\ V_{sens'}(\text{że})\ y : \bigvee\limits_{x'\subset^0 x} Exp(x,\ y) \wedge R_2^1(x',\ y),$

[$x\ V_{sens'}(\text{that})\ y : \bigvee\limits_{x'\subset^0 x} Exp(x,\ y) \wedge R_2^1(x',\ y),$]

where x' represents the sensory organ (or, more precisely, a body part of) x, R_2^1 is a constant (cf. (26)) and the apostrophe by *sens* indicates that the verb in question contains a reference to the organ involved.

Expressions in which the object of sensory perception is specified, e.g. *Kowalski widzi dom* (Kowalski is seeing a house) cannot be considered verbs, since e.g. in the Polish language acceptable forms include both *Kowalski widzi dom* and *Kowalski widzi, że...* (Kowalski sees that...). In such cases it is necessary to regard the second argument of the functor *Exp* as a sentence. This is due to the fact that upon seeing a house we also see how it looks like. The proposed formula (in which y is a proper name in the expression specified in the *definiendum*) is as follows:

(90) $x\ V_{sens'}\ y : \bigvee\limits_{i} Exp(x,\ P_i(y)).$

If the verb specifies the sensory organ involved, the notation should be expanded to:

(91) $x\ V_{sens'}\ y : \bigvee\limits_{i}\ \bigvee\limits_{x'\subset^0 x}\ x\ Exp(x,\ P_i(y) \wedge R_2^1(x',\ y)).$

For sentences such as *Kowalski czuje, że swędzi go ręka* (Kowalski feels that his hand is itching), we arrive at:

(92) $x\ V_{sens'}\ (\text{że})\ y : \bigvee\limits_{i}\ \bigvee\limits_{x'\subset^0 x}\ (y = P_i(x') \wedge Exp(x,\ P_i(x'))) \wedge Exp\ (x,\ \neg$ $P_0(x')).$

Interpretation: x experiences that a part of x's body is in a certain non-standard state.

The verbs *widzieć* (to see) and *słyszeć* (to hear) — and presumably also their equivalents in other languages — have an additional specialised meaning rarely compared to that of *czuć* (to feel) and other verbs referring to sensations without specifying the organ involved, namely 'to have the ability of sight/hearing' or even 'to regain sight/hearing'. To analyse such meanings we would have to start with interpreting potential states, therefore no complete formula may be presented at this point. In any case, such expressions are usually heavily dependent on the context.

To emphasise that the sensations are experienced by x consciously, the following formula may be used:

(93) x *świadomie* V_{sens} $y : Exp(x, Exp\ (x, y))$,

   $[x$ *consciously* V_{sens} $y : Exp(x, Exp\ (x, y))$,$]$

which means that: x is experiencing that x is experiencing (that) y.

Verbs signifying measurement and/or calculation may be represented generally as:

(94) $x\ V_m\ y : \bigvee\limits_{z} M(x, y, z)$.

The model refers simply to the functor M (cf. (15)), but in this case y may also stand for numerical data of a given calculation — in such situations the measurement is the result of the calculation. It may also be assumed that in the case of verbs signifying mathematical operations y is the description of the procedure that is to be done. Thus, the sentence *Kowalski dodaje dwa do trzech* (Kowalski is adding two to three) would be equivalent to 'Kowalski is adding: $2 + 3$' and, at a later stage of interpretation, to 'Kowalski is establishing the measurement for $2 + 3$'. The method may seem rather unnatural, yet the apparatus of the present analysis is not suited for interpreting verbs describing mathematical operations, even though it has proved effective for other verbs. Verbs whose meaning includes mathematical operations are very difficult to interpret, especially since the most basic operations (e.g. addition) are designated by verbs that have other, non-mathematical meanings (the Polish verb *dodać* — to add may also signify 'to say something more', 'to give something more' etc.). The use of the functor M shall, at least for the time being, be limited to the description of the mathematical meanings of the verbs in question.

Verbs of measurement such as *ważyć* (to weigh) and *mierzyć* (to measure) are semantically transitive; the same applies to such verbs as *rachować* (to count), which may also be used without an object — in such cases the emphasis is placed on the action itself. *Kowalski rachuje* (Kowalski

is counting) is equivalent to 'Kowalski is busy with counting (something)'.

The verbs *ważyć* (to weigh), *mierzyć* (to measure), *liczyć* (to count) carry another meaning, which may generally be defined as: to have a specified measure of a given type'. This use may be exemplified by sentences such as *Kowalski waży 58 kilo* (Kowalski weighs 58 kilos), *Kowalski mierzy 185 centymetrów* (Kowalski measures 185 centimetres), *Warszawa liczy milion trzysta tysięcy mieszkańców* (Warsaw has one million three hundred thousand inhabitants; the number of inhabitants is regarded as the measure of the city's size), *Mongolia liczy milion kilometrów kwadratowych powierzchni* (Mongolia extends over one million square kilometres). In such cases the measure must be specified in the surface structure. If we represent such obligatory measurements as m_i, the example sentences may be interpreted as:

(95) $x \; V_m \; m_i : M(s, x, m_i)$.

This interpretation implies that it is the speaker who assigns a given measure to *x*.

Sentences such as *Kowalski się waży* (Kowalski is weighing himself) may be represented as:

(96) $x \; V_{m,efl} : \bigvee_{y} M(x, x, y)$.

Sentences such as *Kowalski daje się zważyć* (Kowalski is letting himself be weighed) could be represented with the following formula:

(97) $x \; V_{mpermiss}: \bigvee_{y} \bigvee_{z} Ag(x, M(y, x, z))$.

Examples (96) and (97) can also serve as the model for interpreting semantically reflexive verbs and the so-called 'permissive' verbs (*x* is letting themselves be *V*).

Sentences such as *Kowalski mierzy stół centymetrem* (Kowalski is measuring the table with a tape measure) may be represented as:

(98) $x \; V_m \; y$ (za pomocą) $z: \bigvee_{w} Ag(x, R_1^2(x, z, y) \wedge M(x, y, w)$,

[$x \; V_m \; y$ (using) $z: \bigvee_{w} Ag(x, R_1^2(x, z, y) \wedge M(x, y, w)$],

where R_1^2 is a constant (cf. (32)).

The final sub-group to consider in this section are 'measure' verbs with an embedded argument (most verbs in this category pertain to mathematical operations). Examples in the Polish language include: *sumować* (to sum), *potęgować* (to exponentiate), *pierwiastkować* (to extract the nth root), *logarytmować* (to logarithmise), *różniczkować* (to differentiate), *całkować* (to integrate), etc. They can be represented as:

(99) $x \; V_{mz} \; y: \bigvee_{w} M(x, y, w) \wedge R_z^1(w, y)$.

Another (relatively small) group of verbs for which a general formula may be devised includes performative verbs such as *chrzcić* (to christen), *błogosławić* (to bless), *przeklinać* (to curse), *wyświęcać* (to ordain), which usually contain an embedded argument (also: *nadawać imię* — to name — which is semantically a performative verb). The notation is as follows:

(100) $\quad x \ V_{perfz} y : (S \ (x, \ P_z(y)) \ \leftrightarrow \ Ag(x, \ P_z(y)) \wedge (x \in \ Hum)$.

Interpretation: informing that y is in a state delineated by z is equivalent to acting so that y be in a state delineated by z. This act of informing does not have to be verbal, it may also consist of a sequence of gestures with a given semantic value. It appears that the apparatus devised for the present work easily lends itself to interpreting verbs that have only recently become the subject of analysis and were causing certain theoretical difficulties.

Apart from performative verbs, languages also contain verbs with performative uses (which also have other, non-performative meanings). This category may be exemplified with *otwierać* (to open) and *zamykać* (to close) in such sentences as: *Otwieram posiedzenie Rady Wydziału* (I hereby open the session of the faculty council). In these cases the announcement (the uttering of a specific formula) itself creates a certain legal condition. Such uses are more difficult to describe with the formal apparatus employed in the present work. This is because the principles adopted in our analysis gravitate towards reistic interpretation — due to reasons that are practical rather than theoretical, let alone philosophical in nature. A certain reistic interpretation of nouns such as *posiedzenie* (a session), *zebranie* (a meeting), *zawody* (a contest), *wystawa* (an exhibition), *zjazd* (a gathering), *konferencja* (a conference) would have to be presented before any sentence in which they appear could be represented in formal notation. This reistic approach may perhaps be abandoned in the course of future research (especially given the fact that even the present work cannot adhere to it fully — the concepts of measure and value, i.e. the third arguments of the functors M and V do not comply with this condition); in this case some problems would no longer be an issue. For the time being we may propose the following tentative interpretation of sentences with verbs that have performative uses but are generally used in a non-performative manner:

(101) $\quad x \ V_{perfi} y : \bigvee_{w} \bigvee_{j} P_j \ (w) \wedge ((S \ (x, \ P_j(w) \wedge P_i(w))) \ \leftrightarrow \ (Ag(x,$ $P_j(w) \wedge P_i(w)))) \wedge (w \in \ Hum) \wedge (x \in \ Hum)$.

Interpretation: the subscript i by the symbol of the performative verb in the *definiendum* indicates which verb (used in its performative meaning) is being analysed; the formula does not feature the subscript z because it

would be difficult to interpret the verb as having an embedded argument. It is assumed that performative uses within the group of verbs under analysis always pertain to human beings (or anthropomorphised objects) in a specific state (usually it is the state of being gathered in a certain place); the performative use pertains to a certain other state of the said human beings related to the pervious state (e.g. if the people are at a stadium, the announcement of the tournament being open is equivalent to the opening of the said event). The interpretation is rather complicated — as noted above, it may later be simplified if alterations in the basic premises of interpretation are made.

Let us now proceed to interpret verbs that cannot be categorised as distinctive groups (at least in the sense of being able to present a general formula featuring *V* and a subscript). First we shall discuss verbs related to location.

Verbs such as *znajdować się* (+ prep) (to be located), *biec* (often + prep) (to run — of rivers, roads, etc.), *leżeć* (+ prep) (to lie), where '+ prep' signifies the use of a locative preposition (in the Polish language), may be represented as:

(102) x ZNAJDUJE SIĘ (prep) $y : L(x, y)$.

[x IS LOCATED (prep) $y : L(x, y)$].

Formulas for the other abovementioned verbs would be analogous, with the reservation that in the case of *biec x* must belong to a class of material or linear objects such as *droga* (a road), *linia kolejowa* (a railway line), *autostrada* (a highway), *szosa* (a lane), *rurociąg* (a pipeline), *linia wysokiego napięcia* (a high-voltage line) or conceptual objects such as *granica* (a border), *trasa* (a route). In the Polish language the verb *biec* may be used without any preposition, e.g. in *droga biegnie doliną* (the road runs through a valley).

For such verbs it is semantically mandatory to add a component specifying location; in some cases these components take such a form that it is possible to interpret them as referring to the manner of construction, yet locative interpretation is never out of the question (e.g. in the case of *rurociąg biegnie pod ziemią* — the pipeline runs underground — the expression *pod ziemią* means 'under the surface of the ground', so it is possible to view it in terms of location with regard to the surface of the ground).

(103) x MIESZKA (prep) $y : \bigvee_{z} R_4^1(x, z) \wedge L(z, y) \wedge (x \in Hum)$.

[x LIVES (prep) $y : \bigvee_{x} R_4^1(x, z) \wedge L(z, y) \wedge (x \in Hum)$.]

The introduction of z may seem surprising or even redundant, yet it is a deliberate and perhaps even necessary step: a person stating that *Kowalski mieszka w Krakowie* (Kowalski lives in Cracow) means that Kowalski is

living in some flat located in Cracow. It is therefore necessary to include the element z representing this flat. Locating x directly with regard to y is not justified, because having a flat does not imply permanent location, i.e. constant presence in the said flat. The relation R_4^1 is a constant (cf. (28)).

Sentences such as *Kowalski mieszka wygodnie* (Kowalski lives comfortably), *Kowalski mieszka w czteropokojowym mieszkaniu* (Kowalski lives in a four-room flat), etc. require a separate formula — they refer to the *modus habitandi* rather than to *locus habitandi* (even though the latter sentence contains the seemingly locative preposition w). It must be remembered that in the case of the verb *mieszkać* (to live) specifying the place or manner of living seems semantically obligatory. Thus, such examples may be interpreted as follows:

(104) x MIESZKA y-owo : $\bigvee\limits_{z} R_4^1(x,\,z) \wedge P_y(z) \wedge (x \in Hum)$.

[x LIVES y-like : $\bigvee\limits_{z} R_4^1(x,\,z) \wedge P_y(z) \wedge (x \in Hum)$.]

(105) x MIEŚCI się (prep) y : $\bigvee\limits_{z} R_4^1(x,\,y) \wedge L(x,\,y) \wedge (x \in Inst)$.

[x IS LOCATED (prep) y : $\bigvee\limits_{z} R_4^1(x,\,y) \wedge L(x,\,y) \wedge (x \in Inst)$].

It appears that this verb needs to be interpreted differently than *mieszkać*, since the connection between an institution and its seat is locationally permanent, at least for a given period of time.

The following section of the present analysis contains the interpretation of several verbs related to the change of location, yet considered from the perspective of location and not the movement itself.

(106) x UDAJE SIĘ (prep) y : $\bigvee\limits_{z} Ag(x,\, Trans(L(x,\,z),\, L(x,\,y)))$.

[x GOES (prep) y : $\bigvee\limits_{z} Ag(x,\, Trans(L(x,\,z),\, L(x,\,y)))$.]

In this case it is semantically mandatory to specify the destination.

(107) x OSIEDLA SIĘ (prep) y : $Ag(x,\, L(x,\,y)) \wedge Ag(x,\, R_4^1(x,\,y)) \wedge (x \in Hum)$.

[x SETTLES (prep) y : $Ag(x,\, L(x,\,y)) \wedge Ag(x,\, R_4^1(x,\,y)) \wedge (x \in Hum)$].

(108) x PRZENOSI SIĘ (z) y (do) z : $Ag(x,\, Trans(R_4^1(x,\,y),\, R_4^1(x,\,z))) \wedge (x \in Hum)$.

[x RELOCATES (from) y (to) z : $Ag(x,\, Trans(R_4^1(x,\,y),\, R_4^1(x,\,z))) \wedge (x \in Hum)$].

The above interpretation covers both meanings of the verb *przenosić się*: the first meaning refers to the change in the place of residence; the second — to a change e.g. of the place of work. To ascertain the meaning of the verb in any given case, one needs to refer to the meanings of the arguments y and z.

(109) x EMIGRUJE (z) y (do) $z : \bigvee\limits_{u,w} Ag(x, \neg\, R_4^1(x, y)) \wedge Ag(x, R_4^1(x, z)) \wedge V(x, y, u) \wedge V(x, z, w) \wedge (w > u) \wedge (u < 0) \wedge (y, z \in\ Country)$.

[x EMIGRATES (from) y (to) $z : \bigvee\limits_{u,w} Ag(x, \neg\, R_4^1(x, y)) \wedge Ag(x, R_4^1(x, z)) \wedge V(x, y, u) \wedge V(x, z, w) \wedge (w > u) \wedge (u < 0) \wedge (y, z \in\ Country)$].

The details of this interpretation may raise some doubts; one may for example question the necessity of u being negative — perhaps it would be sufficient to specify that u is smaller than w.

What is more, in some sentences with the verbs *przenosi się* and *emigruje* the argument y is not stated explicitly, since the emphasis is put on z as the destination. In such cases In such cases y must appear in the *definiens* as a variable bound to the quantifier of existence.

In the case of *emigrować*, the first two elements of the conjugation should perhaps be extended to: $Ag(x, Trans(R_4^1\ (x, y), \neg\, R_4^1(x, y)))$ and $Ag(x, Trans(\neg\, R_4^1(x, z), R_4^1(x, z)))$, which would clearly point to x ending its formal contact with country y and establishing such contact with country z. It would perhaps be more advisable to substitute the two elements with the notation introduced earlier in the interpretation of the verb *przenosić się* and keep the latter part of the formula (i.e. the indication that z is evaluated more positively by x and that both y and z are countries).

Problems such as the one discussed above in connection with the verb *emigrować* clearly illustrate the difficulties that may arise in the process of formal verb description; yet such issues discredit neither the principles nor the value of formal description. In some cases the problems only reflect our imperfect understanding of certain verbs, which becomes apparent during attempts at specifying their meaning.

This may be a good opportunity to demonstrate that the apparatus adapted for the purposes of the present study is sufficient to interpret at least some occasional locative expressions:

(110) x PRZYBYŁ tutaj $: \bigvee\limits_{y,z} Ag(x, Trans(L(x, y), L(x, z)) \wedge L(s, z) \wedge (x \in\ Hum)$.

[x CAME here $: \bigvee\limits_{y,z} Ag(x, Trans(L(x, y), L(x, z)) \wedge L(s, z) \wedge (x \in\ Hum)$].

(111) x ODSZEDŁ stąd $: \bigvee\limits_{y,z} Ag(x, Trans(L(x, y), L(x, z)) \wedge L(s, y) \wedge (x \in\ Hum)$.

[x LEFT this place: $\bigvee\limits_{y,z} Ag(x, Trans(L(x, y), L(x, z)) \wedge L(s, y) \wedge (x \in\ Hum)$].

(112) x UDAŁ SIĘ tam : $\bigvee\limits_{y,z} Ag(x, \, Trans(L(x, \, y), \, L(x, \, z)) \wedge \neg \, L(s, \, z)$
$\wedge \, (x \in \, Hum)$.

[x WENT there : $\bigvee\limits_{y,z} Ag(x, \, Trans(L(x, \, y), \, L(x, \, z)) \wedge \neg \, L(s, \, z) \wedge (x \in$
$Hum)]$.

In the case of the verb *odszedł* the formula refers to the general meaning of 'leaving the place', without specifying the mode of transport (in Polish the verb could also imply walking away). The occasional nature of the expression is emphasised by the reference to the speaker. For the sake of clarity, in the examples chosen for the present analysis $x \in \, Hum$ and is the agent of the action. It would, however, be possible to choose other examples in which x would not be the agent — in such cases the first element of the conjunction would be limited to $Trans(L(x, \, y), \, L(x, \, z))$. The matter has no bearing on the notation of the occasional elements of utterances. Example (112) only provides information in a negative way: *tam* (there) is understood merely as 'not here' with regard to the speaker. This does not, however, seem to be a fault of the formal apparatus: the word *tam* is used either anaphorically, i.e. in relation to a previously mentioned location, or deictically (ostensibly) by extra-linguistic means (i.e. not using any natural language but making a gesture). The forms of communication that go beyond the channel of natural languages cannot be taken into consideration in a work concerned with the semantic interpretation of utterances made in a natural language.

The following section shall contain the analysis of (broadly understood) verbs of movement. It should be noted that auto-agentive verbs (i.e. ones in which the result of the action performed by x affects x themselves) are semantically reflexive irrespective of whether this reflexivity is expressed grammatically or not.

(113) x IDZIE: $\bigvee\limits_{y,z} \bigvee\limits_{i} Ag(x, \, Trans(L(x, \, y), \, L(x, \, z))) \wedge P_i(x) \wedge (x \in$
$Anim)$.

[x WALKS: $\bigvee\limits_{y,z} \bigvee\limits_{i} Ag(x, \, Trans(L(x, \, y), \, L(x, \, z))) \wedge P_i(x) \wedge (x \in \, Anim)]$.

In this case the state P_i signifies that the movement is made on foot and in a given fashion: the verb *iść* needs to be distinguished from *biec* (to run), *pływać* (to swim), *skakać* (to jump), *czołgać się* (to crawl), *pełzać* (to slither), *lecieć* (to fly; in relation to birds), etc. It is a closer equivalent to the English verb 'to walk' that 'to go', the meaning of which is often more similar to that of *udawać się (do)*, with the mode of transport specified only by the context.

The environment in which movement occurs (the ground, water,

air) may be indicated by defining the state of x. This method does not necessitate any emendation in the conceptual apparatus adopted in the present analysis. In future research it will be possible to indicate a given situation by introducing fixed (i.e. not variable) subscripts and superscripts to be added to P (as in the case of the relations discussed in the introduction).

Verbs such as *pchać* (to push), *przesuwać* (to shift), *przenosić* (to move — referring to a physical object) may be represented as:

(114) x PRZESUWA $y : \bigvee\limits_{w}, z \ Ag(x, \ Trans(L(y, \ w), \ L(y, \ z)))$.

[x MOVES $y : \bigvee\limits_{w}, z \ Ag(x, \ Trans(L(y, \ w), \ L(y, \ z)))$.]

Verbs such as *przepędzać*, *przeganiać* (both mean: to drive, e.g. cattle) can be represented as:

(115) x PRZEPĘDZA $y : \bigvee\limits_{w,z} Ag(x, \ Ag(y, \ Trans(L(y, \ w), \ L(y, \ z)))) \wedge (x \in Anim) \wedge (y \in Anim)$.

[x DRIVES $y : \bigvee\limits_{w,z} Ag(x, \ Ag(y, \ Trans(L(y, \ w), \ L(y, \ z)))) \wedge (x \in Anim) \wedge (y \in Anim)$].

Interpretation: x acts so that y moves in an auto-agentive manner. Naturally, if the *definiendum* of (114) or (115) contains locative elements w and/or z, they should not be bound to any quantifiers in the *definiens*.

The Polish verb *zapędzać* (to drive into) semantically requires the destination to be specified (in non-metaphorical uses; metaphorical ones may be less precise, e.g. *zapędzać do roboty* — to drive to work, to force to work). This need is usually reflected in the surface structure, with the exception of situations in which the destination is clear from the context. The use of the verb *odpędzać* (to drive off) suggests a movement away from the speaker, if the 'starting point' is not specified explicitly (similarly to *opędzać się od...*, which clearly signifies 'to drive something away from oneself').

(116) x ODPĘDZA $y : \bigvee\limits_{w}, z \ L(x, \ w) \wedge Ag(x, \ Ag(y, \ Trans(L(y, \ w), \ L(y, \ z)))) \wedge (x \in Anim) \wedge (y \in Anim)$.

[x DRIVES y off $: \bigvee\limits_{w}, z \ L(x, \ w) \wedge Ag(x, \ Ag(y, \ Trans(L(y, \ w), \ L(y, \ z)))) \wedge (x \in Anim) \wedge (y \in Anim)$.]

(117) x ODPĘDZA y od $u : \bigvee\limits_{w,z} L(u, \ w) \wedge Ag(x, \ Ag(y, \ Trans(L(y, \ w), \ L(y, \ z)))) \wedge (x \in Anim) \wedge (y \in Anim)$.

[x DRIVES y off $u : \bigvee\limits_{w,z} L(u, \ w) \wedge Ag(x, \ Ag(y, \ Trans(L(y, \ w), \ L(y, \ z)))) \wedge (x \in Anim) \wedge (y \in Anim)$.]

The latter two formulas could possibly be simplified to:

(118) x ODPĘDZA (od siebie) $y : \bigvee_{z} Ag(x, Ag(y, Trans(L(y, x), L(y, z)))) \wedge (x \in Anim) \wedge (y \in Anim)$.

[x DRIVES y (away from oneself) $: \bigvee_{z} Ag(x, Ag(y, Trans(L(y, x), L(y, z)))) \wedge (x \in Anim) \wedge (y \in Anim)$.]

(119) x ODPĘDZA y od $u : \bigvee_{w}: Ag(x, Ag(y, Trans(L(y, u), L(y, w)))) \wedge (x \in Anim) \wedge (y \in Anim)$.

[x DRIVES y off $u : \bigvee_{w}: Ag(x, Ag(y, Trans(L(y, u), L(y, w)))) \wedge (x \in Anim) \wedge (y \in Anim)$.]

In the English language the 'starting point' may be specified with other means; the best equivalent for *odpędzać* is 'to drive off', which is based on different grammatical mechanisms, but very close with regard to meaning.

The verb *jechać* presents a different set of problems. It signifies transportation on the back of an animal or by means of a vehicle — and does not have a direct equivalent e.g. in the English language. In its basic meaning, *jechać* is associated with travelling by land, but its reduced meaning does not entail such a limitation, especially if it appears with prefixation — *pojechać, wyjechać, przyjechać*. In such cases it may also signify flying by plane or travelling by boat.

The interpretation of *jechać* is made even more complicated by the fact that (contrarily to English verbs, which are more specialised in their meaning) it may describe many different situations. It may be used to signify travelling with or without being in control of the means of transport (the English equivalents for the former case are: 'to drive' and 'to ride'). What is more, in the latter case the object may not be aware of being transported (e.g. if the sentence pertains to goods or infants) or travel of their own volition (at least in the direct sense; indirectly, a person may travel e.g. as a result of their employer's request). In the Polish language the mentioned differences are not reflected in the structure of the sentence — as the same verb *jechać* is used for all cases — the present analysis will provide varying interpretations of the verb to mirror the semantic differences of other languages.

(120) x JEDZIE^{1a} $: \bigvee_{u} \bigvee_{i} \bigvee_{y} \bigvee_{w,z} Ag(u, R^1_i(x, y)) \wedge T(Trans(L(x, w), L(x, z)), Trans(L(y, w), L(y, z))) \wedge ((y \in Anim_{transport}) \vee (y \in Vehicle))$,

[x IS TRANSPORTED$: \bigvee_{u} \bigvee_{i} \bigvee_{y} \bigvee_{w,z} Ag(u, R^1_i(x, y)) \wedge T(Trans(L(x, w), L(x, z)), Trans(L(y, w), L(y, z))) \wedge ((y \in Anim_{transport}) \vee (y \in Vehicle))$,]

where R^1_i represents the specific relation of being transported, the categorisations of y are obvious in the light of the above discussion, and the second element of the conjugation in the *definiens* specifies that the

movement of x is simultaneous with the movement of y and proceeds from the same point in space to the same location.

(121) x JEDZIE^{1b} : $\bigvee\limits_{i} \bigvee\limits_{y} \bigvee\limits_{w,z} z\, Ag(x, R_i^1(x, y)) \wedge T(Trans(L(x, w), L(x, z)), Trans(L(y, w), L(y, z))) \wedge ((y \in Anim_{transport}) \vee (y \in Vehicle))$,

[x IS TRANSPORTED OF THEIR OWN VOLITION: $\bigvee\limits_{i} \bigvee\limits_{y} \bigvee\limits_{w,z} Ag(x, R_i^1(x, y)) \wedge T(Trans(L(x, w), L(x, z)), Trans(L(y, w), L(y, z))) \wedge ((y \in Anim_{transport}) \vee (y \in Vehicle))$,]

The difference between (120) and (121) consists in the fact that in the latter case x is the agent in the first part of the conjugation in the *definiens*, which makes the introduction of the bound variable u redundant.

(122) x JEDZIE^2 : $\bigvee\limits_{i} \bigvee\limits_{y} \bigvee\limits_{w,z} Ag(x, R_i^1(x, y)) \wedge Ag(x, Trans(L(y, w), L(y, z)) \wedge T(Trans(L(x, w), L(x, z)), Trans(L(y, w), L(y, z))) \wedge ((y \in Anim_{transport}) \vee (y \in Vehicle))$.

[x DRIVES/RIDES : $\bigvee\limits_{i} \bigvee\limits_{y} \bigvee\limits_{w,z} Ag(x, R_i^1(x, y)) \wedge Ag(x, Trans(L(y, w), L(y, z)) \wedge T(Trans(L(x, w), L(x, z)), Trans(L(y, w), L(y, z))) \wedge ((y \in Anim_{transport}) \vee (y \in Vehicle))$].

This formula has an additional element in its conjunction (the second part), which specifies that x is causing the movement of y.

As regards the relation $R_i^1(x, y)$ appearing in formulas (120) — (122), an additional stipulation may be introduced, specifying that:

(123) $R_i^1(x, y) \to L(x, y)$,

yet this does not appear necessary; in future studies the relation appearing in the above formulas may probably be introduced as a constant.

The verbs *płynąć* and *lecieć* also have varied meanings. The cases when the verbs signify 'to go by boat' and 'to go by air' and pertain to objects transported by or in control of the respective modes of transport, require a different categorisation of y and the introduction of the predicate P_j, which specifies the state of y (which may be located in a gaseous or a liquid environment, or in outer space). When the verbs *płynąć* and *lecieć* pertain to creatures that are flying or swimming (e.g. fish, birds, insects), their interpretation needs to include the appropriate categorisation of x, an indication that the movement is auto-agentive (cf. the first element of the conjunction in (113)) and the appropriate indication of the state of x (being in water or in air). The formal notation of these verbs is not presented in the analysis, as it can be easily extrapolated.

Verbs such as *opadać*, *wznosić się* etc. ('to descend' and 'to ascend' respectively, in the motional sense) can be interpreted in two differing ways:

agentive and non-agentive. The corresponding formulas would be as follows:

(124) $x \text{ OPADA}^1 : \bigvee_i \bigvee_y \bigvee_z Ag(x, \textit{Trans}(L(x, y), L(x, z))) \wedge R_i^1(x, \text{z});$

[$x \text{ DESCENDS}^1 : \bigvee_i \bigvee_y \bigvee_z Ag(x, \textit{Trans}(L(x, y), L(x, z))) \wedge R_i^1(x, \text{z})$];

(125) $x \text{ OPADA}^2 : \bigvee_i \bigvee_y \bigvee_z \textit{Trans}(L(x, y), L(x, z)) \wedge R_i^1(y, \text{z});$

[$x \text{ DESCENDS}^2 : \bigvee_i \bigvee_y \bigvee_z \textit{Trans}(L(x, y), L(x, z)) \wedge R_i^1(y, \text{z})$].

The verb *opadać* is slightly more problematic in its semi-metaphorical uses, e.g. in the sentence *droga opada* (the road descends). The verb is not used figuratively, like in such sentences as *zapał opada* (enthusiasm diminishes), because the object is physical, yet expressions such as *droga opada* are rather imprecise. The suggested formal representation is as follows:

(126) $x \text{ OPADA}^3 : \bigvee_{x_1,x_2 \subset^0 x} \bigvee_i \bigvee_{y,z} L(x_1, y) \wedge L(x_2, z) \wedge R_i^1(y, \text{z}) \wedge (x \in$

Linear).

[$x \text{ DESCENDS}^3 : \bigvee_{x_1,x_2 \subset^0 x} \bigvee_i \bigvee_{y,z}, L(x_1, y) \wedge L(x_2, z) \wedge R_i^1(y, \text{z}) \wedge (x \in$

Linear)].

Interpretation: there exist certain sections of a road (a linear object) located at different points in space and a specific relation exists between the said sections. In the case of (124) — (126) R_i^1 represents the relation of being located higher. In the case of the verb *wznosić się* (to ascend), the notation will be analogous, but R_i^1 will stand for the opposite type of relation (i.e. being located lower). It appears that the verb *spadać* (to fall) may only be interpreted in a non-agentive manner, i.e. using formula (125).

Other verbs signifying movement greatly differ in interpretation, owing to the many dissimilarities between them. Such verbs often require adding a specific (often very complex) location — the apparatus used in the present analysis should suffice to represent them in formal notation. In many cases analysis would require the interpretation of not only the verb itself, but also of the locative components.

The group of verbs signifying the movement of a liquid may also be described relatively easily, by introducing a proper categorisation such as $x \in$ *Liquid*. Some problems may arise in connection with colloquial semi-metaphorical uses such as *rzeka płynie* (the river flows), as, technically speaking, it is not the river that flows, but the water in it. However, even such problems may be overcome using the apparatus of the present work (a similar — though not entirely equivalent — problematic issue was discussed in connection with (126)).

Verbs indicating the transition from one state to another, such as

blednąć, *blednieć* (both meaning: to pale), *zielenieć* (to become green), *czerwienieć* (to redden), *stygnąć* (to cool down), *topnieć* (to melt), *rosnąć* (to grow), *kurczyć się* (to shrink), etc., not understood as a transition from a standard to a non-standard state (cf. *gnić*, *pleśnieć*, *płowieć*, etc.), may be divided into two categories. The first one includes verbs that indicate a new state without providing information on the previous state (e.g. *czerwienieć*, *zielenieć*). Such verbs may be interpreted as follows:

(127) x ZIELENIEJE : $\bigvee_{i} Trans(\neg\, P_i(x),\, P_i(x)) \wedge (i \in\ Colour)$,

[x BECOMES GREEN : $\bigvee_{i} Trans(\neg\, P_i(x),\, P_i(x)) \wedge (i \in\ Colour)$,]

where i represents the state and is appropriately categorised.

The latter category contains verbs that give some indication of the previous state as well as the new one and specify the relation between the two states. These can be interpreted as:

(128) x STYGNIE : $\bigvee_{i,j} \bigvee_{z,z'}\ Trans(P_i(x),\, P_j(x)) \wedge M(s,\, P_i(x),\, z) \wedge M(s,$ $P_j(x),\, z') \wedge (z < z') \wedge (z,\, z' \in\ Temp)$.

[x COOLS DOWN : $\bigvee_{i,j} \bigvee_{z,z'}\ Trans(P_i(x),\, P_j(x)) \wedge M(s,\, P_i(x),\, z) \wedge M(s,$ $P_j(x),\, z') \wedge (z < z') \wedge (z,\, z' \in\ Temp)$].

Interpretation: x undergoes a transition from a specific state to another, and the specified measure (in this case: temperature) of the new state is lower than that of the previous state. The verb *rosnąć* (meaning: 'to grow', 'to become larger') could be represented using a very similar formula, in which the measure of the previous state would be smaller than that of the new state, and the measure would be categorised differently (as e.g. *height*, *size*, etc.).

The verb *topnieć* (to melt) is a separate case. It resembles the latter category, but signifies a change in the state of matter; it is also the case with *zamarzać* (to freeze) and *parować* (to evaporate; the other meaning of the verb *parować* — to steam-boil — shall not be discussed in the present analysis). The change in the state of matter is, of course, related to the change in temperature, yet this fact is not explicitly conveyed by the verbs (it belongs to our extra-linguistic knowledge). Such verbs may be represented using the following general formula:

(129) $\bigvee_{i,j}\ Trans(P_i(x),\, P_j(x)) \wedge (i,\, j \in\ State)$,

Where *State* stands for the general category of the state of matter; for each verb the category may be specified further, e.g. as *Solid*, *Liquid*, *Gas*, etc.).

Very rarely verbs may also refer to the subjective feeling of transition

from one state to another; the feeling may or may not be rooted in a factual transition — the verb itself gives no indication thereof. Presumably, such verbs may only belong to the latter of the two groups discussed above. The category may be exemplified by the verb *marznąć* (to become cold):

(130) x MARZNIE $: \bigvee_{i,j} \bigvee_{z,z'} Exp(x,\ Trans(P_i(x),\ P_j(x))) \wedge M(x,\ P_i(x),\ z)$
$\wedge\ M(x,\ P_j(x),\ z') \wedge Exp(x,\ z' < z)) \wedge (z,\ z' \in\ Temp)$.

The same verb may also be interpreted as: x feels that they are cold. In this case the correct formula would be:

(131) $\quad x$ MARZNIE $: \bigvee_i \bigvee_z Exp(x,\ P_i(x)) \wedge M(x,\ P_i(x),\ z) \wedge Exp(x,$
$small(z)) \wedge (z \in\ Temp)$.

It is now time to discuss the issues related to describing the most problematic group of verbs, namely the ones referring to psychological states and modality.

Some similarities may be found between such verbs and the already discussed verbs related to experiencing. Let us reiterate the statement that to indicate that x is experiencing certain sensations consciously, the following formula may be used:

(132) $\quad x$ *świadomie* V_{sens}(że) $y : Exp(x,\ Exp(x,\ y))$.
[x *consciously* V_{sens}(that) $y : Exp(x,\ Exp(x,\ y))$].

However, the above formula will not be used throughout the present analysis, because on the linguistic level the verbs signifying the experiencing of emotional states do not explicitly state whether the sensation is experienced consciously, subconsciously or involuntarily.

Verbs designating emotional states may be represented by one of the two general formulas:

(133) $\quad x\ V_{+em}\ y : \bigvee_z V(x,\ R_2^1(x,\ y) \vee R_3^1(x,\ y) \vee R_4^1(x,\ y),\ z) \wedge (z > 0)$;

(134) $\quad x\ V_{-em}\ y : \bigvee_z V(x,\ R_2^1(x,\ y) \vee R_3^1(x,\ y) \vee R_4^1(x,\ y),\ z) \wedge (z < 0)$.

The only difference between these two is that (133) pertains to positive emotional states (i.e. ones evaluated positively by the person experiencing them), whereas (134) refers to negative emotional states. The difference is indicated by the use of '+' and '-' signs in the subscripts (in the *definiendum*) and the specification that z is either less than or more than zero (in the *definiens*).

Each emotional state is considered from the point of view of the person experiencing it — i.e. from the perspective of x. The relations corresponding to such states and delineated by specific verbs may be symmetrical — which

is dependent on the second argument, namely *y*. In some categories symmetry can never occur — irrespective of whether the verb designates an emotional state or a sensation; cf. *Jan widzi dom* (Jan sees a house), *Jan lubi grochówkę* (Jan likes bean soup). In other cases the relation may be symmetrical: *Jan widzi Marię* (Jan sees Maria), *Jan lubi Marię* (Jan likes Maria); yet symmetry is never assumed necessary. Moreover, the symmetry of relations is rarely (if at all) conveyed by the verb itself. For this reason, the formal notation invariably presents the verbs through the prism of *x*.

The idea behind such an interpretation is that *x* may ascribe a positive or a negative value to their contacts with *y*; the contact may be physical/sensual, notional, or social. Examples of the first category include e.g. liking some kind of food or some fabric used for clothing or decoration; the second category is exemplified by sentences referring to feelings towards imaginary characters, e.g. from a book; the third type of contact is described in sentences referring to feelings towards specific people. It must be noted that the value is connected to *x*'s personal attitude towards a given object/person. This reservation is particularly significant in the case of the third type of contact: we may esteem a person, but dislike them (or *vice versa*). In such a case we would ascribe a positive value to the character features of a given person, but not to our personal contacts with this person.

(135) x CENI $y : \bigvee_i \bigvee_z V(x, P_i(y), z) \land (z > 0) \land (i \in Eth \cup Int \cup Prof \cup Econ)$.

[x ESTEEMS $y : \bigvee_i \bigvee_z V(x, P_i(y), z) \land (z > 0) \land (i \in Eth \cup Int \cup Prof \cup Econ)$].

Interpretation: *x* ascribes a positive value to a certain feature (state) of *y*, and the features (states) in question are ethical, intellectual, professional or economical in nature.

The details of this interpretation may be altered in the course of future studies. One issue worth considering is whether social contact does not always imply some sort of physical contact (it may be so). Reducing purely notional contact to the realm of the senses would be more difficult, but even this could be achieved with the help of some theoretical assumptions. The categorisation of the subscript *i* included in the above formula shall perhaps be altered as well.

Cases where reciprocity is explicitly stated could be represented as:

(136) x i y $V_{+em} wzajemnie : \bigvee_{w,z} V(x, R_4^1(x, y), w) \land V(y, R_4^1(y, x), z) \land (w > 0) \land (z > 0)$.

$[x$ and y $V_{+em} reciprocally : \bigvee_{w,z}, V(x, R_4^1(x, y), w) \wedge V(y, R_4^1(y, x), z)$
$\wedge (w > 0) \wedge (z > 0)]$.

In this case the choice is limited to social contacts, since the definition of the relation R_4^1 allows for symmetry (it is a matter of the assumed convention, which practically eliminates the possibility for symmetry in the case of the relation R_2^1 interpreted narrowly as sensual contact experienced by one side only). As noted above, the accuracy of the formal measures adopted in the analysis is a matter for discussion. In the Polish language such cases are expressed with a reflexive form of the verb such as *Jan i Maria lubią się* — there is no need to add the adverb *wzajemnie* (meaning: 'reciprocally'); in the English language more explicit forms such as *John and Mary like each other* are used. Verbs conveying negative emotional value could be represented using a formula very similar to (136), in which the values of w and z would be specified as less than zero. If both w and z are either greater or less than zero, comparing the two values does not seem necessary, since the verbs in the category under analysis do not imply that the emotional state experienced by both parties is of equal intensity.

Verbs expressing opinions in a general fashion, e.g. *sądzić, że...* (to suppose that), *przypuszczać, że...* (to assume that), *myśleć, że...* (to think that), etc. may be represented using the following basic formula (the verb *myśleć* signifying 'to muse' in sentences that do not specify the subject of consideration, e.g. *Jan myśli*, will be discussed below):

(137) x SĄDZI (że) y: $B(x, y)$,
        $[x$ SUPPOSES (that) y: $B(x, y)]$.

The formula does not set any limitations regarding the time difference between the moment in which a given supposition is made and the time of the occurrence specified in y; it is understandable that opinions may pertain to occurrences that (allegedly) took place before the supposition was experienced, at the same time or even after. As we shall soon demonstrate, the statement is not true for all verbs.

(138) x WIE, że $y : \bigvee_{t,t'}, B_t(x, y_{t'}) \wedge y_{t'} \wedge (t' \leqslant t)$.
        $[x$ KNOWS that $y : \bigvee_{t,t'}, B_t(x, y_{t'}) \wedge y_{t'} \wedge (t' \leqslant t)]$.

The present analysis focuses on a rather strong understanding of the verb *wiedzieć, że...* (to know that), which is consistent with the intuitive perception of the verb (even though one may sometimes encounter weaker definitions which do not entail the veracity of the subject of knowledge). Thus, it must be assumed that a person's knowledge cannot pertain to subsequent occurrences. Such events can be predicted with a very high

degree of probability; they can be conjectured, but not known about (the only exception, discussed below, is virtual rather than factual). This is the reason for introducing a temporal reservation as the final element of the conjunction in the *definiens* of (138).

The mentioned exception pertains to expressions such as *Kowalski wie, że jutro jest sobota* (Kowalski knows that tomorrow is Saturday), *Kowalski wie, że pojutrze będzie zaćmienie słońca* (Kowalski knows that a solar eclipse will occur the day after tomorrow), etc. If such statements are true, i.e. if on Friday Kowalski is aware that the next day will be Saturday, or if Kowalski has been informed that a specific astronomical phenomenon will occur in two days, the sentences may indeed appear to be exceptions from the rule specified in (138). The exceptions are only virtual, since Kowalski's knowledge stems from previously acquired familiarity with certain conventions (the calendar in the first example) or laws of nature (as in the second example). Thus, such situations may be represented in the form of the following principle:

(139)　$(B_t(x, y_{t'})\ y_{t'} \wedge (t' > t)) \rightarrow \bigvee\limits_{t'' \leqslant t} \bigvee\limits_{z} (B_t(x, z_{t''}) \wedge z_{t''} \wedge B_t(x, z_{t''} \rightarrow$

$y_{t'}) \wedge (z_{t''} \rightarrow y_{t'}))$.

Interpretation: If x knows that a certain future event will occur, then x knows that this future occurrence results from another occurrence which is not subsequent to the time when x knows about the future occurrence.

Since formula (139) contains the expression that could be abbreviated to 'knows that' (it appears twice to the right side of the main implication symbol), the antecedent of the implication can be abbreviated to:

(140)　$\bigvee\limits_{t'' \leqslant t} \bigvee\limits_{z}(know^1_t(x, z_{t''}) \wedge z_{t''} \wedge know^1_t (x, z_{t''} \rightarrow y_{t'}) \wedge (z_{t''} \rightarrow y_{t'}))$.

The same — somewhat intuitive — method will be used further on to shorten the formal notation which may prove too lengthy and, as a result, difficult to read. Moreover, it shall be assumed that $know^1$ represents 'to know that...', whereas $know^2$ stands for 'to know whether' (see: below).

(141)　x MYLI SIĘ (sądząc) że y: $\bigvee\limits_{t,t'} B_t(x, y_{t'}) \wedge \neg\ y_{t'} \wedge (t' \leqslant t)$.

[x IS WRONG (in supposing) that y: $\bigvee\limits_{t,t'} B_t(x, y_{t'}) \wedge \neg\ y_{t'} \wedge (t' \leqslant t)$].

The conditions for relative chronology are the same as in the case of (138).

(142)　x NIE WIE, że y : $\bigvee\limits_{t,t'} \neg\ B_t(x, y_{t'}) \wedge y_{t'} \wedge (t' \leqslant t)$.

[x DOES NOT KNOW that y : $\bigvee\limits_{t,t'} \neg\ B_t(x, y_{t'}) \wedge y_{t'} \wedge (t' \leqslant t)$.]

As seen from the above formula, *nie wiedzieć, że...* (to not know that...) is simply the negation of *wiedzieć, że...*; comparing the *definiens* of (138)

and (142) we see that only the first element of the conjunction is negated. The formula is thus consistent with the general assumptions of the present work: both *Kowalski wie, że jego żona jest chora* (Kowalski knows that his wife is ill) and *Kowalski nie wie, że jego żona jest chora* (Kowalski does not know that his wife is ill) implies that Kowalski's wife is not well. This fact is reflected in (138) and (142), as in both cases $y_{t'}$ is presented as a true statement. This differentiates the two formulas from (141), in which only $y_{t'}$ is negated (i.e. $y_{t'}$ is interpreted as false).

(143) x WIE czy $y : \bigvee_{t,t'} ((B_t(x, y_{t'}) \wedge y_{t'}) \vee (B_t(x, \neg y_{t'}) \wedge \neg y_{t'})) \wedge$ $(t' \leqslant t)$.

[x KNOWS whether $y : \bigvee_{t,t'} ((B_t(x, y_{t'}) \wedge y_{t'}) \vee (B_t(x, \neg y_{t'}) \wedge \neg y_{t'}))$ $\wedge (t' \leqslant t)$].

Interpretation: x knows that $y_{t'}$ or x knows that $\neg y_{t'}$. The formula lacks information regarding the actual situation: it is not known whether it is $y_{t'}$ or $\neg y_{t'}$ that is true.

(144) x NIE WIE, czy $y : \bigvee_{t,t'} \neg B_t(x, y_{t'}) \wedge \neg B_t(x, \neg y_{t'}) \wedge (t' \leqslant t)$.

[x DOES NOT KNOW whether $y : \bigvee_{t,t'} \neg B_t(x, y_{t'}) \wedge \neg B_t(x, \neg y_{t'}) \wedge (t' \leqslant t)$.]

There are two issues which must be discussed in connection with the above formulas. The first of them is related to the difference between *wiedzieć, że...* (to know that) and *wiedzieć, czy...* (to know whether). The formal notations for these expressions seem much more dissimilar than the phrases suggest. The expression 'x knows whether y' signifies: 'x knows that y or x knows that $\neg y$', whereas 'x does not know whether y' means: 'x does not presume that y and x does not presume that $\neg y$'. None of these expressions indicate what the factual situation might be. Secondly, it must be noted that 'x does not know whether y' goes beyond a simple negation of (143), just as (142) is not a simple negation of (138). A reference to (133) and (134) demonstrates that 'x does not like y' is not a mere negation of 'x likes y': the first of the two expressions is represented by formula (134), the second — by formula (133). The only difference between (133) and (134) appears in the last element of the conjunction (the value of z is either positive or negative).

The verb *informować* (to inform) and all other verbs that signify the conveying of information (by a human being or an information device) may be represented simply as:

(145) x INFORMUJE, że $y : S(x, y)$,

[x INFORMS that y : $S(x, y)$].

The recipient of the information is entirely insignificant, as is the matter of the veracity of the information conveyed and the temporal relation between the moment of informing and the time to which the piece of data pertains. In the case of information devices that are not associated with having any beliefs, more specific formulas are as follows:

(146) x TRAFNIE INFORMUJE, że y : $\bigvee_{t,t'} S_t(x, y_{t'}) \wedge y_{t'} \wedge (t' \leqslant t)$;

[x ACCURATELY INFORMS that y : $\bigvee_{t,t'}, S_t(x, y_{t'}) \wedge y_{t'} \wedge (t' \leqslant t)$];

(147) x MYLNIE INFORMUJE, że y : $\bigvee_{t,t'}, S_t(x, y_{t'}) \wedge \neg y_{t'} \wedge (t' \leqslant t)$.

[x ERRONEOUSLY INFORMS that y : $\bigvee_{t,t'}, S_t(x, y_{t'}) \wedge \neg y_{t'} \wedge (t' \leqslant t)$].

X is not categorised as an information device, since the same expressions could pertain to human beings, if the utterance focuses on the accuracy or inaccuracy of the statement, and not on the issue of intentions.

In the opposite case the formulas are as follows:

(148) x w dobrej wierze INFORMUJE, że y : $S(x, y) \wedge B(x, y)$;

[x in good faith INFORMS that y : $S(x, y) \wedge B(x, y)$];

(149) x w złej wierze INFORMUJE, że y : $S(x, y) \wedge B(x, \neg y)$.

[x in bad faith INFORMS that y : $S(x, y) \wedge B(x, \neg y)$].

In these two cases it is the issue of veracity that is disregarded, as the message focuses on the speaker's intentions.

By combining the two approaches and taking both the veracity and the speaker's intention into account, we arrive at four possible situations, presented — for the time being — only as the notation for the right side of the formula (the *definiens*):

(150) $\bigvee_{t,t'} (t' \leqslant t) \wedge S_t(x, y_{t'}) \wedge B_t(x, y_{t'}) \wedge y_{t'}$;

(151) $\bigvee_{t,t'} (t' \leqslant t) \wedge S_t(x, y_{t'}) \wedge B_t(x, y_{t'}) \wedge \neg y_{t'}$;

(152) $\bigvee_{t,t'} (t' \leqslant t) \wedge S_t(x, y_{t'}) \wedge B_t(x, \neg y_{t'}) \wedge y_{t'}$;

(153) $\bigvee_{t,t'} (t' \leqslant t) \wedge S_t(x, y_{t'}) \wedge B_t(x, \neg y_{t'}) \wedge \neg y_{t'}$;

If we disregard the order of the elements — which is of no consequence given the commutative property of conjunctions — formula (150) may be interpreted as: 'x knows that y and x informs that y'; (151) is equivalent to: 'x in good faith erroneously informs that y'; (152) represents: 'x knows that $\neg y$ and in bad faith informs that y'. Formula (153) conveys the most complicated message: 'x accurately informs that y, but acts in bad faith, as

x is convinced that $\neg\ y$'. It appears that all cases of conveying information in bad faith may be considered as lying, thus:

(154) x KŁAMIE, że $y : S(x,\ y) \wedge B(x,\ \neg\ y)$,
     [x LIES that $y : S(x,\ y) \wedge B(x,\ \neg\ y)$],

would not be dependent on the veracity of the piece of information. The formula would also apply to cases in which the piece of information pertains to future events, which cannot be measured in terms of veracity. The general formula for 'x *kłamie*' (x is lying) would be:

(155) x KŁAMIE $: \bigvee_y S(x,\ y) \wedge B(x,\ \neg\ y)$,

     [x LIES $: \bigvee_y S(x,\ y) \wedge B(x,\ \neg\ y)$].

We shall, for the time being, disregard the issue of how the information was understood. It will be discussed in a later section of the present article, yet it does not seem significant for the analysis of the verb *kłamać* (to lie), if we assume that the verb indicates a discrepancy between the content of the message and the beliefs of the speaker. What seems more problematic is the source of the knowledge that x informs that y while being convinced that $\neg\ y$; all information on the beliefs and convictions of other people is indirect by nature and based on more or less justified suppositions. Thus, the situation described in (155) would pertain e.g. to the events of a novel, if we assume the convention of the author's omniscience (with regard to the work). In factual (and not notional) cases the more appropriate formula would be:

(156) x KŁAMIE $: \bigvee_y S(x,\ y) \wedge B(s, B(\ x,\ \neg\ y))$.

[x LIES $: \bigvee_y S(x,\ y) \wedge B(s, B(\ x,\ \neg\ y))$.]

Interpretation: x informs that y and the speaker is convinced that x is convinced that $\neg\ y$.

The verb *udawać, że...* (to pretend that...; not in the sense of play-pretending or acting) conveys a similar meaning, yet there seems to be a fundamental difference between *udawać* and *kłamać*. It does not consist in the fact that pretending is more related to non-verbal behaviour, as such actions may, in certain contexts, have a significant informative value (and, as noted above, the functor S does not pertain solely to verbal communication; for this reason the medium for conveying information is not categorised in the formulas presented, at least for the time being). The most important difference is that pretending always pertains to matters in some way related to the person pretending. Thus, the verb may be represented as:

(157) x udaje, że $y : (y = y(x)) \wedge S(x,\ y) \wedge B(s,\ B(x,\ \neg\ y))$.

[x is pretending that $y : (y = y(x)) \land S(x, y) \land B(s, B(x, \neg\, y))$.]

It must be emphasised that in this case veracity is of no importance: a person may pretend to be ill and be convinced that they are well, while in fact being ill and not knowing about it. (For more on *kłamać* and *udawać* see below).

The verb *grać* (to act; in the theatrical sense) is seemingly similar in meaning to *udawać*, yet a more detailed semantic analysis demonstrates, that the resemblance is very superficial. The matter shall be discussed in a later section of the work.

The verb *myśleć* (to think) poses many difficulties, mostly due to the fact that it is rather elusive to define, especially in the sense of 'consciously experiencing certain cerebral processes' rather than 'having an opinion' (i.e. thinking that...). If we interpret thinking as conveying a message to oneself and receiving it, the verb *myśleć* may be represented as:

(158) x MYŚLI : $\bigvee\limits_{y} Exp(x, (S(x, y) \land Exp(x, y)))$.

[x THINKS : $\bigvee\limits_{y} Exp(x, (S(x, y) \land Exp(x, y)))$].

The verb *rozumieć* (to understand) has several basic meanings and uses, which differ from the semantic point of view: *rozumieć*[1](to understand the content of semantic information), *rozumieć*[2](to understand a given language), *rozumieć*[3](to understand a problem), *rozumieć*[4](to understand the motives of someone's behaviour). This is not to mean that these four types represent the entire scope of the meaning of the verb *rozumieć*; yet only these types shall be analysed in the present study. The interpretations are as follows (as mentioned, the formulas make use of the previously presented definitions of other verbs, in this case the verb *wiedzieć* — to know):

(159) x ROZUMIE[1] (że) $y : \bigvee\limits_{z}\bigvee\limits_{w} S(z, y) \land R_1^3(w, y) \land R_2^1(x, w) \land$ $know^1(x, R_1^3(w, y))$.

[x UNDERSTANDS[1] (that) $y : \bigvee\limits_{z}\bigvee\limits_{w} S(z, y) \land R_1^3(w, y) \land R_2^1(x, w) \land$ $know^1(x, R_1^3(w, y))$.]

Interpretation: a person is sending a piece of information y through the medium of w, while x receives it and knows that it is the carrier of information y.

(169) x ROZUMIE[2] (język) $L_i : \bigvee\limits_{z}\bigvee\limits_{y}\bigvee\limits_{w} S(z, y) \land R_1^3(w, y) \land (w \in L_i)) \rightarrow$ $(R_2^1\,(x, w) \land know^1(x, R_1^3(w, y)))$.

[x UNDERSTANDS[2] (language) $L_i : \bigvee\limits_{z}\bigvee\limits_{y}\bigvee\limits_{w} S(z, y) \land R_1^3(w, y) \land (w \in L_i)) \rightarrow (R_2^1\,(x, w) \land know^1(x, R_1^3(w, y)))$.]

Interpretation: if a person is sending a piece of information y through the medium of w belonging to language (the system of symbols in the code) L_i then if x perceives w then x knows that it is the carrier of information y.

(161) x ROZUMIE^3 (dlaczego) $y : \bigvee\limits_{z} know^1(x, z) \wedge know^1(x, z \rightarrow y)$.

[x UNDERSTANDS^3 (why) $y : \bigvee\limits_{z} know^1(x, z) \wedge know^1(x, z \rightarrow y)$].

(162) x ROZUMIE^4 (dlaczego) $y : \bigvee\limits_{z} know^1(x, z) \wedge B(x, z \rightarrow y)$.

[x UNDERSTANDS^4 (why) $y : \bigvee\limits_{z} know^1(x, z) \wedge B(x, z \rightarrow y)$].

Both cases refer to explaining a certain phenomenon; the difference is demonstrated by the second element of the conjunction: it seems that in the case of understanding motives for somebody's behaviour it is more accurate to treat this as a belief and not as knowledge.

The verb *rozumieć*^{2} may also be used in a different context, namely one in which x is not a human being but an automaton or an animal that reacts to a command. The symbolic interpretation presented in the *definiens* of (160) cannot be applied to such cases, since x is not likely to have any beliefs (as *know* would imply). Moreover, y needs to be limited to belonging to the set of instructions for *x*. The formula presented below may raise doubts, but appears acceptable, if the theoretical apparatus of the present work is adhered to.

(163) x ROZUMIE$^{2'}$ $y : \bigvee\limits_{z}\bigvee\limits_{y}\bigvee\limits_{w}\bigvee\limits_{i}\bigvee\limits_{j}(S(z, y) \wedge (y \in P_j(x)) \wedge R_1^3(w, y) \wedge$
$(w \in L_i)) \rightarrow (R_2^1(x, w) \wedge Ag(x, y))$.

[x UNDERSTANDS$^{2'}$ $y : \bigvee\limits_{z}\bigvee\limits_{y}\bigvee\limits_{w}\bigvee\limits_{i}\bigvee\limits_{j}(S(z, y) \wedge (y \in P_j(x)) \wedge R_1^3(w, y) \wedge$
$(w \in L_i)) \rightarrow (R_2^1(x, w) \wedge Ag(x, y))$].

Additional limitations (which were not introduced in (160) are placed on y — the information needs to pertain to a certain state of x; when x perceives the carrier of this piece of information (or receives a signal) it acts so that it is in the state delineated by y, i.e. behaves as instructed.

The concept of understanding is closely related to that of communication. In the present work, the corresponding situations are illustrated in a slightly different manner. It might be assumed that the verb *rozumieć* has yet another basic meaning: *rozumieć*^{5}*kogoś* (to understand someone) — to understand the piece of information sent that someone. The nuances of meaning are reflected in the surface structure: in the case of 'x *rozumie*^{5} y', what needs to stand for y is a name (of the sender of the information) and not a sentence (the message conveyed). For maximum clarity, the *definiendum* in the four formulas presented below appears in the passive voice, in order to distinguish these cases from the previously discussed meanings.

(164) x JEST ROZUMIANY przez y : $\bigvee\limits_{z}\bigvee\limits_{w} S(x, z) \wedge R_1^3(w, z) \wedge R_2^1(y, w)$ $\wedge\ know^1(y, R_1^3(w, z)))$.

[x IS UNDERSTOOD by y : $\bigvee\limits_{z}\bigvee\limits_{w} S(x, z) \wedge R_1^3(w, z) \wedge R_2^1(y, w) \wedge know^1(y, R_1^3(w, z)))$].

The differences between this formula and (159) are limited to the dissimilar categorisation of the variables x, y, z

(165) x NIE JEST ROZUMIANY przez y : $\bigvee\limits_{z}\bigvee\limits_{w} S(x, z) \wedge R_1^3(w, z) \wedge R_2^1(y, w) \wedge \neg\ know^1(y, R_1^3(w, z)))$.

[x IS NOT UNDERSTOOD by y : $\bigvee\limits_{z}\bigvee\limits_{w} S(x, z) \wedge R_1^3(w, z) \wedge R_2^1(y, w) \wedge \neg\ know^1(y, R_1^3(w, z)))$].

The only difference between the above formula and (164) consists in the negation of the final element of the conjunction in the *definiens*.

(166) x NIE JEST ROZUMIANY przez y z powodu zniekształcenia sygnału: $\bigvee\limits_{z}\bigvee\limits_{w,u} S(x, z) \wedge R_1^3(w, z) \wedge R_2^1(y, u) \wedge (u \neq w) \wedge \neg\ B(y, R_1^3(u, z)))$.

[x IS NOT UNDERSTOOD by y due to the signal being distorted: $\bigvee\limits_{z}\bigvee\limits_{w,u} S(x, z) \wedge R_1^3(w, z) \wedge R_2^1(y, u) \wedge (u \neq w) \wedge \neg\ B(y, R_1^3(u, z)))$].

(167) x JEST ROZUMIANY przez y pomimo zniekształcenia sygnału: $\bigvee\limits_{z}\bigvee\limits_{w,u} S(x, z) \wedge R_1^3(w, z) \wedge R_2^1(y, u) \wedge (u \neq w) \wedge B(y, R_1^3(u, z)))$.

[x IS UNDERSTOOD by y despite the signal being distorted: $\bigvee\limits_{z}\bigvee\limits_{w,u} S(x, z) \wedge R_1^3(w, z) \wedge R_2^1(y, u) \wedge (u \neq w) \wedge B(y, R_1^3(u, z)))$].

The final elements of the *definiens* in formulas (166) and (167) prove even more problematic: we cannot state that y knows that u is carrying information z (in (167)) or that y does not know that u is carrying information z (in (166)), since the definition of the verb 'to know' would imply that it is u that is the carrier of information z, while, in fact, in the moment when the information was generated, it was transmitted by the medium of w. Strictly speaking, u is not carrying the piece of information z (it may be carrying a different message, or not carrying any message at all). Formula (167) represents a case of error correction. The manner in which y arrives at the conclusion that u is a distorted carrier of information z is a problem that shall not be discussed in the present analysis.

The case described in (167) is similar to the circumstances indicated by the use of the verb *domyślać się* (to surmise):

(168) x DOMYŚLA SIĘ (że) y: $\bigvee\limits_{z} know^1(x, z) \wedge B(x, z \rightarrow y)$.

[x SURMISES (that) y: $\bigvee\limits_{z} know^1(x, z) \wedge B(x, z \rightarrow y)$].

This interpretation implies that y — which is the subject of the surmise — does not have to be true, i.e. that one may surmise erroneously. Nevertheless, the situation appears to change when a perfective form in the past tense is used: '*x domyślił się, że y*' signifies 'x guessed that y', which suggests that y is true.

This phrase may be represented as:

(169) x DOMYŚLIŁ SIĘ (że) y: $\bigvee\limits_{z} \bigvee\limits_{t_1,t_2,t_3,t_4} (t_1 < t_4) \wedge know^1{}_{t2}(x, z_{t2}) \wedge$ $B_{t1}(x, z_{t2} \rightarrow y_{t3})\ know^1{}_{t4}(x, z_{t3})$.

[x GUESSED (that) y: $\bigvee\limits_{z} \bigvee\limits_{t_1,t_2,t_3,t_4} (t_1 < t_4) \wedge know^1{}_{t2}(x, z_{t2}) \wedge B_{t1}(x, z_{t2}$ $\rightarrow y_{t3})\ know^1{}_{t4}(x, z_{t3})$].

The veracity of y_{t3} is implied by the final element of the conjunction constituting the *definiens*. The definition of $know^1$ entails that $t_2 \leqslant t_1$ and that $t_3 \leqslant t_4$, yet there is no general method for establishing the temporal relations between t_3 and t_2 or t_2. Significantly, x could have guessed that y on the basis of z believing that z implies a previous occurrence of y or portends the future occurrence of y, etc.

(170) x INFORMUJe y, że z: $\bigvee\limits_{w} S(x, z) \wedge R_1^3(w, z) \wedge Ag\ (x, R_2^1(y, w))$.

[x INFORMS y that z: $\bigvee\limits_{w} S(x, z) \wedge R_1^3(w, z) \wedge Ag\ (x, R_2^1(y, w))$.]

Interpretation: x conveys the message z by means of z and acts so that z reaches y. This interpretation does not imply that y understands the message z.

(171) x OCENIA y : $\bigvee\limits_{z} \bigvee\limits_{i} V(x, P_i(y), z)$.

[x EVALUATES y : $\bigvee\limits_{z} \bigvee\limits_{i} V(x, P_i(y), z)$].

The interpretation of the above formula stems directly from the role of the functor V. If y designates an occurrence and not an object, i.e. is a sentence and not a name, then the formula should take the following form:

(172) x OCENIA y : $\bigvee\limits_{z} V(x, y, z)$.

[x EVALUATES y : $\bigvee\limits_{z} V(x, y, z)$].

(173) x NIE DOCENIA y: $\bigvee\limits_{i} \bigvee\limits_{w,z} V(x, P_i(y), w) \wedge V(s, P_i(y), z) \wedge B(s,$ $(0 < w < z)) \wedge B(s, correct(z))$.

[x UNDERVALUES y: $\bigvee\limits_{i} \bigvee\limits_{w,z} V(x, P_i(y), w) \wedge V(s, P_i(y), z) \wedge B(s, (0$ $< w < z)) \wedge B(s, correct(z))$.]

The verb *nie doceniać* (to undervalue) appears to denote that the speaker believes that x evaluates y positively, but not high enough.

(174) x PRZECENIA $y : \bigvee_i \bigvee_{w,z} V(x,\, P_i(y),\, w) \wedge V(s,\, P_i(y),\, z) \wedge B(s,$
$(w > z)) \wedge B(s,\, correct(z)).$

[x OVERVALUES $y : \bigvee_i \bigvee_{w,z} z\ V(x,\, P_i(y),\, w) \wedge V(s,\, P_i(y),\, z) \wedge B(s,\, (w$
$> z)) \wedge B(s,\, correct(z))$].

In this case the evaluation does not seem to contain any reference to the zero point on the scale.

(175) x DOCENIA $y : \bigvee_i \bigvee_{w,z} V(x,\, P_i(y),\, z) \wedge (z > 0) \wedge B(s,\, correct(z)).$

Formulas (173) — (173) pertain mostly to situations in which one human being is evaluated by another. Utterances such as *Jan nie docenia ewentualnych konsekwencji tego faktu* (Jan underestimates the possible consequences of this fact) or *Jan przecenia znaczenie tego faktu* (Jan overestimates the importance of this fact) are much more difficult to interpret; but possibly easier than *Jan nie docenia grożącego mu niebezpieczeństwa* (Jan underestimates the danger he is in). The problem with interpretation is that such utterances do not simply imply the fact that Jan ascribes a certain value to a given phenomenon. In the case of underestimating danger, Jan may for example deem the unpleasant occurrence to be less probable than it is in the opinion of the speaker. In such a situation Jan ascribes a given measure to a certain probability (which the speaker considers to be too small). The sentence may also be understood as: Jan thinks that his actions will have certain consequences, whereas the speaker is convinced that these actions will have different consequences, ones that Jan (or the speaker, or both) will regard as worse. This example could be interpreted in terms of either values or measures. The above analysis emphasises the importance of context. Depending on the interpretation, the formula would be:

(176) x NIE DOCENIA (groźby) $y : \bigvee_{i,j,m,n} \bigvee_z V(x,\, y,\, z) \wedge (z < 0) \wedge B(x,$
$Prob(y,\, [i,\, j])) \wedge B(s,\, Prob(y,\, [m,\, n])) \wedge (m \geqslant i) \wedge (n > j).$

[x IS UNDERESTIMATING (the threat of) $y : \bigvee_{i,j,m,n} \bigvee_z V(x,\, y,\, z) \wedge (z$
$< 0) \wedge B(x,\, Prob(y,\, [i,\, j])) \wedge B(s,\, Prob(y,\, [m,\, n])) \wedge (m \geqslant i) \wedge (n > j)$].

or

(177) x NIE DOCENIA (groźby) $y : \bigvee_{z_1,z_2} \bigvee_{w_1,w_2} B(x,\, y \to z_1) \wedge B(s,\, y$
$\to z_2) \wedge V(x,\, z_1,\, w_1) \wedge V(s,\, z_2,\, w_2) \wedge (w_1 > w_2) \wedge (w_2 < 0).$

[x IS UNDERESTIMATING (the threat of) $y : \bigvee_{z_1,z_2} \bigvee_{w_1,w_2} B(x,\, y \to z_1) \wedge$
$B(s,\, y \to z_2) \wedge V(x,\, z_1,\, w_1) \wedge V(s,\, z_2,\, w_2) \wedge (w_1 > w_2) \wedge (w_2 < 0)$].

The above interpretations are merely examples; one may easily imagine a situation in which (176) and (177) would occur simultaneously: the

speaker would deem y more probable and more detrimental to x than in x's estimation.

(178) x BOI SIĘ (że) y : $\bigvee\limits_{i,j} \bigvee\limits_{z} B(x,\ Prob(y,\ [i,\ j])) \wedge B(x,\ (j > 0)) \wedge$

$V(x,\ y,\ z) \wedge (z < 0).$

     $[x$ IS AFRAID (that) $y : \bigvee\limits_{i,j} \bigvee\limits_{z} B(x,\ Prob(y,\ [i,\ j])) \wedge B(x,\ (j > 0)) \wedge$

$V(x,\ y,\ z) \wedge (z < 0).]$

Interpretation: x considers occurrence y to be possible and to be disadvantageous to x (i.e. valued negatively).

In many cases $y = y(x)$, which means that the occurrence y pertains to x personally. This is also true for such abbreviated expressions as *Kowalski boi się choroby* (Kowalski is afraid of illness), which is equivalent to: *Kowalski boi się, że zachoruje* (Kowalski is afraid that he will fall ill).

(179) x BOI SIĘ y: $\bigvee\limits_{i,j} \bigvee\limits_{z} B(x,\ Prob(R_2^1\ (x,\ y) \vee R_4^1(x,\ y)),\ [i,\ j]) \wedge B(x,$

$(j < 0)) \wedge V(x,\ R_2^1(x,\ y) \vee R_4^1(x,\ y),\ z) \wedge (z < 0).$

     $[x$ IS AFRAID of y: $\bigvee\limits_{i,j} \bigvee\limits_{z} B(x,\ Prob(R_2^1\ (x,\ y) \vee R_4^1(x,\ y)),\ [i,\ j]) \wedge B(x,\ (j$

$< 0)) \wedge V(x,\ R_2^1(x,\ y) \vee R_4^1(x,\ y),\ z) \wedge (z < 0)].$

Interpretation: x considers their social or physical contact with y to be possible and to be disadvantageous to x (i.e. valued negatively).

Major problems with interpretation also appear in connection with the verb *dziwić się* (to be astonished). The present analysis pertains to cases when y is a sentence, as exemplified in the expressions *dziwić się, że...* (to be astonished that); thus, *dziwić się czemuś* (to be astonished at something) is considered equivalent to *dziwić się, że*. Firstly, the present study contains the assumption that *dziwić się, że...* (to be astonished that) implies *wiedzieć, że...* (to know that); secondly, it considers two different situations in which the expression may be used: (a) when initially x is not taking the possibility of y into account, and (b) when initially x considers y unlikely.

(180) x DZIWI SIĘ (że) y : $Exp(x,\ Trans(\neg\ B(x,\ y),\ know^1(x,\ y))).$

     $[x$ IS ASTONISHED (that) $y : Exp(x,\ Trans(\neg\ B(x,\ y),\ know^1(x,\ y)))].$

(181) x DZIWI SIĘ (że) y : $\bigvee\limits_{i,j} Exp(x,\ Trans(B(x,\ Prob(y,\ [i,\ j])\ \wedge$

$small(j)),\ know^1(x,\ y))).$

     $[x$ IS ASTONISHED (that) $y : \bigvee\limits_{i,j} Exp(x,\ Trans(B(x,\ Prob(y,\ [i,\ j])\ \wedge$

$small(j)),\ know^1(x,\ y)))].$

The above interpretations do not seem entirely satisfactory. Formula (180) is especially wanting, as the same interpretation could be used for the phrase *x dowiaduje się, że y* (x finds out that y). The only possible

counterargument against this allegation is the use of the functor *Exp*, yet even this defence is rather feeble. On the other hand, a more accurate notation would be difficult to devise; the formal interpretation of *dowiadywać się* (to find out that) ought to be more complex, as this verb indicates receiving a specific piece of information (contrarily to *przekonać się* — to become convinced). The following two examples are more convenient to analyse in their perfective forms:

(182) x DOWIEDZIAŁ SIĘ, że $y : \bigvee_{z} \bigvee_{w} S(z, y) \wedge R_1^3(w, y) \wedge R_2^1(x, w) \wedge$ $Exp(x, Trans(\neg B(x, y), know^1(x, y)))$.

[x FOUND OUT that $y : \bigvee_{z} \bigvee_{w} S(z, y) \wedge R_1^3(w, y) \wedge R_2^1(x, w) \wedge Exp(x, Trans(\neg B(x, y), know^1(x, y)))$].

(183) x PRZEKONAŁ SIĘ, że $y : Exp(x, y) \wedge Exp(x, Trans(\neg B(x, y), know^1(x, y)))$.

[x BECAME CONVINCED that $y : Exp(x, y) \wedge Exp(x, Trans(\neg B(x, y), know^1(x, y)))$].

The verbs *pamiętać* (to remember) and *zapomnieć* (to forget) may be interpreted twofold:

(184) x PAMIĘTA, że $y : Trans(know^1(x, y), know^1(x, y))$.

[x REMEMBERS that $y : Trans(know^1(x, y), know^1(x, y))$].

(185) x PAMIĘTA, że $y : Exp(x, Trans(know^1(x, y), know^1(x, y)))$.

[x REMEMBERS that $y : Exp(x, Trans(know^1(x, y), know^1(x, y)))$].

(186) x ZAPOMNIAŁ, że $y : Trans(know^1(x, y), \neg B(x, y))$.

[x FORGOT that $y : Trans(know^1(x, y), \neg B(x, y))$].

(197) x ZAPOMNIAŁ, że $y : Exp(x, \bigvee_{z} Trans(know^1(x, y), \neg B(x, y)))$ $\wedge (z = y)$.

[x FORGOT that $y : Exp(x, \bigvee_{z} Trans(know^1(x, y), \neg B(x, y))) \wedge (z = y)$].

The above interpretations take into account that the processes of remembering or forgetting may be conscious or subconscious. In all four cases y is regarded as a sentence. If y is a name, the verb may be interpreted as follows:

(188) x PAMIĘTA o $y : Exp(x, Trans(R_3^1 (x, y), R_3^1(x, y)))$.

This signifies that x is aware of the lasting mental contact with y (in this case a reference to the functor *Exp* seems mandatory).

As regards *x zapomniał y* (*x* forgot *y*; if *y* is a proper name), the expression may be regarded as an abbreviated form of '*x* forgot to take *y*', which, in turn, signifies: '*x* should have taken *y*, but did not, without the

intention of not taking *y*'. The case is rather complicated and shall not be analysed in the present study.

(189) *x* WOLI, żeby *y* niż żeby *z*: $\bigvee_{u,w} \bigvee_{t,t'} V_t(x, y_{t'}, u) \wedge V_t(x, z_{t'}, u) \wedge$

$(u > w) \wedge (t < t')$.

[*x* PREFERS that *y* than that *z*: $\bigvee_{t,t'} V_t(x, y_{t'}, u) \wedge V_t(x, z_{t'}, u) \wedge (u$

$> w) \wedge (t < t')$].

In the case of the abbreviated form *x woli y niż z* (x prefers y to z), where both *x* and *z* are names, the formula has to be adjusted in the following fashion: *y* and *z* (respectively) need to be substituted with $R_2^1(x, y)$ and $R_2^1(x, z)$, or $R_3^1(x, y)$ and $R_3^1(x, z)$, or $R_4^1(x, y)$ and $R_4^1(x, z)$. The choice of the formula is dependent on the context, i.e. on the type of contact between *x* and *y* and *z*, which, in turn, depends on the types of names represented by *y* and *z*.

(190) *x* CHCE (żeby) *y*: $\bigvee_{t,t'} \bigvee_{i,j} \bigvee_{w,z} B_t(x, Prob(y_{t'}[i, j])) \wedge (j > 0) \wedge V_t(x,$

$y_{t'}, w) \wedge V_t(x, \neg y_{t'}, z) \wedge (w > 0) \wedge (z < 0) \wedge (t < t')$.

[*x* WANTS (that) *y*: $\bigvee_{t,t'} \bigvee_{i,j} \bigvee_{w,z} B_t(x, Prob(y_{t'}[i, j])) \wedge (j > 0) \wedge V_t(x, y_{t'},$

$w) \wedge V_t(x, \neg y_{t'}, z) \wedge (w > 0) \wedge (z < 0) \wedge (t < t')$].

In the case of the abbreviated form *x chce y* (x wants y), where *y* is a name, *y* needs to be substituted with $R_{2,t'}^1(x, y)$ or $R_{4,t'}^1(x, y)$, depending on the type of contact between *x* and *y*. This, in turn, is to some extent dependent on the names represented by *x* and *y*.

(191) *x* CHCIAŁBY (żeby) *y* : $\bigvee_{t,t'} \bigvee_{w,z} V_t(x, y_{t'}, w) \wedge V_t(x, \neg y_{t'}, z) \wedge$

$(w > 0) \wedge (z < 0) \wedge (t < t')$.

[*x* WOULD WANT (that) *y* : $\bigvee_{t,t'} \bigvee_{w,z} V_t(x, y_{t'}, w) \wedge V_t(x, \neg y_{t'}, z) \wedge (w >$

$0) \wedge (z < 0) \wedge (t < t')$].

(192) *x* CHCIAŁBY (żeby) *y* : $\bigvee_{t,t'} \bigvee_{w,z} know^1_t (x, \neg y_{t'}) \wedge V_t(x, y_{t'}, w) \wedge$

$V_t(x, \neg y_{t'}, z) \wedge (w > 0) \wedge (z < 0)$.

[*x* WOULD WANT (that) *y* : $\bigvee_{t,t'} \bigvee_{w,z} know^1_t (x, \neg y_{t'}) \wedge V_t(x, y_{t'}, w) \wedge$

$V_t(x, \neg y_{t'}, z) \wedge (w > 0) \wedge (z < 0)$].

The differences between the formulas (190), (191) and (192) stem from the following: (190) pertains to wanting something that *x* considers possible (whether this belief is justified or not relevant), while (191) describes a wish which *x* considers impossible to come true and referring to the future. Lastly, (192) refers to a situation in which *x* wishes for something impossible to happen in the present or to have happened in the past. The wishes expressed

in (191) and (192) are nothing more but dreams.

(193) x DĄŻY (do tego żeby) y: $\bigvee\limits_{t,t',t''} \bigvee\limits_{i,j,m,n} \bigvee\limits_{u,w} \bigvee\limits_{z} B_t(x, Prob(y_{t'}[i, j]) \wedge$
$(j > 0)) \wedge V_t(x, y_{t'}, u) \wedge V_t(x, \neg\, y_{t'}, w) \wedge (u > w) \wedge B_t(x, Ag_t(x, z_{t''}) \rightarrow$
$(Prob(y_{t'}, [m, n] \wedge (m \geqslant i) \wedge (n > j) \wedge Ag_t(x, z_{t''}) \wedge (t'' \leqslant t') \wedge (t < t')).$

[x STRIVES for y: $\bigvee\limits_{t,t',t''} \bigvee\limits_{i,j,m,n} \bigvee\limits_{u,w} \bigvee\limits_{z} B_t(x, Prob(y_{t'}[i, j]) \wedge (j > 0)) \wedge V_t(x,$
$y_{t'}, u) \wedge V_t(x, \neg\, y_{t'}, w) \wedge (u > w) \wedge B_t(x, Ag_t(x, z_{t''}) \rightarrow (Prob(y_{t'}, [m, n] \wedge$
$(m \geqslant i) \wedge (n > j) \wedge Ag_t(x, z_{t''}) \wedge (t'' \leqslant t') \wedge (t < t'))].$

Interpretation: x considers a certain future occurrence y to be probable and prefers it to $\neg\, y$; and x thinks that if x acts so that z, then y will be more probable; therefore x acts so that z; z is not subsequent to y.

In the case of the verb *mieć nadzieję* it will be more convenient to use the English equivalent 'to hope that':

(194) x HOPES (that) y : $\bigvee\limits_{i,j} \bigvee\limits_{z} B(x, Prob(y,[i, j]) \wedge (j > 0) \wedge V(x, y,$
$z) \wedge (z > 0).$

It is equally convenient to refer to the English equivalent in the case of the verb *zdawać sobie sprawę* (*z tego*), *że* — 'to realise that':

(195) x REALISES that y : $Exp(x, Trans(\neg\, B(x, y), know^1(x, y))).$

(196) x DOWODZI, że y : $\bigvee\limits_{z} S(x, y) \wedge Ag(x, Trans(\neg\, B(z, y), know^1(x,$
$y))).$

[x PROVES that y : $\bigvee\limits_{z} S(x, y) \wedge Ag(x, Trans(\neg\, B(z, y), know^1(x, y)))],$

(197) x PRZEKONUJE y, że z : $S(x, z) \wedge Ag(x, Trans(\neg\, B(y, z), B(y,$
$z))).$

[x convinces y that z : $S(x, z) \wedge Ag(x, Trans(\neg\, B(y, z), B(y, z)))].$

The difference between (196) and (197) is based on the fact that in the case of (196) the message conveyed needs to be true, whereas in (197) it is not a necessary condition.

(198) x WYJAŚNIA y-*owi* (że) z : $Ag(x, Trans(\neg\, understand^i(y, z),$
$understand^i(y, z))) \wedge (i = 1, 3, 4).$

[x EXPLAINS to y (that) z : $Ag(x, Trans(\neg\, understand^i(y, z), understand^i(y, z))) \wedge (i = 1, 3, 4)].$

Interpretation: x acts so that y understands that z. The verb 'understand' is used in the meaning labelled as *rozumieć*[1](*understand*[1]), *rozumieć*[3](*understand*[3]) or *rozumieć*[4](*understand*[4]; cf. (159) — (162)). In the case of *rozumieć*[4] the veracity of the z being explained is a necessary condition, which constitutes one of the differences between the verbs *wyjaśniać* and *dowodzić* (to prove).

(199) x DEFINIUJE $y : \bigvee_{w} \bigvee_{z} know^1(x, R_1^3(z, w)) \wedge S(x, R_1^3(z, w) \wedge R_1^3(y, w))$.

[x DEFINES $y : \bigvee_{w} \bigvee_{z} know^1(x, R_1^3(z, w)) \wedge S(x, R_1^3(z, w) \wedge R_1^3(y, w))$].

(200) x SUGERUJE, że $y : \bigvee_{z} strive(x, B(z, y))$.

[x SUGGESTS that $y : \bigvee_{z} strive(x, B(z, y))$].

(201) x SUGERUJE, że $y : \bigvee_{z} \bigvee_{i,j}, j \ (know^1(z, x) \rightarrow Prob(B(z, y), [i, j]))$
$\wedge significant(i, j)$.

[x SUGGESTS that $y : \bigvee_{z} \bigvee_{i,j}, j \ (know^1(z, x) \rightarrow Prob(B(z, y), [i, j])) \wedge$
$significant(i, j)$].

Formulas (200) and (201) represent two different meanings of the verb *sugerować* (to suggest). In the former, x is a person, whereas in the latter case x is a certain fact facilitating the formation of a given opinion (in the person noticing that fact).

The verb *grać* (to impersonate, to imitate; as in a theatrical performance) may be represented as:

(202) x GRA $y : \bigvee_{z} S(x, x = y) \wedge know^1(x, \neg \ (x = y)) \wedge \neg strive(x,$
$B(z, x = y)) \wedge strive(x, R_1^3(z, y))$.

[x IMITATES $y : \bigvee_{z} S(x, x = y) \wedge know^1(x, \neg \ (x = y)) \wedge \neg strive(x,$
$B(z, x = y)) \wedge strive(x, R_1^3(z, y))$].

(203) x PROSI y (żeby) $z : \bigvee_{t,t',t'',t'''} (z = z(y)) \wedge strive_t(x, realise_{t'} \ (y,$
$hope_t(x, Ag_{t''}(y, z_{t'''})))) \wedge (t \leqslant \ t') \wedge (t' < t'') \wedge (t'' \leqslant \ t''')$.

[x ASKS y (that) $z : \bigvee_{t,t',t'',t'''} (z = z(y)) \wedge strive_t(x, realise_{t'} \ (y, hope_t(x,$
$Ag_{t''}(y, z_{t'''})))) \wedge (t \leqslant \ t') \wedge (t' < t'') \wedge (t'' \leqslant \ t''')$].

(204) x OBIECUJE (że) $y : \bigvee_{z} \bigvee_{t,t',t''} (y = y(x)) \wedge strive_t(x, B_{t'}(z, Ag_{t'}(x,$
$y_{t''}))) \wedge (t \leqslant \ t') \wedge (t' \leqslant \ t'') \wedge (t < t'')$.

[x PROMISES (that) $y : \bigvee_{z} \bigvee_{t,t',t''} (y = y(x)) \wedge strive_t(x, B_{t'}(z, Ag_{t'}(x,$
$y_{t''}))) \wedge (t \leqslant \ t') \wedge (t' \leqslant \ t'') \wedge (t < t'')$].

(205) x ZNAJDUJE^1 $y : \bigvee_{t,t'i,j} \bigvee (t' < t) \wedge Exp_i(Trans_t(\neg R_2^1(x, y), R_2^1(x,$
$y))) \wedge \neg \ B_{t'}(x, Prob(R_2^1 \ (x, y), [i, j]) \wedge significant(i, j)$.

[x FINDS^1 $y : \bigvee_{t,t'i,j} \bigvee (t' < t) \wedge Exp_i(Trans_t(\neg R_2^1 \ (x, y), R_2^1(x, y))) \wedge \neg$
$B_{t'}(x, Prob(R_2^1 \ (x, y), [i, j]) \wedge significant(i, j))$].

(206) x SZUKA $y : know^1(x, \neg R_2^1(x, y)) \wedge strive(x, R_2^1(x, y))$.

[x SEEKS $y : know^1(x, \neg R_2^1(x, y)) \wedge strive(x, R_2^1(x, y))$].

(207) x ZNAJDUJE^2 y: $\bigvee\limits_{t,t'}$ $seek_t(x, y) \wedge Ag_{t'}(x, Trans(\neg\, R_2^1(x, y), R_2^1(x,$

$y))) \wedge (t \leqslant t')$.

[x FINDS^2 y: $\bigvee\limits_{t,t'}$ $seek_t(x, y) \wedge Ag_{t'}(x, Trans(\neg\, R_2^1(x, y), R_2^1(x, y))) \wedge$

$(t \leqslant t')$].

The meaning of the verb *osiągnąć* equivalent to the English 'to succeed in doing something' may be represented as:

(208) x SUCCEEDS (in) y : $strive(x, y) \wedge Ag(x, y)$.

(209) x ZDĄŻYŁ y : $\bigvee\limits_{t,t'}\bigvee\limits_{i,j} Ag_t(x, y) \wedge (t \leqslant t') \wedge \bigvee\limits_{t''>t'} Prob(Ag_{t''}(x, y),$

$[i, j] \wedge (j = 0)$.

[x MADE IT IN TIME to y : $\bigvee\limits_{t,t'}\bigvee\limits_{i,j} Ag_t(x, y) \wedge (t \leqslant t') \wedge \bigvee\limits_{t''>t'} Prob(Ag_{t''}(x,$

$y), [i, j] \wedge (j = 0)$.]

The meaning of the verb *zdążyć* requires us to abandon the rule of presenting example phrases in the present tense.

Many of the formulas presented above do not encompass the full scope of the meaning of the verb they pertain to. Several interpretations require additional clarification (e.g. the formula for *definiować*). Moreover, the analysis of the verb *grać* (to act; to imitate; used in the theatrical sense) necessitates significant modifications in the formal description of the verb *kłamać* (to lie). It is not sufficient to interpret *kłamać* as: to inform that p while being convinced that not-p, since in this case an actor playing their role would have to be accused of lying. Thus, the formula for the verb *kłamać* should be amended to:

(210) x KŁAMIE (że) y : $\bigvee\limits_{z} S(x, y) \wedge B(x, \neg\, y) \wedge strive(x, B(z, y))$.

[x LIES (that) y : $\bigvee\limits_{z} S(x, y) \wedge B(x, \neg\, y) \wedge strive(x, B(z, y))$].

Interpretation: x informs that y while being convinced that not-y and x strives for other people to be convinced that y. This last part of the formula differs from the interpretation of the verb *grać*(to imitate, to act). (This is analogous to *udawać* — 'to pretent' — but in the case of the latter verb y $= y$ (x).)

To interpret the polysemantic verb *móc* we shall utilise its English equivalents 'can' and 'may'. The meaning of 'can' encompasses one of the meanings of *móc* (equivalent to that of *potrafić*). 'May' will be divided into two sub-categories, may^1 and may^2 — the former meaning deals with probability, the latter is deontic.

(211) x CAN y : $\bigvee\limits_{i,j}\bigvee\limits_{t,t'} strive_t(x, y) \rightarrow (Prob(Ag_{t'}(x, y), [i, j]) \wedge (j > 0)$

$\wedge (t \leqslant t')$.

Perhaps the interpretation should be slightly more complex — it may be argued that the *definiens* ought to refer to a belief held by the speaker. In this case the formula would take the following form (the elements of the formula were rearranged for purely technical reasons):

(212) x CAN $y : \bigvee\limits_{i,jt,t',t''} \bigvee (t \leqslant t') \wedge (t'' < t) \wedge B_{t''}(s, strive_t(x, y) \rightarrow$
$(Prob(Ag_{t'}(x, y), [i, j]) \wedge (j > 0)))$.

(213) x MAY^1 $y : \bigvee\limits_{i,j} (y = y (x) \wedge B(s, Prob(y), [i, j]) \wedge (j > 0)$.

The temporal relation between the moment of s having a given belief and the moment of y occurring is not specified, since the verb may pertain to past events regarded by the speaker as possible (if the speaker has not been informed whether the occurrence had taken place or not).

(214) x MAY$^2 y : \bigvee\limits_{i} \bigvee\limits_{z} \bigvee\limits_{t,t'} (Ag_t(x, y) \rightarrow P_{i,t'}(x)) \wedge (V(x, P_i(x), z) \vee$
$V(s, P_i(x), z) \wedge \neg (z < 0) \wedge (t \leqslant t')$.

Interpretation: if x acts so that y then x will enter a certain state which is not valued negatively by x or the speaker (or both).

A very similar differentiation may be observed in the case of the meaning of *powinien*^{1} ('should'; dealing with probability) and *powinien*^{2} ('should'; deontic).

(215) x POWINIEN^1 $y : \bigvee\limits_{k} \bigvee\limits_{i,j} (y = P_k(x)) \wedge B(s, Prob(y, [i, j]) \wedge large(i,$
$j))$.

  $[x$ SHOULD^1 $y : \bigvee\limits_{k} \bigvee\limits_{i,j} (y = P_k(x)) \wedge B(s, Prob(y, [i, j]) \wedge large(i, j))]$.

The use of the verb *musieć* (must) when referring to probability constitutes a special case:

(216) x MUSI^1 $y : \bigvee\limits_{k} \bigvee\limits_{i,j} (y = P_k(x)) \wedge B(s, Prob(y, [i, j]) \wedge (i = 1))$.

Formulas (213), (215) and (216) do not specify the temporal relation between the moment in which the speaker asserts their belief and the moment of y occurring. The only difference between the three formulas consists in the perceived level of y's probability. The fact whether y is categorised as $y(x)$ or $P_k(x)$ is of secondary concern; a mere matter of notation: it may be assumed that $P_k(x)$ is a special case of $y(x)$.

(217) x POWINIEN^2 $y : \bigvee\limits_{i} \bigvee\limits_{z} \bigvee\limits_{t,t'} (t \leqslant t') \wedge (\neg Ag_t(x, y) \rightarrow P_{i,t'}(x)) \wedge$
$(V(x, P_i(x), z) \vee V(s, P_i(x), z) \wedge (z < 0)$.

  $[x$ SHOULD^2 $y : \bigvee\limits_{i} \bigvee\limits_{z} \bigvee\limits_{t,t'} (t \leqslant t') \wedge (\neg Ag_t(x, y) \rightarrow P_{i,t'}(x)) \wedge (V(x,$
$P_i(x), z) \vee V(s, P_i(x), z) \wedge (z < 0)]$.

Interpretation: if x does not act so that y, then x will enter a certain

state which is valued negatively by x or the speaker (or both). The state may be interpreted as a type of a sanction (ethical, legal social, etc.). Moreover, the disjunction appearing in the *definiens* of formula (217) should perhaps be extended to: $(B(s, V(x, P_i(x), z)))$. This would indicate that the speaker is convinced that x ascribes a negative value to the state, or that it is the speaker that ascribes that value, or that both these statements are true. In this case (217) would contain no direct indication regarding x's own evaluation of the state in question. The decision which form of (217) to accept (i.e. the original notation or the extended one) should depend on the interpretation of the expression presented in the *definiendum*. There seems to be no easy answer to this question, as expressions such as the one appearing in the *definiendum* of (217) are used in a rather intuitive fashion. The more elaborate formula seems a safer option, and the method of notation adapted in the present analysis allows for its extension to be introduced easily.

The verb *powinien* may be used in yet another sense, which is also deontic, but more complex than the one already discussed. The meaning shall be represented as *powinien*$^{2'}$ and appears in phrases such as *numer rejestracyjny pojazdu powinien być widoczny* (the vehicle registration plate should be visible). In formula (215) the categorisation of x is not specified: it can be a human being, a social group, a living organism, a meteorological phenomenon, etc. In (217), however, x is a human being or a group — this is due to the fact that x appears as the first element in the relation V, i.e. the entity that ascribes a given value to a given experience. Even if we choose the extended version of the formula, we need to assume that the speaker is granting x the status of an evaluating entity. The sentence about the registration plate represents a different set of circumstances; consequently, the verb requires a different interpretation:

(218) $x \text{ POWINIEN}^{2'} y : \bigvee_{i,j} \bigvee_{w} \bigvee_{z} \bigvee_{t,t'} (y = P_i(x)) \wedge (\neg Ag_t(w, P_i(x)) \rightarrow$

$P_{j,,t'}(w)) \wedge (V(x, P_j(w), z) \vee V(s, P_j(w), z) \wedge (z < 0) \wedge (t \leqslant t')).$

$[x \text{ SHOULD}^{2'} y : \bigvee_{i,j} \bigvee_{w} \bigvee_{z} \bigvee_{t,t'} (y = P_i(x)) \wedge (\neg Ag_t(w, P_i(x)) \rightarrow P_{j,,t'}(w))$

$\wedge (V(x, P_j(w), z) \vee V(s, P_j(w), z) \wedge (z < 0) \wedge (t \leqslant t'))].$

Interpretation: there exists a w, which is a human being or a group and is the subject of a certain sanction if not-y, i.e. if x is not in a certain specified state. In the case of our example sentence, someone will be held accountable for the fact that the registration plate on a specific vehicle is not visible. Naturally, the disjunction in the *definiens* of (218) could be extended similarly to that of (217).

(219) x POSTANAWIA (że) $y : \bigvee\limits_{t,t'} (y = y\,(x)) \wedge (t < t') \wedge Exp_t(x,$ $Trans_t(\neg\ want(x,\ y),\ want(x,\ y))) \wedge B_t(x,\ strive_{t'}(x,\ y))$.

   [x DECIDES (that) $y : \bigvee\limits_{t,t'} (y = y\,(x)) \wedge (t < t') \wedge Exp_t(x,\ Trans_t(\neg$ $want(x,\ y),\ want(x,\ y))) \wedge B_t(x,\ strive_{t'}(x,\ y))$].

   It must be remembered that $\neg\ want$ is to be interpreted as 'it is not so that n wants' rather than as 'n does not want' (which could be represented as *not-want*). In the case of 'n does not want' the negation is much stronger than a simple negation; the phrase 'n does not want that m' is equivalent to 'n wants that not-m'. The statement communicated in formula (219) is not as strong.

   Descriptions of verbs pertaining to intellectual processes are relatively complicated and may raise questions. The amount of controversy will depend largely on the interpretation of the said mental processes e.g. within the methodology of science. Such discrepancies may affect the description of the meaning of a given verb, yet belong to the realm of the extra-linguistic. Interpreted as they are in methodology, verbs referring to intellectual processes do not seem to be a part of natural languages *sensu stricto*, because in natural languages they are used in a rather intuitive and even naive fashion. The two examples presented below are included for reference only and serve to demonstrate the method of describing such verbs in accordance with the general assumptions of the present analysis. It seems that the possible differences in interpretation resulting from differing methodological approaches to the verbs may be reflected in the corresponding formulas. Therefore, at least in certain cases one may assume that specific elements of the formal notation are merely abbreviated references to certain methodological assumptions, which may be very intricate. Such an approach seems justified, especially in the light of the — already mentioned — fact that the nuances of methodological interpretation go beyond the meaning of any given verb, or at least those of its meanings that are closest to the colloquial uses.

   (220) x BADA $y : \bigvee\limits_{i,j} \bigvee\limits_{k} \bigvee\limits_{t,t'} (t < t') \wedge B_t(x,\ Prob(P_k(y),\ [i,j]) \wedge (j > 0)$ $\wedge\ strive_{t'}(x,\ know^2{}_{t'},\ (x,\ P_k(y)))$.

   [x ANALYSES $y : \bigvee\limits_{i,j} \bigvee\limits_{k} \bigvee\limits_{t,t'} (t < t') \wedge B_t(x,\ Prob(P_k(y),\ [i,j]) \wedge (j > 0)$ $\wedge\ strive_{t'}(x,\ know^2{}_{t'},\ (x,\ P_k(y)))$].

   Interpretation: x starts with a working hypothesis assuming that y may be in the state of P_k and strives to ascertain whether it is indeed so; $know^2$ represents *wiedzieć, czy...* (to know whether).

(221) x WNIOSKUJE (że) y : $\bigvee\limits_{t,t',t'',t'''} \bigvee\limits_{i,j,m,n,p,q} \bigvee\limits_{z} (t \leqslant t' \leqslant t'') \wedge (t' <$
$t'') \wedge (t''' \leqslant t') \wedge B_t(x, Prob(y, [i, j]) \wedge (j \geqslant 0) \wedge B_{t'}(x, Prob(z_{t''}, [m, n])$
$\wedge B_{t''}(x, Prob(z_{t'''}, [m, n]) \rightarrow Prob(y, [p, q])) \wedge (p \geqslant i) \wedge (q > j) \wedge (p \leqslant$
$m) \wedge (q \leqslant n)$.

[x INFERS (that) y : $\bigvee\limits_{t,t',t'',t'''} \bigvee\limits_{i,j,m,n,p,q} \bigvee\limits_{z} (t \leqslant t' \leqslant t'') \wedge (t' < t'')$
$\wedge (t''' \leqslant t') \wedge B_t(x, Prob(y, [i, j]) \wedge (j \geqslant 0) \wedge B_{t'}(x, Prob(z_{t''}, [m, n]) \wedge$
$B_{t''}(x, Prob(z_{t'''}, [m, n]) \rightarrow Prob(y, [p, q])) \wedge (p \geqslant i) \wedge (q > j) \wedge (p \leqslant m)$
$\wedge (q \leqslant n)$].

Interpretation: x holds a certain belief regarding the probability of y, and in x's opinion the probability increases due to z but in such a manner that it does not exceed the probability of z as seen by x (where z represents the premises for the inference). This interpretation only refers to the correctness of the inference and does not imply the veracity of z nor, consequently, the veracity of y.
   ***

   The interpretations presented in this work should be regarded as preliminary and incomplete. The issue of interpreting verbs is exceedingly problematic, as in many cases verbs are understood in a rather intuitive fashion; the nuances of their meaning are not easy to specify. In other cases colloquial uses differ greatly from the manner in which a given verb is employed in professional or specialised contexts. The categorisation of arguments also requires work. To make matters worse, some verbs only take arguments belonging to a very narrow category. In other cases still, the principle of reistic interpretation adapted in the present study for practical reasons forces us to present a description which differs considerably from habitual uses.

   The present study contains the analysis of just a handful of verbs. Many of the disregarded ones would require a very elaborate interpretation, especially in formal notation. E.g. *winić kogoś za coś* (to blame somebody for something) may be interpreted as: to be convinced that someone did not act as they could and should have acted. This raises the question of whether the interpretation of *powinien*[2] (should[2]) ought to include an element implying that someone should do something and that they have a possibility of doing this. This seems to be an accurate interpretation of the verb in question, yet it is not entirely clear if its use (at least in colloquial language) entails such a semantic element. Many more analyses will be needed to extract all such nuances of meaning.

   The methods of analysis and formal description of the meanings of

verbs adopted in the present work is by no means regarded as the only possible solution or advertised as the best. Any possible criticism should above all target inconsistencies and/or contradictions that might have found their way into the system, or point to other, simpler or more convenient solutions for the problems delineated in the analysis.

Despite the incompleteness of the interpretations presented in this work and the controversies associated with them, publishing the analysis at its present stage seems justified due to the significance of the issues it tackles and on the grounds that works presenting a large number of verbs are relatively few. The apparatus used does not appear to be overly complex.

The present work makes use of various published and unpublished ideas and concepts proposed by O. A. Wojtasiewicz and B. Bojar and related to the analysis of verbs and syntax conducted in the Chair of Formal Linguistics at the University of Warsaw. A number of ideas were introduced by scholars working at this institution — A. Bogusławski and Z. Saloni. Others were directly or indirectly inspired by various works of Morris, Hintikka, Ajdukiewicz, Lakoff and other scholars, mostly from the United States and the U.S.S.R. Given the sheer amount of relevant literature, in many cases the author of a given concept is difficult or even impossible to identify, since the idea has since been adopted and utilised numerous times. The work shall be continued so that, among other things, its results can be used in developing a semantic code.

Postscriptum. The principles of description presented above are not final and shall presumably undergo many modifications and will certainly be extended, since a great number of verbs have not yet been analysed. Even at this stage, however, some elements may already be amended or at least reassessed. If the relation of $R_y^1(x, z)$ (cf. (37)) is interpreted as 'x is a(n) y of z' or 'x is a(n) y for z' or 'x is in a relation y towards z', then the looser interpretation of 'x and z are in a relation delineated by y' may seem too vague. However, the benefits of adopting the more precise interpretation are considerable. In the case of 'x *wiosłuje*' (x rows; cf. (60)) we arrive at: 'x acts so that an oar is an oar to x', i.e. 'x uses an oar as an oar'. In this case, the verb *matkować* (to mother; cf. (61)) would have to be interpreted as: 'x acts so that x is a mother to y'. The question whether the differences in notation between (37) 'x is a mother to y' and (61) suffice to express the difference between 'being someone's mother' and 'mothering someone' remains open (naturally, to compare the formulas we would have to change the variables in (37) to $R_z^1(x, z)$, yet this is a purely technical matter).

If — perhaps justifiably — the more specified interpretation is

adopted, the notation in (64) requires changes, otherwise we would arrive at 'x is a ford to y'. The new version of the formula would be:

(64a) $R_z^1(x, y) \wedge Ag(x, R_z^1(z, x)) \wedge (y \in \textit{Inland Waters})$,

which should be interpreted as: 'a ford is a ford (in relation) to y and x acts so that a ford is a ford to x'.

A different type of emendation may be introduced to (104). A more accurate formula would be:

(104a) $\bigvee_{w,z} R_4^1(x, w) \wedge L(w, z) \wedge P_y(w) \wedge (x \in \textit{Hum})$,

i.e. x lives in a given flat the state of which is delineated by y.

Barbara Starosta
CONTRIBUTION TO THE SEMIOTICS OF QUESTIONS

Introduction

The issue of the logic of questions was relatively popular with Polish authors (Ajdukiewicz 1960; Giedymin 1964; Kubiński 1971). Works by Tadeusz Kubiński, Kazimierz Ajdukiewicz, Jerzy Giedymin are mentioned by almost all researchers of this issue who publish in English, German or Russian (Åqvist, Harrah, Voishvillo). However, taking into consideration publications about the analysis of artificial and natural languages, the number of works devoted to the semiotics of questions is negligible. On the basis of the bibliography it could be deduced that the issue is either closed and nothing new can be added, or it is an alleged problem and thus not worth spending time on. In the first case, a theory of questions should be developed and verified, while in the other case, there would be no need to create such a theory.

The solution to this dilemma can be sought in the practice of information technology research and the fact that mathematical machines are becoming more popular in scientific research. It turns out that a theory of questions is necessary, for example, to construct theories of information finding systems which are generally based on asking QUESTIONS by a user of a given finding system. Moreover, a theory of questions would be extremely useful in the research on how data are organized in the memory of a machine.

In light of these simple needs, the present state of research on the logical theory of questions is unsatisfactory. The problem is not solved. Hence, Leon Koj (Koj 1971, 1972) focuses on the logical anlaysis of questions in two

articles, and Witold Marciszewski (Marciszewski 1974) also addresses the issue of questions in an article.

The present article is another attempt to face the emerging needs. I shall use a series of assumptions formulated by the above mentioned authors to the full extent. I shall also refer to the "pioneers" mentioned at the beginning.

In relation to the whole of the issue, the scope of my research is extremely narrow. Firstly, I focus on the syntax of questions, and to be more specific — on such a theory of questions in which there are no semantic or pragmatic terms. In my opinion, such a theory plays an analogous role on a negative vocabulary: it clearly separates what can be said about questions exclusively on the basis of the internal structure of expressions, from what can be described only in a language enriched with semantic and pragmatic terms. Secondly, I focus my research only on written language.

1. The notion of question

Before I define the notion of question that I shall use in this article, I shall present characteristics of the language in which I shall distinguish the notion.

Let V stand for a finite set of simple expressions used in Polish writings. It is a set of all NON-ISOMORPHIC inscriptions separated by a space, $V = (a_1, ..., a_n)$. Now, I determine the operation of joining, called concatenation, of set V^* generated by set V. The elements of this set, which I call phrases, are: expressions of vocabulary V, pairs of these expressions joined as a result of concatenation, and all possible complex expressions obtained through repetition of the operation of joining of the mentioned elements.

Among all possible phrases, only part occurs in written Polish texts. These phrases are treated here as DISTINCTIVE PHRASES and their set is marked with ϕ. To such distinctive phrases belong the following inscriptions e.g.: *trawa rośnie wysoko* "the grass grows high," *szczyt głupoty* "the peak of stupidity," *Jan z Czarnolasu* "John of Blackwood," *Bibliografia* "bibliography," etc.

What is referred to as language L is an ordered pair $L = <V, \phi>$. A detailed description of this model of language was presented in my article *O pewnym modelu języka naturalnego* (Starosta 1974).

What is referred to as QUESTION is the phrase in language L which ends in a question mark symbolized with *?*.

Now, I determine the notion of SPECIFIC TERM of question, or in shorter words — INTERROGATIVE TERM, as follows:

Expression a, $a \in V$ is a specific term of question, that is an INTER-ROGATIVE TERM if and only if it occurs ONLY in questions.

By introducing the above definition of interrogative term I go beyond the framework outlined in language L: for I make a DIVISION of vocabulary V into expressions that occur in questions and expressions that do not. Language L characterized above does not presuppose the operation of division. It is convenient then to extend the notion of language for further considerations.

If P stands for a finite class of divisions of vocabulary V, and $P = (P_1, P_2 \ldots P_n)$, then language L is defined as an ordered set $<V, \phi, P>$.

A division can be made of the vocabulary into expressions that occur only in questions and the remaining ones which differentiate from the vocabulary such as interrogative terms: *czy* "auxiliary DO, BE, HAVE, ...," *który* "which/what," *jaka* "which/ what," *gdzie* "where," *dlaczego* "why," and many others. This is one of the possible divisions of vocabulary, which can be conventionally called division D_1. Also, vocabulary V can be divided into expressions that occur in EVERY distinctive phrase, and expressions that occur only in phrases that end in: a dot, a question mark, or an exclamation mark. This division, which I mark as D_2, can be conventionally treated as a division of expressions of the vocabulary into NAMES and non-names. I shall not introduce further divisions of vocabulary V. Hence, as a result, language L is characterized by vocabulary V, distinctive phrases ϕ, and two divisions D_1 and D_2.

Distinctive phrases which consist of not only names but also expressions that are not names shall be called SENTENCES. In the case of such a division of distinctive phrases, questions belong to the set of sentences. A separate subset in the set of sentences are sentences that end in a dot. I shall call such sentences affirmative.

2. Classification of questions

The most detailed division of questions into types is the division based on the shape of the interrogative term. In the case of such a division, there are as many types of questions as there are interrogative terms in vocabulary V. Other criteria of division are extra-syntactic. For example, when the notion of a set of potential answers is introduced with a reference to conventions of using questions and extra-linguistic knowledge, so that questions are characterized depending on the characteristics of the set of answers.

If we treat interrogative terms as operators binding variables which take values from the sets of answers, then the type of set of answers may be a

basis for question classification. In this case we assume that two types of questions are equal if the sets of their potential answers are equal. This latter type of division is adopted by e.g. Koj who divides questions into two classes: questions in which the interrogative operator binds a name variable, and questions in which the interrogative operator binds a sentence variable. In the case of another criterion of division, when finiteness or infiniteness of sets of answers is taken into consideration, a division into open and closed questions is obtained. There may be many divisions of sets of answers, and hence there may be many possible question classifications.

In this work I shall use a statistic criterion. I divide interrogative terms dichotomically into such that appear most frequently in questions of language *L*, and the remaining ones. The statistical sieve separates the interrogative term *czy* "auxiliary DO, BE, HAVE, ..." In further considerations I shall only analyze questions in which there is the interrogative term *czy*. I shall call such questions *czy*-questions.

Czy-questions are the most frequent questions in scientific publications. They occur extremely often in texts on the methodology of teaching. They are the main type of question in the so called curriculum-based teaching and all kinds of tests. Their commonness is due to what, by analogy to name-properties, may be called DEFINITENESS. For *czy*-questions are the only ones that determine a definite set of potential answers in a mechanical manner, so to speak, by means of only the notion of sentence negation. Moreover, they entropy of the *czy*-question may be calculated on the basis of analysis of the structure of the question itself. Additionally, *czy*-questions determine not only the quantity but also the quality of the information provided by their answers. They have an analogous role as gauging instruments used in scientific research and practice.

3. Types of *czy*-questions

In many works, questions with the operator *czy* "auxiliary DO, BE, HAVE,..." are called closed end questions or fixed-alternative questions. For Tadeusz Kubiński such questions are only the ones in which the interrogative term *czy* occurs only once and when the set of answers to the question consists of two elements. The set consists of the sentence following the interrogative term and the negation of the sentence. For example, the set of potential answers to the question: *Czy Jaś lubi lody?* ["Does John like ice-cream?"] consists of two sentences: *Jaś lubi lody* ["John likes ice-cream"] and *Nieprawda, że Jaś lubi lody* ["It's not true that John likes ice-cream."] Already at this moment it is worth highlighting that the set of answers is

unequivocally determined by the question. Elements of the set are disjunctive and mutually exhaust all possible answers.

Following Kubiński, I assume that closed end questions are a special case of n-element *czy-* questions when $n = 1$. Kubiński differentiates two types of questions among n-element *czy-* questions: conjunctive and alternative.

Conjunctive questions occur in texts in two equivalent forms. If p_1, p_2, ..., p_n are affirmative sentences, then the notation of the two forms of questions is:

Czy $(p_1 \wedge p_2 \wedge ... \wedge p_n)$? and *Czy* $p_1 \wedge$ *czy* $p_2 \wedge ... \wedge$ *czy* p_n?

In the case of both forms of conjunctive questions, the set of answers A is: $A = \{p_1 \wedge p_2 \wedge ... \wedge p_n, \sim p_1 \wedge p_2 \wedge ... \wedge p_n, \sim p_1 \wedge \sim p_2 \wedge ... \wedge p_n,$ ..... $\sim p_1 \wedge \sim p_2 \wedge \sim ... \sim \wedge p_n\}$.

The set of potential answers to a conjunctive *czy*-question consists of 2^n elements, where n is the number of interrogative terms *czy* which may occur in the question.

Alternative *czy*-questions may be presented as follows: *Czy* $(p_1 \cup p_2 \cup ... \cup p_n)$, where $\cup$ stands for a disjunctive alternative. For example, *Czy wyjedziesz w góry, czy nad morze, czy też pozostaniesz w domu*? ["Are you going to go to the mountains, the seaside, or maybe stay at home?"].

The sets of answers to alternative questions are precisely defined. If n is the number of interrogative terms in the question, then the set of potential answers consists of n elements.

Except for conjunctive and alternative *czy*-questions, Kubiński differentiates CONDITIONAL *czy*-questions. They are a sequence of *czy*-questions in which the following question depends on the answers to the previous questions. Questions of this type are presented by means of a tree diagram in many publications. In the simplest case — with one-element *czy*-questions, the conditional *czy*-question has the following form: *Czy jeżeli p_1 to p_2, a jeżeli p_2, to czy p_3, a jeżeli p_3, to czy p_4, itd.* ["If p_1 then p_2, and if p_2, then p_3, and if p_3, then p_4, etc."]. The tree diagram in such a case is as follows:

$$p_1 \quad \sim p_1$$
$$p_2 \qquad \sim p_2$$
$$p_3 \qquad \sim p_3$$
$$p_4 \qquad \sim p_4$$
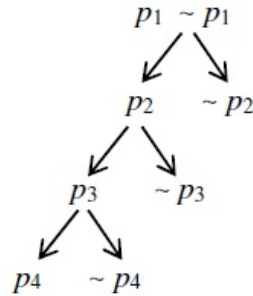
The *czy*-question tree is frequently used in scientific research. Questions of this type do not determine a straightforward set of answers, but indicate the direction of narrowing the set: they force us to look in a certain set, then in a subset of the set, then in a subset of the subset, etc. until reaching a set of answers that is easier to search through and significantly less numerous than the initial set.

The first *czy*-question and the following ones may consist of n-elements. When *czy*-questions are alternative we deal with an alternative n-element tree, when *czy*-questions are conjunctive, a tree is called conjunctive or multiplicative (Watanabe 1969). I shall not analyze conditional *czy*-questions as they require a separate study.

To sum up, *czy*-questions divide into alternative and conjunctive questions, moreover there is a distinctive group of conditional *czy*-questions. In the case of all these types, the set of potential answers is unequivocally determined by the structure of the question. In order to establish the set it is not necessary to have access to additional knowledge. All the information comes from the question itself.

From the point of view of the user, *czy*-questions are extremely informative, for they give much information about the SET of answers. Simultaneously, they are questions of relatively low information value: in the case of a closed end question, the information maximally amounts to 1 bit. A simple example should explain this apparent paradox, and at the same time will be a starting point to draw an analogy between the role of *czy*-questions in language L and the role of gauging instruments.

If the question is, e.g.: *Jakie jest napięcie w akumulatorze samochodowym?* ["What is the car battery voltage?"], the set of potential answers is determined in very general terms. For it consists of all affirmative sentences which describe all possible car battery voltages. The information contained in the question equals the question's entropy and amounts to hundreds of bits. It is worth reminding ourselves here that if E_i stands for the question's initial

entropy, and E_f stands for the question's entropy after receiving the answer, and if we assume that the answer provides exhaustive information, then the question's information equals the remainder of entropies $E_i — E_f = I$, and $E_f = 0$. The question's information equals the question's entropy: $I = E_i$.

If the question *jakie* "what" is supplemented or replaced by the question *czy* "auxiliary DO, BE, HAVE, ...," then the set of answers becomes more defined, e.g. *Czy napięcie akumulatora samochodowego wynosi 2 V, czy 3 V, czy 12 V, czy też 24 V?* ["Is the car battery of voltage 2 V, or 3 V, or 12 V, or perhaps 24 V?"], or *Czy napięcie akumulatora samochodowego wynosi 0, 1/2, 1, ..., 24 V?* ["Is the car battery of voltage 0, 1/2, 1, ..., 24 V?], etc. Admittedly, thus formulated questions still do not inform us which car battery is meant, but the information of these particular questions may be calculated. It is log 4 = 2 bits and log 48 < 5 bits.

When it is said that question *A* is extremely informative, what is meant is either the difference in the entropy of the question or a question of a different type, e.g. the difference in the entropy of the question *jakie* "what" and the question *czy* "auxiliary DO, BE, HAVE, ..." in the above examples, or what is meant is a situation in which it is assumed on the basis of additional knowledge that one of the expected answers is hardly probable. When, as a result of an experiment or research, this very answer proves to be correct, it is said that it provided much information. For example, there are two potential answers to the question *Czy istnieje życie na Marsie?* ["Is there life on Mars?"], that is: *there is life on Mars* and *there is no life on Mars*. When the element set of potential answers to the question is considered, then the information of the question is 1 bit. However, it is possible to treat each of the potential answers separately and consider the information of each of them, then the information of the answer *there is life on Mars* may be enormous. It depends on our calculation of the probability of this answer. For example, if it is assumed that the probability of this answer amounts to only $\frac{1}{10000}$, then $I = — \log \frac{1}{10000}$ $I = \log 10000 \simeq$ 14 bits.

I shall not discuss the above-mentioned types of information in this article. The first requires an analysis of questions of a different kind than *czy*-questions, the other is related to the pragmatic nature of research. I shall, however, discuss the information of *czy*-questions that is determined inclusively on the basis of the structure of these questions. But before doing so, I shall highlight the analogy between the role of *czy*-questions in language *L* and the role of gauging instruments.

Let us return to the example of the car battery voltage. In order to learn what the car battery voltage is, it needs to be measured by means

of a proper range voltmeter. The instrument we use determines the set of potential results of measurement. Hence, e.g. a voltmeter with a range from 600 to 1000 V, and a precision voltage reference of 10 V determines a different set of potential answers than e.g. a voltmeter with a range from 0 to 100 V, and a precision voltage reference of 1 V.

In language *L*, *czy*-questions function as such gauging instruments: they narrow and determine in advance the set of potential answers. The analogy is especially useful when one wants to establish the information of *czy*-questions by means of the notion of information defined without referring to the notion of probability (Ingarden 1963). Then, information is a function of a gauging instrument, or — more precisely — as a function of the set of potential results of measurement. In the case considered here, the information of the *czy*-question is a function of the set of potential answers to the question.

4. Information enclosed in the *czy*-question

I shall not deal with the notion of information here. Those interested should refer to the article "Uwagi o pojęciu informacji" [Some remarks on the notion of information] (Starosta 1973) and works listed in the bibliography. May I recall, however, that information is a function defined on the subsets of non-empty and finite set *X*. The class of subsets of set *X*, which is marked here by *U*, is a Borel field. It is closed under the set-theoretic operations of union and intersection, and, moreover, contains the entire set *X* treated as one or a certain event, and the empty set treated as zero or an impossible event. The function of information which is defined for the entire complex of events is characterized by the following axioms (Ingarden 1963):

1. If set *B* is a subset of set *A*, $(A, B \in U)$,

   then

$$I(B) \geqslant I(A)$$

2. Two sets *A* and *B*, $(A, B \in U)$ are independent if and only if

$$I(A \cap B) = I(A) + I(B)$$

3. The information of a certain event equals zero

$$I\ (X) = 0$$

4. The information of an impossible event equals $+ \infty$

$$I(0) = + \infty$$

Additionally, if we introduce normalization, then:

5. $I(A) = 1$ if and only if

    a. Set A contains two elements, $A = \{a_1,\ a_2\}$
      and
    b. $I(a_1) = I(a_2)$

Introducing the notion of information which is defined by the above axioms enables us to formulate a few theorems concerning *czy*-questions.

THEOREM 1. If a set of potential answers to question B is a subset of potential answers to question A, then the information contained in question B is not greater than the information contained in question A. For example, the information in the question: *Czy kolor tej ściany jest czerwony, czy zielony, czy żółty?* ["Is the colour of this wall red, green, or yellow?"] is smaller than the information in the question *Czy kolor tej ściany jest czerwony, czy zielony?* ["Is the colour of this wall red, or green?"].

A conclusion arises that, in order for the information contained in the two questions A and B to be equal, the condition that the sets of potential answers are equally numerous is not sufficient. These sets must contain THE SAME elements. For example, the information in the question *Czy Zbyszek bawi się, czy poszedł do szkoły?* ["Is Zbyszek playing, or is he at school?"] is not equal, according to this theorem, to the information contained in the question *Czy Jasio leży w łóżku, czy biega po pokoju?* ["Is John lying in bed, or is he running around the room?"]. For, sets of potential answers to each of these questions are disjoint.

However, if we take into consideration the normalization axiom, then the information of the first question is equal to the information of the second question and amounts to 2 bits. In this case, we are only interested in how many elements the sets of answers contain.

THEOREM 2. The information contained in question A and question B equals the sum of information of each of these questions if and only if the sets of potential answers to these questions are independent.

When these sets are dependent, the information contained in both of these questions equals the sum of information of each of these questions diminished by the information provided by the set of answers which is the intersection of both sets considered. For example, the information contained in the questions *Czy Stasio bawi się, czy też poszedł do szkoły?* [''Is Stasio playing, or is he also at school?''] and *Czy Stasio bawi się, czy też leży w łóżku?* [''Is Stasio playing, or is he also lying in bed?''] is treated as equal to the information of the question *Czy Stasio bawi się, czy poszedł do szkoły, czy też leży w łóżku?* [''Is Stasio playing, or is he at school, or is he also lying in bed?''].

The measure of the probability of the set of potential answers to *czy*-questions is determined by definition of information, in the following way (Ingarden, Urbanik 1961):

THEOREM 3: If $I(A)$ is information in the set of *czy*-questions, then for each $A \in U$ there is one and only one positive measure of probability $P(A)$ determined on A and such that for each subset of set A, $B \subset A$ and for each $b \subset B$.

$$P(b/B) \ = \ \frac{P(b/A)}{P(B/A)}$$

and

$$I(A) = \ - \sum_{i=1}^{n} Pa/A \ log \ a_i/A,$$

where $a_1, a_2, ..., a_n$, stand for all disjoint subsets of A which exhaust set A.

In the case when set A is interpreted as a set of potential answers to a *czy*-question, $a_1, a_2, ..., a_n$ are elements of this set.

Calculating the information of a *czy*-question, we can use the normalization axiom directly, or theorem 3. In the latter case, which uses the assumption that every potential answer to a *czy*-question is equally probable, that is when $P(a_1/A) = P(a_2/A) = ... = P(a_n/A)$, $P(a/A)$ equals $\frac{1}{n}$, then:

$$I(A) = \log n,$$

where n is the number of sentences in the set of potential answers.

Finally, it is worth remarking that the information of n-element alternative *czy*-questions is in principle smaller than the information of n-element conjunctive *czy*-questions. For the set of answers to alternative questions amounts to n elements, while the set of answers to conjunctive questions amounts to 2^n elements. This explains the intuition connected with such questions: conjunctive *czy*-questions are less determined and, with the same assumptions, allow more possible answers than alternative questions.

To sum up: I have shown that the information of *czy*-questions is determined by their structure. Moreover, I have drawn the conclusion that in order for two pieces of information to be EQUAL, the condition that the sets of potential answers are equally numerous is not sufficient, the sets must be identical. Two sets can provide the same quantity of information which is qualitatively different. Last but not least, I have remarked that alternative *czy*-questions are less informative than conjunctive *czy*-questions when they have the same number of elements.

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Witold Marciszewski
SEMANTIC ORGANISATION OF A TEXT

> *Good order is the foundation of all good things.*
> Edmund Burke

1. The purpose of the concept of semantic organisation

We sometimes refer to some utterances as chaotic or disorganised. These two synonyms imply a negative approach. There is no term in the terminology of logic to negate chaos, i.e. to denote a certain order of thoughts which should be appreciated. In this paper, I will refer to this idea of an order of thoughts as 'semantic organisation of a text' or just as 'semantic organisation'.[1]

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[1]Adopting the term "organisation" is explained by the fact that it is convenient to use a word which has two more grammatical versions: the adjective "organised" and the verb "to organise". The words "order" and "ordering", although also having the same advantage, are reserved to be used a bit further, namely to describe one of the elements or aspects of semantic organisation: they will be used precisely in the meaning ascribed to them in logic, in the theory of relations, when we refer to ordering relations. The adjective "semantic" is applied in the narrower meaning, which is becoming increasingly popular after Morris. It concerns the aspect of language which analyses the relations between the language and the reality described by it. Semantics implies syntactics, but it can leave aside pragmatics. In this paper, we will also leave aside the problems which could be called pragmatic organisation of a text, i.e. organisation taking into account the reactions of the recipient (for instance, many digressions which are not justified from the semantic point of view can be justified in the context of the pragmatic organisation, as they evoke a desired reaction of the recipient). An illustration of the semantic nature of these deliberations is the way the terms "concept" and "proposition" are applied here. Although these terms can be interpreted pragmatically, in this paper they are used in their semantically defined meaning — the basis for the definition of these terms is the concept of logical equivalence; they refer to the concept of the semantic model. Cf. Carnap 1956.

Edmund Burke (1729—1797), the British philosopher and politician who praised order as the basis of all good, would certainly agree that order in utterances brings about particularly valuable things: the knowledge that only ordered speech can convey; communication between the author and the reader, between the speaker and the audience; mutual respect between people, stemming from the fact that the concern for the order in utterances shows the author's respect for the recipient and gives rise to the recipient's respect for the author; and finally, aesthetical contentment provided by each lucid work.

However, it must be said that the idea of such an order of thoughts in speech is quite far from a clear definition which would make this concept lucid and operational. In the article, we will make an attempt at explication, i.e. we will put forward a sort of regulating definition, taking into account at least two applications: one related to the understanding of texts, and the other to evaluation by reviewers, editors, polemicists — in other words, all critical recipients of texts.

Any understanding, whether of a text, of human behaviour, or of the construction of a machine, consists in isolating elements of the whole and identifying the relations between these elements. In other words, it is about capturing the structure, the internal organisation of the analysed system. With regard to texts, there are at least two types of elements which can be distinguished in order to analyse the various relations between them: propositions and individual concepts. However, not all propositions expressed in a text and not all concepts deserve the same attention. Among propositions we distinguish the main theses — those which should be mentioned in, for instance, an abstract of the given text. Among concepts, we distinguish key concepts — those, which deserve to be mentioned in the subject index to the text.

The above distinction between an abstract or summary on the one hand and a subject index on the other hand is only the first approximation. If a subject index is expanded by adding to every term its relations with other terms (I propose to name such an index a relational index), then for every index there will exist an abstract of the given text which will be equivalent in content and different only in terms of graphical layout. This, of course, does not eliminate the point of drawing up both an index and an abstract to the same text, as each of them serves a different practical purpose.[2]

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[2]I will not go deeper into the problems of indexing and drawing up abstracts, as I elaborated on these subjects separately in my two other works (Marciszewski 1970, 1972). In the latter, I introduced the notion of a relational index as information not

The coincidence that some indexes are equivalent to some abstracts does not change the fact that there are two ways of achieving these equivalent results: by choosing entire sentences and examining the relations between them, and by choosing individual concepts and examining the relations between them. The purpose of both these methods is to capture the structure of the text, i.e. to help understand it. However, none of them is universal, and thus both are worth applying if we aim at the fullest possible understanding of a text. As a matter of fact, observing a relation between some concepts is nothing more than making a proposition, and as in our analysis we only take into account the key concepts, what we get as a result is a set of the most elementary propositions, which in turn constitutes a kind of abstract, a list of key statements. Now, if we go deeper into examining the relations between these statements, we will get a more refined abstract, which is not replaceable by a relational index. However, if we start from this type of abstract, omitting the indexation stage, we might fail to notice some noteworthy relations between concepts. Only an index — a list of key concepts — makes it possible to juxtapose every concept with every other concept and then to attempt to find all essential relations using a combinatorial method. And only this can be called a full understanding, i.e. an exhaustive presentation of the semantic organisation of a text.

The same methods serve two more goals: the construction and the critical analysis of texts. The former is necessary for authors, who can use it to obtain a sort of algorithm for constructing texts, based on the concept of logical organisation. The latter is a tool for reviewers, who have to evaluate texts in terms of logical organisation, as well as for editors, who decide whether to publish a text, and for all other people whose task it is to evaluate written works in terms of their formal characteristics.

Explication, which will be employed here, consists in the following procedure: an unclear or vague term, used intuitively, i.e. without clearly formulated criteria of application, is replaced with a new term, of a technical nature, which is given explicit conditions of application, as precise as possible. The terms expressing intuitions which we are referring to are expressions such as "order of thoughts", "transparency", etc. The technical term which is supposed to replace them is the "semantic organisation of a text". In search of a precise definition of this concept, we obviously have to try to emphasize and respect the intuitions underlying the terms replaced by our new technical term.

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only on concepts, but also on the theses of the analysed text.

It seems that the idea of the order of thoughts in a text is related to at least four intuitions, with relations between them yet to be examined. First of all, in order to write and speak in an orderly manner, one has to write or speak on a given subject, sticking to this subject from the beginning to the end. Secondly, a well constructed text is always divided into parts, such as chapters, sections, paragraphs, etc. Of course, the division cannot be mechanical or arbitrary — in given units of text it should group sentences concerning the same subject; thus, another condition for the organisation of a text is the logical division of the set of sentences of which the text is composed. Thirdly, there should exist (or at least it is desirable for it to exist) an order in the narrower sense, as it is understood in the theory of relations: in our set of sentences, or at least in some of its subsets, there should be an ordering relation between the elements. An example of such a relation is the time sequence in historical narration or an inferential relation in a deductive system. Fourthly, there should be something which linguists refer to as coherence of a text, i.e. the connections (not necessarily of an ordering relation type) between the elements of a text. For example, in historical narration, the connecting element is the name of the main character of the events in question, in syllogism it is the middle term, etc. I will call this feature coherence.

In the next sections, we will focus on each of these four aspects of organisation of a text, starting from coherence, which is, in a way, a fundamental characteristic of a text. In order to describe it, we will use the tool of graphical representation of a text in a coordinate system, in which relations between concepts are transformed into spatial relations. I will call the result of such a transformation the table of relations (for the given text). Every sentence containing key concepts is marked as a binary relation — on one axis we mark the elements of the domain of the relation, and on the other the elements of codomain, and on each intersection we mark the relevant relational predicate. The numerical indicator of coherence of the text will depend on the number of intersections, as its function. Other configurations presented in the table will provide indicators for some other characteristics of the text.

2. Text coherence

Let us use a very simple example of a coherent text — a conclusion method traditionally known as a polysyllogism. Let us assume, in order to adapt this example to our problem, that all terms with which the name variables would be replaced in this formula express key concepts. Below a

simple (only 'three-tiered') type of polysyllogism:

Each A is B
EACH B IS C
Each A is C
EACH C IS D
Each A is D
EACH D IS E
Each A is E

Each sentence of this text describes a relation of inclusion between the scopes of the terms. In order to note these relations in the table of relations, we shall introduce the following symbols: i for the relation of inclusion, $\bar{i}$ with a horizontal line above it for a converse relation, i in parentheses for the relations which are not mentioned in our polysyllogism but which may be inferred from it (this includes the relations of inclusion between several terms and all their converses). The vertical column shows the first argument, and the horizontal row the second argument of the inclusion.

Table 1.

	A	B	C	D	E
A	$=$	i	i	i	i
B	$(\bar{i})$	$=$	i	(i)	(i)
C	$(\bar{i})$	$(\bar{i})$	$=$	i	(i)
D	$(\bar{i})$	$(\bar{i})$	$(\bar{i})$	$=$	i
E	$(\bar{i})$	$(\bar{i})$	$(\bar{i})$	$(\bar{i})$	$=$

The number of intersections visible in the table, compared with the number of all possible intersections (n^2, where n is the number of terms), would be a natural indicator of the coherence of a text, intuitively understood as the 'density' of the conceptual network. It will be more convenient, however, to take into account not all possible intersections but only the ones grouped on one side of the diagonal, i.e. excluding everything that is on the other side of the diagonal and the diagonal itself, as the diagonal consists only of simple equal signs, and one side shows solely the converses of the relations which are on the other side. Both these types of data are trivial. After this modification, the maximum number of intersections p for n terms is:

(1) $max(p) = \dfrac{n^2 - n}{2}$

As can be seen in Table 1, the text of the polysyllogism has maximum coherence if we take into account the relations of inclusion which can be inferred from the relations described explicitly in the text.

Minimum coherence would mean that each term is connected with only one other term, e.g. *A* only with *B*, but not with *C*, not with *D*, etc. For *n* terms the number of intersections will then be *n* minus one, as illustrated by the table below:

Table 2.

	A	*B*	*C*	*D*	*E*
A	=	+			
B		=	+		
C			=	+	
D				=	+
E					=

We subtract one from *n* because the first intersection will always be a trivial equality, and only the next ones will express some non-trivial relations. Thus, the minimum number of intersections, i.e. minimum coherence, is described by the formula:

(2) $min(p) = n - 1$

The coherence of the texts that we usually deal with will be somewhere in between the minimum and the maximum. For instance, a narration which speaks about the characteristics of one person or about what happened to that person, can be presented as the following table of relations, in which *N* is the name of the character, while *A*, *B*, etc. refer to the respective characteristics or events. Our relational predicate for statements about the character will be the symbol of belonging to a certain class, in this case *e* (from *est*), and the symbol for the direct preceding of events will be *a* (from *ante*).

Table 3.

	N	A	B	C	D
N	=	e	e	e	e
A		=	a		
B			=	a	
C				=	a
D					=

The coherence of this text is characterised by the number of intersections (7), which is between the maximum (in this case 10) and the minimum (4). For a comparative characterisation of coherence, it would suffice to use the indicators provided above, which make it possible to put every text on a scale between the two extremes. However, it would also be advisable to have at our disposal a classifying concept of coherence, i.e. one that would divide the set of texts into coherent and non-coherent. The natural demarcation line seems to be the medium value between the two extremes:

$$(3)\ med(p) = \frac{n^2+n-2}{4}$$

Now it is for us to decide (a bit arbitrarily), whether to assume as the condition of coherence that the number of intersections is to be greater than $med(p)$, or greater than or equal to it. It seems that we can adopt the second, more liberal approach. The fragment of narration analysed above seems coherent (it tells the subsequent events which happened to the same character), and the number of intersections is 7, so it is equal to $med(p)$.

We have already defined the notions of minimum, maximum, and medium coherence, and the classifying concept of coherence — by dividing a set of texts into coherent and non-coherent. For texts containing the same number of key concepts, here symbolised by n, there also exists a way of comparing their coherence if we take it as a gradable feature: out of two texts having the same number of key concepts, the one for which the table of relations shows more intersections is more coherent. We only have to define the method of comparing the coherence of texts with unequal numbers of key concepts. The natural measure of this will be the relation between the number of intersections in a given table and the maximum number of intersections for this table, here symbolised by $max(p)$. Moreover, it would be desirable to express the maximum and the minimum always with the same number, regardless of the value of p and n — for instance 1 and 0, respectively.

These conditions are fulfilled by the following formula for z (the grade of coherence of a text):

(4) $z = \frac{p - min(p)}{max(p) - min(p)}$

This function ascribes value 0 to $min(p)$ and value 1 to $max(p)$, and values from the range $0 \leqslant z \leqslant 1$ to the numbers between these two extremes; $med(p)$ receives the value 0.5. For example, if $n = 6$, the values are as follows:

Table 4.

value of argument p	5	6	7	8	9	10	11	12	13	14	15
value of function z	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1

The essence of the operation of moving from p to z consists in choosing as many numbers in the range $[0,1]$ as there are in the range $[min(p), max(p)]$, where the subsequent numbers from the latter are attributed to subsequent numbers selected from $[0,1]$, maintaining equal spaces between them (i.e. equal spaces between the numbers of one of these sequences are reflected by equal spaces between the relevant numbers of the other).

Considering that for the same text we will get different indicators of coherence, depending on whether we take into account solely the relations explicitly mentioned in the text or also those which can be inferred from it, actual coherence should be distinguished from potential coherence. The latter also covers the relations which can be expressed in the language of the text by using sentences inferred from the sentences explicitly belonging in the text. For example, in the polysyllogism examined earlier in this paper, potential coherence reached its maximum, while actual coherence had a value less than one, namely 0.5.

The relation between the actual and potential coherence of a text can be considered a measure of the feature for which there is actually no term either in every-day or academic language, but its opposite being colloquially referred to as pathology. We could call it coherence, but this term is ambiguous and only one of its meanings are close to the concept which we are dealing with here. The function attributing this feature, or a certain degree of it, to a text could be the difference between the potential coherence indicator and the actual coherence indicator. It equals zero when the text does not leave anything to the speculations of the recipient.

3. Monotopicality

A well organised text keeps to the topic. A more refined composition may contain several intertwining topics but we will focus on the simplest case, when there is one topic elaborated on throughout the whole text. We shall call this feature of a text 'monotopicality'. The table of relations for any topic instantly shows whether a text is monotopical or not. Monotopicality exists when there is a sequence of predicates in one of the columns or one of the rows which is stronger than all other sequences and in extreme cases even spans the whole row or column.

This is illustrated by the following example, in which symbols from A to F in the column always represent the first argument of the relation, the symbols in the upper row represent the second argument, and the "+" sign at the intersection shows that there exists a certain relation between the arguments (it may repeat or may be different each time).

Table 5.

	A	*B*	*C*	*D*	*E*	*F*
A	=	+				
B	+	=	+			
C	+		=	+		
D	+			=	+	
E	+				=	+
F	+					=

The topic of the text in the above example is A, as this concept enters in relations with all the other key concepts of the text in question. For instance, the topic of the present article, i.e. logical organisation, is in various relations to all the other key concepts discussed here, such as coherence, monotopicality, ordering, etc.

What is the relation between complete monotopicality, which consists in filling the whole row or column with predicates, and the feature of a text discussed in the previous section, called coherence? It can be easily observed that when the number of concepts $n \geqslant 6$, monotopicality is the sufficient condition of coherence. For Table 5, in which n equals 6, the coherence indicator is 0.5, and thus the text presented in this table should be classified as coherent (in the classifying sense of the term). When n is less than six, monotopicality contributes even more to coherence. For instance, if $n = 5$ and the text is monotopical, the coherence indicator will be 2/3. As shown in Table 5, after cutting out the sixth symbol (F) in both dimensions, the number of intersections is 8, which is a higher share of all possible

intersections than when $n > 5$, as the maximum in this case is 10 and the minimum is 4, which leads, according to the formula (4), to $z = 2/3$.

The condition of monotopicality is fulfilled by every text in which the same things are said repeatedly about the same object (which would be a pathological case) or different things are said about the same topic (which is a correct situation). The things 'said about something', in turn, can be grouped in classes. For instance, talking about the subsequent events in someone's biography, we group them into chapters according to certain periods of time (childhood, youth, 'the age of defeat', etc.) or according to certain topics. Such a division of a text can be multi-tiered if we divide larger parts of the text into smaller units, e.g. chapters into sections and then into paragraphs. Each of these units should be monotopical, and the topics of a fragment being a part of a larger unit should be related in a certain way to the topic of the higher unit. We will deal with these problems in the next section.

4. Structural adequacy

It is natural to look at a text as a set of sentences. In logic, an operation of dividing a set into subsets or the result of this operation is called partition.[3] Although in this case it is hard to define disjointness and completeness, which are to characterize the logical partition of a set, both are in a sense guaranteed in advance even in the most chaotic of texts, if we consider subsets of sentences grouped next to each other and separated from the adjacent groups (for example by a paragraph indent) as the result of partition. This way, each sentence belongs to a subset, i.e. to a fragment of text, and thus the partition is complete; furthermore, it is physically impossible for one and the same sentence, understood as an inscription (hence something material) to be in two places at the same time, which would violate the condition of disjointness. However, when talking about a correct division of a text, we do not have in mind any such trivial correctness. The intention behind such statements could be described as follows (which is probably not the only possible way).

In order to be able to examine the structure of a text, expressed by what is commonly called a division of this text, let us distinguish the physical and the thematic structure. Both structures can be presented as a tree. For

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[3]Translator's note: the author uses one Polish word "podział", which corresponds to both "partition" and "division". I will use the word "partition" when talking about a division of a text wherever it is treated as a set of sentences, and "division" when it is used in the common meaning.

the physical structure, the top of the tree, marked by any number, e.g. 1, is the whole text, and the largest units (e.g. chapters) are the tree's upper branches; we will assign to them numbers consisting of two digits: 1.1, 1.2, 1.3, etc. Lower branches will be fragments of chapters, thus the third level from the top will feature numbers consisting of three digits: 1.1.1, 1.1.2, etc., and further 1.2.1, 1.2.2, etc.

In the thematic structure, the top of the tree is the general topic of the whole text, that is what the title of the text should describe. The subsequent levels of branches represent the topics which, if the correct line of thought is followed, should be the topics of chapters, and then parts of chapters, etc. We assume that for each main topic there is at least one correct way to divide it into branches and that not every branching is correct. What is the factor determining whether they are correct or not?

In order to find the answer, we have to notice that every topic can be assigned a question or a set of questions. For instance, the topic: "Semantic organization of a text" is equivalent to the following question: "What is semantic organization of a text?"; while the topic: "Development of speech in children who are deaf" can be read as the following question: "How to develop speech in children who are deaf?".

The transformation of a topic into a question is the first step towards creating a thematic tree. The question, in turn, is assigned a disjunctive answer, which is a part of the supposition of the question. The supposition itself is also a disjunction, but in the case of the *wh*-questions the disjunction usually has so many elements and is so hard to formulate by just enumerating all these elements, that we usually formulate it as an existential sentence.[4] The supposition of the question: "What events (in the life of a student) cause failures at school?" is the following sentence: "(*Ex*) (*x* causes failures at school)", in which the variable *x* belongs to the set of events.

However, what we start with as a given when solving a problem is a significantly limited disjunction, i.e. such a disjunction that entails only elements which can potentially — as far as we know — become answers to the question. For instance, nobody will put events such as the coronation of Charlemagne or the eruption of Vesuvius among the possible reasons for school failures. With such a far-reaching limitation of disjunctions of all answers, reducing them to the disjunctions of only these hypotheses which our current knowledge allows us to make, the disjunction defines the plan of the analysis (i.e. the plan of the process of problem-solving) and

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[4]In Marciszewski 1974, I further developed the idea of a supposition of a question as a disjunction of answers which is the starting point for research,.

indirectly also determines the thematic structure of the text reporting on the results and possibly also the course of such research. Namely, the research process consists in eliminating the elements making up the disjunction of possible (as far as we know) answers, until only one answer is left. Thematic branches are formed by new questions appearing over the course of examining the individual elements of the disjunction. These questions concern data necessary for accepting or rejecting the examined element of the disjunction.

Naturally, not all steps of the analysis must be reflected in the text reporting on the research. Some elements of the disjunction which were taken into consideration and then eliminated by the researcher may be so uninteresting for the recipient that it is better to just pass them over in silence. The analysis includes some operations on a trial and error basis, while the report usually refers to only those steps which are necessary to understand the final result. For example, in the course of the reflections underlying this section of the article, there has appeared an idea to present the discussed feature of a text as the result of a logical partition of the set of sentences forming a text. This idea was therefore one of the elements of a disjunction of answers. It was rejected, which was reflected in some brief critical comments on this proposal at the beginning of this paragraph. These comments present only a certain final state; they do not reflect the stage of the analysis in which the said disjunction of answers was temporarily treated as the right answer. To sum up, the thematic structure of a text is a transformation of the structure of the analysis, formed by omitting some elements which are irrelevant for communication with the recipient, the structure of the analysis (in other words — the plan of the analysis) being determined by the initial problem leading to a disjunction of possible answers (formed by confronting the supposition of a question with our knowledge on the subject). This disjunction is branching into new questions generated by its elements, which must be answered in order to accept or reject the given element of the alternative.

After roughly outlining the method of obtaining/forming the thematic structure of a text, we can already evaluate the structural adequacy of a text in the following way: a text is structurally adequate if and only if there exists a thematic structure which represents the branching of the main topic of the text, illustrated by a tree which is isomorphic to the tree representing the physical structure of the text. This isomorphism consists in the fact that the images of both trees are identical, and where on the tops (points of intersection) of the tree of physical structure there are the numbers of text parts, in the tree of thematic structure there are the formulated topics of

the corresponding parts of the text.

One of the transgressions against structural adequacy is the existence of redundant elements in the physical structure of a text, i.e. elements with a topic not present in the thematic structure, for instance digressions which are not justified by anything other than the one incidental fact that the author had this particular association (however, if they are justified solely by, for example, didactic reasons, they may be justified in the pragmatic organisation of a text but will not be determined by its semantic organisation). Another transgression against structural adequacy — opposite, in a way, to the previous one — is the physical structure missing a fragment which should be there, according to the thematic structure of the text. This would be the case when a given thematic structure contains a topic which has no counterpart in the physical structure (a corresponding fragment of the text). We call it a gap in the flow of thoughts or skipping a thought. Yet another error occurs when there exist corresponding elements of both structures — i.e. each topic formed by branching the main problem has a corresponding fragment of text devoted to it and, at the same time, each fragment is devoted to one of the topics forming the thematic structure — but the corresponding elements are in different places in each of the structures, which means that they have different numbers in the numbering system describing their positions in the trees.

Naturally, in order to assess how structurally adequate a given text is, the two structures must be analysed separately. Thus, the thematic structure cannot be constructed on the basis of the physical structure. A person attempting to conduct a critical analysis of a text must construct, independently from the author, different possible thematic trees formed by branching the main problem (there may be more than one tree), in order to check whether one of them is isomorphic to the tree of physical structure. Undeniably, this would require a huge amount of work and skill on the part of the critic, but it seems that there is no other way to evaluate the structural adequacy of a text. It is worth pointing out (and may be of some solace) that the more a text fulfils the conditions of structural adequacy, the easier the work of a critic will be. Furthermore, the critic's ambitions might not be as high as to require her to propose alternative thematic structures in the event of detecting a defect in the structure of the analysed text: she may just be content with identifying the ambiguities or difficulties, which is much easier.

A numerical measure of structural adequacy can be formed in the following way. If the physical and thematic structures are exactly isomorphic

to each other, structural adequacy is 1. If there is no similarity between the two structures, as for instance in an unlikely case when a text entitled "The Tides of the Sea" would be about squaring the circle or breeding pigeons, structural adequacy is minimal and equals 0. The number of possible grades between 0 and 1 depends on the complexity of the thematic structure concerned. After calculating by a combinatorial method the number of possible differences between the thematic and physical structure, we could estimate how far the text is from maximum structural adequacy, measured by the number of differences actually occurring between the structures in relation to all possible differences.

5. Ordering of a text

Looking at a text as a set of sentences, we would say that it is linearly ordered — in accordance with logical terminology — if there is a linear ordering relation between the elements of the set, i.e. a relation which is transitive, asymmetrical, and total in the given set. We will say that it is partially ordered if there are no expectations as to the condition of totality, while the two other conditions are met. An example of a linearly ordered text (very hard to find) is the beginning of the Gospel of St. Matthew, which is a kind of lineage of the Messiah: "Abraham was the father of Isaac, Isaac the father of Jacob, Jacob the father of Judah" (etc.). The ordering relation for the set of ancestors is the relation of descent; the text describes this relation, therefore it comprises a relation ordering the set of names. Although the relation directly concerns names, it indirectly defines a certain order in the set of sentences as well. Texts are usually only partially ordered, without fulfilling the condition of totality. As mentioned further in this article, the existence of at least one partial ordering in a set of sentences should be considered a necessary condition to call the set a text. It is worth pointing out that the proposed conception of ordering refers to sentences, and not to a set of terms or concepts as in the previously analysed features of a text, like coherence. The reason for this is that one of the important relations ordering a text is the relation of deducibility, i.e. inferential consequence, which exists between sentences. When an ordering relation directly concerns names or concepts, like in the genealogy quoted above (another example would be historical narration observing a proper chronological order of events), it is usually possible to determine the order between the sentences defined by the order between the terms.

In the case of longer texts, such as an article, essay, or a short story, which are sets of sentences divided (also as regards their physical structure)

into subsets, the notion of linear order must be modified. Usually, linear order exists only within the set (family) of these subsets, while it does not exist in the set consisting of all sentences of the text. Moreover, if within each of these subsets — chapters, sections, paragraphs — the sentences making up these subsets are linearly ordered, the result is the same as with one linearly ordered set of sentences divided into these subsets. Namely, each sentence will have its clearly defined position in a given text — let us call it T — which means that any change of this position would create a text not equivalent to T (the equivalence in question would have to be defined separately, but we can assume, putting it simply, that it is an inferential or logical equivalence, as long as a text is treated as a conjunction of the sentences of which it is composed).

Such a combination of ordering and division is formally similar to e.g. alphabetical ordering of a set of surnames, in which every surname has a clearly defined position due to the linear ordering of sets, which are: the set of surnames starting with A, the set of surnames starting with B, etc. The subsets within each set are ordered according to a different relation, determined by second letters of the surnames, which gives us another sequence of subsets, each of them being further divided according to third letters, etc. Hence, it is not the case that there is one linear ordering relation which orders a set composed of surnames. There are various ordering relations, the difference between them being which letter of the surnames they concern, and each of them ordering not a set of surnames but a set composed of subsets of the set of surnames. However, the result is the same as in the case of one and the same ordering relation in a single and only set composed of certain surnames. It would be advisable to introduce a new term for this type of ordering, but to avoid using too many terms we shall extend the meaning of ordering of a set to include the above case as well.

In order to define a certain numerical indicator of ordering of a text, marked as $U(T)$, it is sufficient to take into account two values, symbolized by the letters z and i. The former, namely z, is the number of sentences making up the text T, while i is the number of texts which can be obtained from T by permutations of elements, without changing the meaning of T. The underlying idea of this condition is that these permutations are semantically irrelevant (hence the symbol i). As regards the criterion of identical meaning, it is rather inadvisable for it to be the same for all types of texts. The conditions for maintaining identical meaning are different in an academic text than in a feature article or in a poem. In academic texts, identical meaning could come down to inferential equivalence (cf. Ajdukiewicz 1960).

If T is linearly ordered, this means that there are no permutations which would lead to the creation of a text with identical meaning as T. In other words, each rearrangement of sentences introduces a shift in meaning, and thus $i = 0$. At the opposite extreme, there is the case when all rearrangements are irrelevant; for example, a sequence of expressions which is a record of a schizophrenic knight's move thinking , where $i = z!$. It seems natural to assume that this type of record does not deserve to be called a text, which is equivalent to assuming that the necessary condition for a text is that i is less than $z!$.

These considerations lead to the following function as an indicator for the ordering of a text:

(5) $U(T) = 1 - \frac{i}{z!}$

The function fulfils the above intuition when minimum order (i.e. no order) is ascribed the value 0, and maximum order is ascribed the value 1. In consequence, for a linearly ordered text, i.e. when $i = 0$, the indicator has the value 1, while for a 'knight's move thinking' type of text, when $i = z!$, the indicator has the value 0. Formula (5) will also provide an answer to the question whether a single sentence can be treated as a text, as long as we know what the value of i is in that case. There are two possibilities: $i = 1$ or $i = 0$, leading to contradictory solutions. Assuming that $i = 1$, a single sentence is not a text, while if $i = 0$, it is a maximally ordered text. The fact that formula (5) reflects this dilemma seems to speak in its favour, as indeed our intuitions in this matter are hesitant — as is often the way with borderline cases, to which our language is not adapted. On the one hand, a single sentence cannot be considered as unordered, just as a person who had no opportunity to sin cannot be accused of sinning. On the other hand, she can barely be called virtuous just because she had no opportunity to act against virtue. The final decision therefore remains a terminological issue, depending on certain practical aspects. For example, if we want to use expressions such as "the text of a signboard" or "the text of a title", it would be convenient to assume that a single sentence is also a text and ascribe value 0 to the i factor. Intuitively, this could be justified by arguing that a single isolated event cannot change its position in the sequence, as there is nothing in relation to which its position could be changed, and thus the only possible change would be to remove the sentence (delete it or cross it out), which would definitely be a relevant change. Therefore, the number of irrelevant changes, symbolized by i, would be 0, and the function $U(T)$

would have the value 1.

The metric notion of order should not be used as an evaluative notion in the sense that the closer the indicator of ordering is to 1, the higher the semantic organization of a text in the given aspect. For it is often the case that there are no factual reasons for a certain order of elements in a given line of thought. For example, when talking about two parallel events, it may be irrelevant in which order I choose to describe them, as by nature the relation in this case is symmetrical and thus is not an ordering relation, so it is not possible to introduce any ordering to the text. On the other hand, some level of ordering is necessary for a positive evaluation of the semantic organization of the text. Since the level of the necessary ordering depends both on the nature of the described object and the conventions governing the given genre, defining the minimum level of necessary ordering (other than zero, based on (5)) must be based on a detailed analysis of various types of texts. Thus a maximum ordering indicator is a sufficient condition to consider a text semantically well organized (in terms of ordering), but it is not a necessary condition. However, the indicator must be always higher than zero.

6. On methodological aspects

This essay, as well as the earlier papers to which it refers, is inspired not only by practical needs, but also by certain philosophical aspects. Let us now direct some attention to this philosophical basis and its methodological implications, comparing them to other current trends in methodology of human science.

I propose (maybe with some exaggeration but with a benefit to clarity) to call the approach specific to this essay 'neophysicalism'. It would be different from physicalism advocated by early logical empirism, in particular by Carnap, in two aspects: in the object and the postulated range of reduction.

The object of reduction in classical physicalism are psychological theses as statements about non-observable (from the outside) states of mind, which it proposes to translate into statements about bodies subject to external observation. Classical behaviourism is an attempt to realise this programme. The essence of what I suggest to call neophysicalism, is the attempt to relate statements about some intentional objects (as defined by Ingarden),[5] such

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[5]The numerous texts by Ingarden on the problem of intentional objects include Ingarden 1960a: 141ff.; 1960b: 180ff. I provide more detailed bibliographic information in Marciszewski 1973.

as meanings, thought structures, conceptual apparatus, etc., to observations concerning physical objects or spatial arrangements, such as inscriptions and their configurations on a plane. Using the terminology of Ryle (1957) and Popper (1968), we could say that both physicalisms postulate a reduction to the 'first world', i.e. the material or physical world, but the older type of physicalism attempts to do it only with the 'second world' — the domain of psychical phenomena, while the new one, proposed here, covers the 'third world' — the domain of intentional objects — as well. It should be stressed here that this neophysicalism can, but not necessarily has to be understood as an ontological position. We can restrict ourselves to treating it as a method of analysing cultural phenomena; even if this method has some underlying philosophical theses, they are weaker, less decisive than the thesis of physicalism or ontological somatism. The intention of the above deliberations is to support methodological neophysicalism.

As regards the scope or level of radicalism of the reduction programme, the difference between the two physicalisms is analogous to the one between (classical) behaviourism and neobehaviourism. The radical and unsupportable programme of behaviourism, identical to the programme of physicalism, postulated absolute translation of all psychological concepts into physical ones, thus totally eliminating psychological concepts. Neobehaviourism, in turn, presents a much more moderate postulate: to define the ways of identifying internal states of a human or animal by external states, observable by senses and describable in physical terms; e.g. the force with which a rat struggles to reach its food, measured by the stretching of a spring, may be treated as an indicator of hunger. Therefore, the programme of total reduction, i.e. translatability of some terms into others, was replaced by a programme of partial reduction, which in terms of logic is expressed in the fact that the sentences linking the two systems of concepts, called reductionist definitions, are not equivalences but mere conditionals (cf. Kotarbińska 1966, Przełęcki 1966a, 1966b).

The postulate of total reduction of intentional objects to physical ones has never been advocated under the name of physicalism, but some similar proposals with respect to items related to language, such as propositions or concepts, can be found in the traditional nominalism. Thus, replacing this radical postulate with the programme of partial reduction, we could coin the term "neonominalism" for the latter. Such a term would, however, be less clear, as there are already many historical layers of nominalism. Another possible term would be "formalism", also with the prefix "neo-", but this term has already become too ambiguous.

Neophysical reduction does not imply a negation of the existence of intentional objects. This ontological question may remain open, just as in neobehaviourism it is possible to pursue the methodological programme without getting ontologically involved into the question of the existence of mental phenomena. However, in the name of intersubjectivity and practical effectiveness of some actions performed on texts, it is postulated that the characteristics of intentional objects, such as e.g. the coherence of a thought construction or the significance of an idea in a given moment, should be described and identified by using physical characteristics, such as a spatial arrangement in the table of relations. This way, the operations involved in understanding or creating a text can be presented in a semi-algorithmic way, by using directives of indexing, abstracting, branching a problem, etc. The operations involved in the evaluation of a text will be supported by the methods of calculating the indicators of coherence, ordering, etc.

This approach to texts and to other creations of culture involves a certain conscious deformation of an object. Indeed, in reality, the semantic organization of a text, even a 'dry' academic text, is independent from its pragmatic organisation. It is also not the case that keeping to the same topic in a text will always be reflected in a specific arrangement of entries in the table of relations. Certain side factors may prevent it, like rich vocabulary, using many various synonyms for the same concepts, or digressions motivated by pragmatic reasons. Such observations can be formulated at every step and could even be treated as reservations against the method of text analysis described in this essay.

Any possible objections should generally be answered by the following paradox: that these kinds of deformation of reality are a necessary condition of transformation. The intuition of an object, in the entire richness of this object and in its essence, is something very valuable, which serves the development of our intellect and our sensitivity, but we should not expect it to provide us with any effective directives of conduct. Bergson understood this very well when he attributed to intuition a contemplative value — inspiring to further learning and acting, but far from technical applications. It is the reality-deforming sciences (and only them), with their abstract and fixed conceptual frameworks, that — according to Bergson — can provide data for practical use.

An excellent illustration which seems to support the above thesis are the achievements of phenomenologists, in particular of Ingarden, in the field of reflections on the language and on various types of texts (cf. footnote 6 above). If the addressees of these reflections struggle through the maze

of conceptual distinctions and — trustingly (such an emotional approach seems to be necessary — let the intuitions of the author lead them, what they will get in return is richness of understandings. Their spiritual sight (if we choose to call it in this exalted manner) abounds with various curiosities of this world of intentional beings, which then becomes as tangible as the reality of our body or mind. Enriched by these experiences, we are likely to become more capable, or at least we have the opportunity to increase our skills, to conduct reflections or research on this world, including research of the kind presented in this essay. This impact, however, is indirect — by stimulating our ability to understand, and not by providing direct premises for practical directives. If we are looking only for direct premises, we can ignore the problem of the existence of intentional objects, the problem of their nature, etc.

It might seem paradoxical that the advantages of practical cognition are growing with every simplification or deformation made by us, but it dissolves after analysing any example. When a wild animal attacks me in a forest, the effectiveness of my defence depends on how much I am able to disregard some characteristics of the situation (e.g. the beautiful silhouette of the animal), in order to concentrate on the characteristics which are relevant in the given situation, such as the strength and agility of the attacking animal and its tactics. Consequently, my perception of the animal is incomplete, and thus deformed, like a caricature emphasizing only some features; but it is this deformation that gives it practical productivity. It would also be unadvisable to apply in situations like this the phenomenological postulate of suspending our own approaches and exposing ourselves totally to the impact of the contemplated object. For it is the approach of the subject that defines the point of view on the object.

Let us say it even more clearly — the passiveness of the cognitive subject is beneficial for contemplative cognition, but not beneficial to practically oriented cognition, which performs a vivisection of the object in order to 'cut out' an aspect of answer for specific practical needs. This is also probably one of the demarcation lines between philosophy and science: a philosopher aims at a contemplative description of the entire world, with respect to its complexity, while a scientist acts more unceremoniously, cutting the reality into various aspects, simplifying them when necessary, applying approximations required by his objectives. In this sense, the phenomenological concept of text is a philosophical concept, while the concept developed here is — at least in its intentions — a draft of a scientific theory.

When drawing such comparisons, we have to mention one more approach

to the problem of texts, called the theory of humanist interpretation, and applied for instance by methodologists from the Poznań philosophical circles (cf. e.g. Kmita and Nowak 1968, Zamiara 1974). It is close to the present deliberations as regards the approval of intentional simplifications, in the theory called idealizations. The fundamental idealization thesis of this theory is the assumption that the subject, in this case the author of a text, is rational. We must admit that this assumption plays an effective role in many analyses or interpretations of texts. If in the postulates characterising rationality we included the principle of non-contradiction, as it is usually done, we would get a directive for different types of interpretation, including abstracts. The directive would be as follows: if in the analyzed text there are both sentences S and non-S, we should not assume that the author accepts the contradiction but that in each case the sentence S expresses a different proposition.

However, it would be a misunderstanding to limit the idealizations in the interpretation or analysis of a text only to the assumption of rationality in this version or another. Another idealization underlying these deliberations as their philosophical basis is that some non-physical features of a text are attributed to certain physical features. The table of relations shows the presence of some of them. For instance, sticking to one subject (a non-physical feature) has a corresponding physical feature which is the sequence of entries in the table of relations filling one whole row or column of the table. In this case, idealization consists of approximation, which in some cases is realized in full, and in others creates a supporting question for the interpretation: why is there no full indicator of monotopicality in this case? The reason might be the multitude of parallel topics, as well as ambiguity of some terms, ineptness of expression or of composition, the existence of digressions. Taking into account these kinds of factors, we achieve a crystallization of our idealizing starting point.

In this essay, using a slightly polemical stylistics, which takes into account the point of view of a possible opponent, the above-mentioned idealizations have been called deformations. Indeed, they lead to a different image of a text than that presented by various concrete texts; let us remember, however, that it is not the concrete thinking but the abstract thinking that contributes to cognition which serves practical purposes, among others.

Such an idealization or deformation is related to all characteristics of a text described above, which are, apart from monotopicality: coherence of a text as the frequency of interrelations between the key concepts, structural adequacy understoood as physical structure consistent with the thematic structure, and finally order, being the result of an ordering relation in a text.

The above list is not necessarily complete and is accompanied by awareness that these are all surface features, not reaching into the depths of thought opening in many texts. But if all authors took the effort to ensure that their texts have these surface features and if all critics demanded it from authors, there would be much less texts in the world which owe their ostensible depth to a clouded surface.

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Teresa Hołówka
TROUBLES WITH THE SUBJECT

Linguistic Problems

Distinguishing the subject and the predicate in a sentence is considered to be one of the basic operations in language analysis. However, what is characteristic is the fact that the examples considered in this context are usually limited to the most elementary utterances: in linguistic works these are usually sentences composed of a *verbum finitum* and a noun ("*A dog barks*"), in logical works sentences composed of a simple predicate and a proper noun ("*Socrates is clever*").

This situation is not accidental, since it turns out that analysis of utterances composed of three or more components encounters considerable difficulties, and the adopted criteria of distinguishing the subject and the predicate become quite ambiguous.

And thus the most popular distinction in linguistics is: the item described in the sentence — what is said about this item in the sentence.[1] Let us take a simple sentence with the object of the following type: *John loves Mary.* We may interpret it in at least four different ways: 1) in this sentence we speak of a John who loves Mary, 2) in this sentence we speak of Mary that she is loved by John, 3) in this sentence we speak of John and Mary and that the former loves the latter, 4) in the sentence we speak of a love relationship between John and Mary. It does not seem that any of these interpretations is more adequate than the others. Linguistics assumes that

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[1] Everyone has come across this distinction over the course of their school education. It is also introduced in most of academic handbooks, e.g. Gałkina-Fedoruk 1957; Klemensiewicz 1961; Kopečny 1958.

the decisive factor in such cases is the formal properties of the expressions, i.e. the semantic subject of the sentence, the expression indicating the item which is described, is the expression being the syntactic subject (i.e. e.g. for inflection languages the noun or another word used in its place, appearing in the nominative and in agreement with the *verbum finitum*). According to the above, the proper interpretation would only be the interpretation in 1).

This traditional standpoint is encumbered with many ambiguities and errors. Above all, there is no deeper justification for the thesis that what is said in this sentence is exactly the same as has been indicated with the use of the syntactical subject. From the fact that "John" in the sentence *John loves Mary* has such and such morphological and syntactical properties, does not follow that this sentence is "more" or "only" about John, and not about Mary or about John and Mary at the same time. One may think that the source of the discussed view is the fact that one is suggested by simple sentences like *John is a teacher* or *John sleeps.* Since we are inclined rather to connect the notion of the "item" with a particular person rather than a class, it is kind of natural, that we split such sentences into two components, one of which refers to a certain item and the second ascribes to such items a certain attribute, i.e. something that is said about this item. Moving on to the analysis of sentences with objects, it is implicitly assumed, that identical or similar semantic relations between the components of the utterance correspond to identical or similar structures, and therefore, in particular, that an expression being the syntactic subject has also the same semantic role in any and all sentences. Such an approach to common language is naive and has often been undermined by the attempts to distinguish between the "surface", a purely external structure of the sentence, and its "deep" structure, constituting the basis for semantic interpretation, which stretch from Port-Royal Grammar up to the contemporary works of Chomsky and his followers. It is, after all, difficult to maintain consequently that e.g. in the sentence *John loves Mary* one speaks of John, whereby in the sentence *Mary is loved by John* one speaks of Mary, and then to explain the equivalence of these types of sentences or to convincingly explain what the difference between them consists of. As Reichenbach (1967) observed, traditional grammar, by assuming a strict division of sentences into two components is unable to acknowledge such phenomena as conversational or symmetrical predicates. The standpoint that the syntactic subject in the sentence has always the semantic function consisting of a reference to the item, which is described, is a mechanical simplification of the case. The role of the word "John" in the sentence *John is a teacher* is different from the role of this word in the sentence *John loves*

Mary, and both are different from the role of the word "John" in the sentence *John nags me.* In the first case John is included into a certain class, in the second — there is a certain relation described between John and Mary (and it is not clear, why in such cases one should be describing one person only), and finally in the third case — the speaker presents his attitude towards John's behaviour (and it is equally justified to assume that it is not John but the speaker that is being spoken of).

The idea connecting the subject of the sentence with the indication of the item described, would require a closer explanation of the expression "to speak of," as well as a justification of the thesis, that in each sentence it is possible to speak of one item only. In the present condition this idea does not provide the tools for a clear analysis of sentences other than one composed of two components. It would also be necessary to impose certain, not necessarily extremely nominalistic, limitations on the term "item," since if "an item" is both what the word "John" refers to in the sentence *John woke Mary*, as well as what the word "knocking" refers to in the sentence *Knocking woke Mary,* than the semantics of the common language is either bound to fall into a vicious circle ("an item" is what in a typical case the subject of the sentence pertains to, and the subject is the expression referring to the item which is described in the sentence) or, in case of no censorship between items and actions, to accept that in sentences such as *John knocks* there are simply two items: John and knocking.

The difficulties connected with sentences with three or more components have made the linguist adopt a more complex definition of the subject: a subject is an expression referring either to a carrier of an action (in the case of sentences with objects) or to the author of the action (Travniček 1951; Klemensiewicz 1962; Patree 1965). Also this standpoint may be argued to present an oversimplified view on the facts which we speak of in common language utterances. Not everything that is presented with the use of verbs is possible to be reduced to the scheme of actions (it was already noticed by Whorf that the notion of authorship is an expression of anthropocentrism characteristic for the western civilisation) (Whorf 1956).

Let us for example consider the following set of sentences:

John hit Peter.
John hates Peter.
John saw Peter.
John scared Peter.
John avoids Peter.

Only in the first case it is admissible to distinguish between the author

and the action. It is not an "action" to hate, to see, to scare or to avoid, although the transitivity of the relevant verbs might suggest that they are aimed at reporting something which belongs to the same category as hitting, giving something, taking something away, etc. Moreover, hating someone is naturally something more active than suddenly seeing somebody, scaring somebody is not directly caused by a given person, but rather by their particular behaviour, and avoiding somebody does not consist in "doing something," but rather in refraining from doing something, etc. Bending the relations between the syntactic object and the verb towards the opposition of the author of an act and the act, is made difficult, rather than impossible, by the semantic description of common language, all the more that in the case of verbs referring to authentic acts the notion of authorship brings many doubts. Are we dealing with authorship where the initiator of the act is an item capable of moving on its own? If yes, then the sentence *a stone broke the window* is a subject-less sentence, and in the sentence *John broke the window with a stone,* one should distinguish the subject "John." But if John constructed an automated device for breaking windows in the neighbour's house, then would it be John who was the author of the action, or the self-moving machine he invented? Further, if consciousness is a condition for the authorship of actions, then the forces of nature should be denied it. Let us take a dog biting a thief, what if the dog was set by its master?

Another standpoint present in linguistics which is relatively less popular, ties together the following opposition: subject — predicate with the opposition datum — novum.[2] Namely, most of the sentences appear in a specific word and situational context. Therefore, there are two elements in the sentence: one referring to the item known to the recipient of the widely understood context, and the other one providing new, hitherto unknown information about that item. The subject understood in such a manner is not always identical to the syntactic subject of the sentence — word order, intonation as well as the use of indicative particles are often the indicator of what datum and what novum is. And thus for example in the sentence *Columbus discovered America*, the word "America" is the subject. It is doubtless that what we utter is seldom drifting in a pragmatic void. Most of the sentences to a smaller or greater extent make reference to the context and is uttered in order to provide the interlocutor with new information. It is also true

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[2] This theory was i.a. propagated by H. Paul, G. v. d. Gabelentz, and in more recent times, V. Mathesius (1967), A. Bogusławska (lecture at a Polish Linguistic Society Meeting in 1965). A later theory of the latter author (*Of the propositional components of an utterance*) differs considerably from the one discussed herein.

to a certain extent that the analysis of the common language, abstracting from conditions in which something is uttered, would be incomplete. Is it so however that when we utter a sentence we really make a reference to one subject at most.

Among the expressions of the common language there is a considerable group of such expressions, what I mean are proper names and pronouns, whose use is governed by contextual rules. No-one will use the sentence *John loves Mary* if they are certain that the recipient will not be able to refer the words "John" and "Mary" to relevant persons. Also, no-one will say *I need this for that,* if the circumstances accompanying the utterance do not indicate clearly to what items both of these pronouns refer. Each expression, whose reference is undetermined outside of the context, is the datum in a particular sentence.

If we even limited the term "context" to utterances or situations directly preceding the analysed sentence, it would still be possible to list a number of cases, where this sentence will contain more than one datum, e.g. *I went to my cousin with the cherries. SHE washed THEM pedantically in cold water. My friend's father went to give a lecture in Cracow. Yet HE totally failed to do IT properly THERE.*

Finally, there are cases, when it is difficult to say what the datum and what the novum is. In the text: *Smith requests a holiday leave. His wife got ill,* the datum of the sentence *His wife got ill* would be the pronoun "his", referring to the abovementioned Smith. Accordingly, this sentence should be interpreted as an utterance communicating two things about Smith: that he has a wife and that this wife got ill. Analogically, the sentence *My cactus is withering,* would be informing not of some cactus but of the person of the speaker, and the sentence *The father of Socrates is not a well known person* would not be about Sophroniscus, but Socrates himself, etc. The sentence, *The mongrel, unfortunately, dies after a few days* in the following text: *I brought myself a dog from the countryside. The mongrel, unfortunately, dies after a few days,* would be about a certain dog, that it was a mongrel and that it died after a few days. On the other hand the word "mongrel" makes a reference to the same item, as the word dog used previously, otherwise we would need to assume that the reference in the quoted utterance is undetermined.

In the datum position there often appear non-nominal expressions, e.g.: *Who is that? IT WAS your friend. — I don't understand why he is always doing all these sports. But it is probably nice to MOVE in the fresh air. — It is not known how it happened. The head of the gang just ESCAPED. — I*

assumed that it will be she who will get admitted to the university. However, the other one WAS. The datum-novum theory would require adaptation of an ontology, whose objects would be what "it was," "to move," "escaped" and "was," etc. refer to; an ontology according to which "an item would be" everything is a certain circumstance that any language expression could refer to totally.

The Problems of the Logicians

As the linguistic standpoints concerning the issue of the subject may be argued as being ambiguous and too general, then the views of logicians are usually characterised by one-sidedness and a too narrow understanding of the subject-predicate relation. According to logicians such relations take place only in certain atom sentences or in some sentences composed of an individual name and a predicate.

According to the tradition reaching as far back as Aristotle, the judgement most fundamental for our thinking is considered to be the judgement consisting in the separation from reality of a certain fragment thereof, a substance and then in ascribing a certain property to such substance; or to use a more modern terminology, a judgement consisting in separation of an individual and including it into a certain set.

The logical controversies pertain to the problem, what sentences express such judgments, i.e. which of the sentences are subject to division into subject and predicate. In the opinion of some (Russell 1967; Searle 1967; Ryle 1951), subjects may only be proper names. Only with the use of proper names do we distinguish the substance without ascribing anything to it, for the reason that proper names do not mean anything (in the sense that they do not connote anything), but they only name something. Any other nominal expressions either have the predicative function, or (defined descriptions) constitute dependent fragments of compound assertions, requiring in their developed notation the use of quantifiers and variables. Therefore, the subject-predicate relation takes place only in atom sentences with a one-argument predicate, i.e. in such sentences as: *John sleeps* or *Warsaw is a city.*

In the opinion of others (Czeżowski 1971; Dąmbska 1971; Ajdukiewicz 1965; LInsky 1967), subjects may be any and all individual names, since as Czeżowski wrote: "an act distinguishing the substance is its reference in a single sentence to a subject in a sentence. This may be effected in one of two ways: either by subordinating the substance under a unit term in a descriptive sentence, or by indication thereof in an occasional expression" (Czeżowski 1971: 172). Therefore, subject-predicate relation occurs also in

such sentences as: *The oldest Polish university is in Cracow* or *Peter's father got sick.* In both concepts the subject of the sentence may be no more than one expression. However, if subjectivity is connected with the function of indication of the object, which is then ascribed a certain property, then it is not clear, why in logics one takes into account only simple properties. In the sentence *John is clever* John is ascribed the feature of being clever, in the sentence *John loves Mary* John and Mary are ascribed a relation of love. After all, relations have particular kinds of properties, and sets of ordered pairs, threes, *n*-s, that are special kinds of sets in general. It does not seem that ascribing simple properties to objects is something substantially different from ascribing relations to objects and that sentences with two grammatical components are an example of utterances which are more fundamental for the common language than sentences composed of three or more components. From the fact that a given structure is simpler does not mean that it is at the same time more typical and characteristic. Therefore, provided we consequently analyse the common language with the application of the categories of contemporary logic, then we have to agree with the thesis that a sentence may have as many subjects and as many expressions indicating the objects it contains. According to the foregoing, the subject-predicate relation would be present not only in such sentences as *John is clever* but also in such sentences as *John loves Mary,* where we could distinguish two subjects: "John" and "Mary" and the predicate "loves." The fact that in logical theories it is admissible to have no more than one subject, is probably a dark remnant of the traditional, grammatical predilection to parse any and all sentences into two clauses: the subject and the predicate.

Understanding of the subject-predicate relation as a relation between the expressions indicating the objects and the expressions ascribing (simple or complex) properties thereto seems to be a good and quite general tool for analysing common language. It remains to be determined, which expressions comprise the class of potential sentence subjects.

Radical logicians tend to believe that a subject of the sentence may only be a proper name, less radical logicians — each individual name. The supporters of the proper names theory emphasize the fact that these expressions never (with the exception of non-proper uses such as *All Barbaras are cheerful*) appear in plural and exceptionally rarely appear in syntactic opposition to the complement. Therefore, the mere rules of common language would suggest that subjects of sentences may only be proper names.

The fact, however, that something cannot be a complement does not prove that anything else cannot be a subject, and inferring conclusions on

the semantic properties thereof on the basis of the formal properties of common language, as seems to be demonstrated by the works of British analytical philosophers, is probably the contemporary illustration of being the victim of the "market illusion" first described by Bacon.

Each use of a proper name is individual and at the same time deprived of connotations, which is demonstrated i.a. by the fact that it may be given totally arbitrarily, whereby any other expressions cannot be freely ascribed to objects without considerable breach of language convention. The role of a proper name consists solely of the separation of some object treated as an original datum of the reality, in having the function of replacing an indicative gesture. Only proper names do not tie any prepositional contents, any predicative elements: "A dog may be called 'Fido', but the word 'Fido' conveys no information or misinformation about the dog's qualities, career or whereabouts. To develop this point: one cannot speak of any paraphrasing of the word 'Fido', or its correct or incorrect translation into French, dictionaries do not tell us what proper names mean for the simple reason that they do not mean anything" (Ryle 1967).

If a criterion for being suitable for a subject was the property of uniqueness and at the same time being deprived of any connotations, then there would be a problem with classifying a large number of expressions of common language. It is true that for didactical reasons it is convenient to illustrate the subject function of an expression with the use of such words as "Mary," "Warsaw" or "Fido," which is popular in Anglo-Saxon literature. What we are, however, inclined to include into the group of proper names does not always meet the logical criteria, if strictly perceived.

The name "Mary" may be given to a woman, a mine, a kind of mineral water or a ship. But it happens rarely that someone calls a woman "John" or a child "Biscuit;" and it would be rather difficult to decide, whether in such cases we would be dealing with a breach of the legal, moral or linguistic convention.

There are a lot of expressions, which in view of their spelling are classified as proper names and are undoubtedly used for naming things, but which are complex word formations with a meaning discernible for those who use them. Jerzy Pelc wrote "[...] it rarely happens that a white dog is called Blackie [...]", we would have objections if we were to give the name Fluffy to a dog with short and sleek hair" (Pelc 1971: 91, 115).

The *-owa* (for a married woman) and *—ówna* (for an unmarried woman) suffixes in the Polish language inform us about the marital status of the designee, and the *-ice* suffix informs us that a name pertains to a geographical

location (”*Police*”). It is common to use pseudonyms and nicknames (”John the Lackland,” ”Siwy,” ”Jędrek Hajduk”). Many expressions are composed of two or more independent words (”Palace of Culture,” ”United States of America,” ”New York,” ”Grand Central”). These are undoubtedly proper names, which lack descriptive elements. As it may be observed, however, they are more common in logical works than in common language. Additionally, the etymologists assure us that they are able to explain the sense of names given to people and things. There arise justified doubts, whether the logical concept of names is not an abstract idea, which similarly to the notion of the perfect gas used in physics, constitutes a model and does not have much to do with the actual functioning of the language.

Certainly, a radical solution is possible: one could include into the category of proper names only these expressions which are totally deprived of descriptiveness, and those complex word formations, whose sense is no longer discernible for the users (which, as linguists put it, got lexicalised). It will then turn out that there are but a few proper names in common language and that the expression of a simple judgement consisting in ascribing a certain quality to a certain object in the prevailing number of cases is impossible, due to the lack of linguistic means. Therefore the differentiation between the subject and the predicate would become a tool of analysis for very few utterances.

As it seems, lack of connotations is not after all a necessary condition for being suitable for a subject of a sentence. Proper names understood in a strict manner are the best for indication of the subject, which does not mean that one cannot use other expressions for this purpose. If it were otherwise, we would be unable to ascribe anything to chairs, doors, buildings and similar objects, since we ascribe proper names only to humans, certain animals, geographical objects and specific human creations. It is obvious that language had to develop means which would allow us to speak of all the things that do not have a name at all, also of the things whose names we do not know at a given time.

The descriptiveness of an expression does not only exclude the function of the subject, but is a condition thereof in many cases. The expression *Palace of Culture* is, in view of its origin, a description, but is not at all used to say something of a certain building, but simply to distinguish it. If somebody says *My youngest son caught measles,* he uses the description ”my youngest son” not in order to ascertain that there exists someone who has the quality of being the youngest son of that person, but in order to provide the recipient with clear instruction for identification of the person who has

just caught measles. Therefore, if the role of distinguishing the thing from which later something is said might be played not only by proper names (although this semantic function is the most characteristic for proper names exactly), then perhaps the class of potential subjects of a sentence needs to be identified, as postulated by the supporters of a milder approach in logistics, with the class of individual names.

This category certainly includes all proper names, descriptions, indicatives and personal pronouns in singular. Such words as "river" may pertain both to all items of a given class, as for example in the sentence *A river affects the humidity of the adjacent grounds,* as well as to exactly one object: *Do not swim in this spot! The river has whirlpools and unexpected depths here.* The situation of this kind is usually typical for common language — for almost each nominal expression it is possible to find (both linguistic and extra-linguistic) contexts, in which it may be a void, an individual or a general name. The same pertains to an extent with non-nominal expressions. Verbs may be one-, two-, or three-argument predicates (*John reads, John reads a novel, John reads Mary's letter*). One gets the impression that the traditional logical qualifications are hardly adjustable to the language we speak every day.

Theoretically, two solutions present themselves to us in this situation. Firstly, we may assume that most utterances in common language are characterised by ellipticity and may be analysed first, after all the abbreviations have been explained. And so, for example the sentence *A river affects the humidity of the adjacent grounds* would be a conventional, abbreviated form of the following sentence: *Each river affects the humidity of the adjacent grounds,* whereas the sentence *The river has whirlpools and unexpected depths here* is an abbreviation of *This river has whirlpools and unexpected depths here.* In the cases of the first kind, the word "river" is a general name, in the cases of the second kind — it is a dependant fragment of an expression pertaining to a single object.

Secondly, one might adopt a thesis that the expressions of common language are habitually polysemic. In both of the sentences quoted above, we are dealing not with two items of the expression "river," but two items of different, although isomorphic expressions: "river"[1] and "river,"[2] being an individual name, similarly, as in the pair of sentences: *It was impossible to move the castle to E4 — This castle has not been inhabited for many years,* there appear two isomorphic expressions "castle"[1] referring to a chess figure and "castle"[2] referring to a certain type of a building. Do these solutions allow for sufficient codification of common language? The postulate for the

supplementation of elliptical utterances before their analysis is well known in linguistics, it pertains, however to other cases. Sentence description should explicitly provide all information contained therein and known to the user. It is justified for such a sentence as *We were waiting until mother left work* to be ascribed the following "deep structure." "I was waiting for mother until mother left work;" otherwise the description would not explicitly indicate the fact that the subordinate sentence pertains to the same person as the object of the main clause. It is also justified e.g. for the sentence *It's been blowing since the morning* to be treated as an abbreviation of the sentence *The wind has been blowing since the morning,* since otherwise the language description would treat as incomplete an utterance, which in the opinion of a user is complete to such an extent that after it has been supplemented it becomes redundant. In such cases the procedure of supplementation is made possible by the strictly linguistic rules (the rule of elimination of the element repeated in the subordinate sentence, the rule of selective limitations for the verb "to blow"); therefore it is known, which missing elements of the utterance are to be supplemented. Sentences of the same kind as *A river affects the humidity of the adjacent grounds* and *The river has whirlpools and unexpected depths here* could indeed be reconstructed; a user hearing them knows that in the first case we are speaking of each river and in the second case we are speaking of a particular river. Nonetheless, most of the utterances in common language are characterised by the fact that their supplementations (in view of the possible emptiness, particularity or generality of the name) cannot be effected without knowledge of the context. Usually the use of the present tense suggests that the name being the syntactic subject has been used in formal supposition. However, this assertion may be considered to be exactly a suggestion and not a linguistic rule. The sentence *The river was sunlit* may pertain perfectly well to any river, e.g. the Nile (if it is uttered by someone on a ship on this river). Yet this may also be a fragment of a sci-fi novel and pertain e.g. to a wide stream of liquid ectoplasm. When we speak, we remove from the language message everything which is unambiguous in a given text. When talking to somebody of our own family, we may say *Father is the central figure in the house* without the fear that our utterance will be understood as an ascertainment of common patriarchalism. Supplementation of a common language utterance (in view of the logical classifications) is possible only in the cases when such operations are justified by language rules, i.e. such rules which are expressed in the users' intuition. A user hearing the sentence *Father is the central figure in the house,* knowing nothing of the circumstances in which it was uttered, cannot be sure whether it pertains to

a particular person or to all fathers. A language researcher has nothing left to do but to suspend the semantic analysis of this utterance or to accept that there are two possible interpretations.

The second possible standpoint, ascribing habitual polysmeny to common language expressions, entails similar consequences. The trouble with answering the question "What is meaning?" is so well-known that there is no need to present it here in detail. We might just note that this standpoint would add to an ordinary homonymy a homonymy of such a kind, which would be characteristic for common nouns in view of their emptiness, particularity or generality. Such words as "castle" would be characterised by double polysemy and it would be extremely difficult to construct such (even "working") a notion of meaning, which would make it possible to distinguish between polysmeny connected with different connotations from polysemy connected with the same connotation but a different denotation.

The theory of habitual polysemy would finally be forced, as in the previous one, to resign from the semantic interpretation of many sentences, if these sentences are provided in isolation from the context. Similarly, it is impossible to determine without the knowledge of the circumstances of the utterance, whether in the sentence *The castle seemed strong,* one meant a chess figure or a historical building, as a researcher of common language is unable to provide a complete semantic interpretation of the sentence *The river is sunlit* without the knowledge of the context, they may only note that the sentence is polysemic.

As it would follow from the above deliberations, adoption of a thesis on the separation of the semantic classes of common language and the assumption on the ellipticity of its utterances connected therewith or the assumption of the habitual polysemy of its expression, does not result in full semantic interpretation of the sentences, and in particular it does not always make it possible to decide the issue of the subject, since the fact that whether in a given sentence a certain object, or objects, is ascribed a certain property is in many cases decided by the context of the utterance.

These difficulties are not at all removed by another research standpoint that has become popular recently in scientific literature, which postulates that broad pragmatic circumstances of utterances are taken into account and that subject to classification are not the types of expressions, but the types of uses of expressions.

The followers of this direction (Pelc 1971; Strawson 1967; Ryle 1967) note that the most striking feature of common language is the fact that the same expression may be used in many various ways. Each expression, depending

on the context, changes its semantic functions and this is a somewhat natural phenomenon — the vocabulary of a language is so slender, as compared to the reality which it needs to encompass, that out of necessity it flexibly adjusts to the changing circumstances of the utterance.

Such properties as emptiness, particularity, generality, demonstrativeness, ascription, etc. pertain not to the expressions themselves, but to their uses. And thus, the word "river" treated as an isolated dictionary entry does not refer to anything, becomes a unit name, an empty name, or a very general name, but only in particular contexts. Therefore, there is no countable class of potential subjects of a sentence, but only a class of subjective uses of expressions, i.e. such uses, in which a given expression, in view of the context, would be characterised by particularity, indicative or identifying nature: "the fulfilment of the conditions for a correct ascriptive use of an expression is a part of what is stated by such a use; but the fulfilment of the conditions for a correct referring use of an expression is never part of what is stated, though it is (in the relevant sense of 'implied') implied by such a use" (Strawson 1967: 402). The criterion of the use of an expression to make a unique reference would be "some device, or devices, for showing both that a unique reference is intended and what a unique reference it is" (Strawson 1967: 401). Nearly every expression of common language may be used as a unique reference, although obviously there exist some expressions which cannot be used in any other way. What is meant here are proper names and some occasional expressions such as e.g. "he," "it" or "I." The devices signalling a unique reference are in this case: minimal descriptiveness and making the expressions maximally dependant on the context.

This is the end of generalisations which may be provided by the theory of common language understood as a theory of the use of expressions and sentences, since the remaining devices, deciding whether an expression has or has not been used as a unique reference are impossible to enumerate explicitly and sufficiently. It would seem that a signal of referential and not ascriptive use of a description is the occurrence thereof in the place of the syntactical subject. Let us look for example at the sentence with a description considered by P. T. Geach (1971) *The stockbroker who employed Joseph did not employ any Negro.* From this sentence it is possible to infer that Joseph is not a Negro. This, in Geach's opinion was to support the fact that the expression *the stockbroker who employed Joseph* is not a name (i.e. it is not the subject). If however one consequently includes pragmatic elements into common language semantics, then one can indicate examples, where the description *the stockbroker who employed Joseph,* depending on

the context, has sometimes a referential and sometimes an ascriptive role. In the following context: *Have you ever come across racism? Several times. The stockbroker who employed Joseph did not employ any Negro* the sole purpose of the description is for the recipient of the utterance to easily identify the person who turned out to be a racist, and not for the recipient to learn that a stockbroker existed who employed Joseph and therefore Joseph is not a Negro, since both of the facts are most probably well known to him (or at least the speaker makes the assumption that the recipient knows who Joseph and his employer are), moreover this is a pragmatic condition for the use of this description in this particular context.

On the other hand, in the context *Was the Joseph you mentioned a Negro? No. The stockbroker who employed Joseph did not employ any Negro,* the description *the stockbroker who employed Joseph* has a clear ascriptive function, since here not only a fact is stated that a certain stockbroker did not employ Negros, but also there is asserted a connection between the fact that a stockbroker employed Joseph, and the fact that the same stockbroker did not employ Negros.

It seems that a sufficiently general characterisation of the factors which decide whether a description is used as a subject or not, is a task doomed to fail. Among these factors a significant role is played by non-linguistic factors, and these are so varied, changing and unpredictable, that someone who would like to characterise the class of subject and predicate uses of expressions, out of necessity would have to limit himself to several stereotypical examples. Strawson wrote "The requirement for the correct application of an expression in its referring use to a certain thing is something over and above any requirement derived from such ascriptive meaning as the expression may have; it is, namely, the requirement that the thing should be in a certain relation to the speaker and to the context of utterance. Let me call this the contextual requirement. Thus, for example, in the limiting case of the word *I* the contextual requirement is that the thing should be identical with the speaker; but in the case of most expressions which have a referring use this requirement cannot be so precisely specified" (Strawson 1967: 401).

Therefore, irrespective of the fact whether one claims that the semantic classes of common language are disjunctive and its utterances are elliptic or polysemic, or whether one resigns from the classification of expressions for the benefit of the classification of uses, the problem of the subject and the predicate considerably exceeds the frames of the description of the language understood as a system, as de Saussure's *langue*. The fact whether a given expression is a subject of a sentence (i.e. whether in such sentences it is

an expression or an abbreviation of a unique and referring expression, or according to the second version, whether in this sentence in its particular use or in one of its uses it pertains to exactly one object and at the same time it distinguishes it or whether, according to the third version, whether in this sentence it is used referentially), is decided in common language not only by the syntactic and semantic rules, but also the non-linguistic context.

This raises the question: is it possible to pursue such semantics of the common language which would resign from the subject-predicate opposition?

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Barbara Stanosz
ON ESTABLISHING THE MEANINGS OF EXPRESSIONS OF AN UNKNOWN LANGUAGE

Allow me to tell you about my own idea for a utopia. An imaginative reader may find my vision of a perfect society somewhat repulsive, although in this respect my conception shares in the fate of all known utopias, but I would defend it on the grounds that it has been designed to explain the world, and not to change it. To wit, the purpose it serves is that of a thought-experiment.

The dominating cultural trait of my ideal society — let us call it group G — is its universal adherence to law and order: everyone respects the existing ideological code and the rules of social organization, always and without exception. A prominent position in the ethical system of group G is attributed to truthfulness and the principle accountability for what one says. So the people communicate to one another only what they believe, and they do so just in case the beliefs are justified. This means that, *qua* informants, everyone here trusts everyone else without the slightest reservations: having heard something, a person immediately incorporates it into his or her own stock of beliefs. Furthermore, so as to honor the principle of accountability for what one says, the G-ians only ask reasonable questions, which they always answer in earnest and to the best of their knowledge. Finally, the orders they issue are always sensible and optimal — vis-à-vis the shared system of values — so every command gets executed.

The main intellectual demand imposed on members of group G is that of good memory and consistency of beliefs: everyone who accepts a given sentence should also accept all the logical consequences it implies in conjunction with the rest of his or her beliefs. Owing to their intellectual upbringing, the

G-ians meet this demand. Not only is education adapted to fulfilling their ideals — so is language. The principle of accountability for what one says requires eliminating the possibility of verbal misunderstanding, therefore the language of group G does not contain any homonyms, ambiguous syntactic structures or indexical expressions: every sentence possesses a unique context-independent interpretation. Given the universal hypertrophy of trust to the spoken word, the range of language usage is correspondingly limited: nobody tells fables, myths or anecdotes, whereas fiction, poetry, religion and metaphysics are only practiced as genres of vocal music. Speech, as well as writing, is reserved for communicating reliable information, reasonable questions and sensible commands.

Now imagine a person from a different culture — call him the Researcher — who knew everything we have said about that society, and decided to visit it with the intention of describing its language. The Researcher's initial attempts had proven unsuccessful: the speech he heard sounded completely foreign, and he found no interpreter among the natives and no dictionary that would enable him to translate G-ian speech into his own language. Yet he was received with kindness and made to feel welcome: no one interfered with his observations and the natives happily participated in his linguistic experiments. So he set to work. Let us trace the various stages of his cognitive enterprise, highlighting its structure rather than chronology, in order to arrive at a rational reconstruction. We shall provide a brief treatment of the first phase, so as to characterize in detail the final stage, in which the Researcher establishes the foundations of a translation of G-ian sentences into his own language.

First of all, the Researcher tries to gather a rich sample of products of the linguistic behavior of members of group G, which is to say he collects as many of their UTTERANCES as he can. Note that the knowledge that members of group G communicate with one another by means of a series of noises generated in the vocal tract does not warrant the conclusion that any such series of noises qualifies as an utterance; the Researcher has to have an additional criterion to distinguish between linguistic and non-linguistic behavior. Let us assume that he does.[1] The result of the first stage of the Researcher's work is a record (e.g., a tape recording) of a significant number of series of sounds (physical events) constituting the G-ians' utterances. Call this set of observed utterances S_0^*.

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[1]The most commonly cited distinguishing characteristics of the acts of producing a series of noises that are linguistic in nature include their arbitrariness and the fact that they are oriented toward the hearer.

Next, the Researcher establishes which elements of S_0^* differ from one another in a linguistically irrelevant sense — that is to say, are tokens of the same MEANINGFUL EXPRESSION (SENTENCE). He does that by enumerating the sounds appearing in the recorded utterances and defining a relation of phonological equivalence between them.[2] Then, he defines the relation of type-identity (as obtained between utterances x and y if all the component sounds of x are phonologically equivalent to the corresponding component sounds of y) and divides the set S_0^* by this relation, arriving at the set S_0 of sentences represented by the recorded utterances. Furthermore, if S_0^* is a representative sample, the Researcher can compose a complete list of phonemes for the language he is reconstructing, which would enable him to pair any novel utterance (not belonging to S_0^*) with the sentence it represents.

At a later stage, the Researcher applies himself to the task of decoding semantically the sentences he hears. By way of preparation he observes closely certain members of G so as to establish what body of beliefs each of them has. Guided by the assumption of rationality, he reconstructs the beliefs of the people under observation as sentences of his native language such that the behaviors of those people are optimal (in light of their goals, which he already knows) if and only if the sentences in question are true. Having thus obtained a catalogue of beliefs of each of the selected subjects, the Researcher then uses those people as involuntary 'interpreters': namely, he registers utterances addressed to them and establishes how the reception of those utterances influences the subjects' stock of beliefs, which in turn allows him to find translations of the sentences represented by those utterances into his own language.

For he reasons as follows. Universal confidence in what is said means that the reception of any sentence (containing information that does not belong to the set of the hearer's previous beliefs) modifies the hearer's body of beliefs. The virtues of the language (non-indexicality and the lack of ambiguity of its sentences) and the logical prowess of the members of group G guarantee that the modification of beliefs brought about by receiving a given sentence is the same for all the hearers. Of course, this sameness does consist in the fact that the differences between the hearers' set of beliefs prior to hearing the sentence and their subsequent set of beliefs are always the same, for those differences depend on the content of the hearer's prior

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[2]It is debatable whether one can establish this relation before acquiring some knowledge about the meanings of linguistic expressions in a given language. Here, I assume that this is possible.

beliefs as well as on the content of the sentence in question. What is identical in such modifications of beliefs caused by receiving a given sentence is a sentence (of the Researcher's language) which, after being added to the set of prior beliefs, axiomatizes the set of subsequent beliefs. It is that sentence which one can take as a translation of the sentence whose reception has evoked the perceived change in beliefs.[3]

This is how the Researcher pairs the sentences of the language of group G received by his involuntary 'interpreters' with the sentences' translations into his own language. Thus, he establishes the truth-conditions of some sentences of the language under investigation, as well as the relations of synonymy and entailment in the set of those sentences. Note, however, that he cannot interpret every sentence heard by his 'interpreters': the sentences that do not result in a change of beliefs remain undecoded; all that he knows about such sentences is that they convey information the subjects under observation must have acquired at an earlier time. Furthermore, regardless of the number of sentences thus interpreted, the explanatory (and, therefore, predictive) value of this kind of description of the language under investigation is very limited: it enables one to 'predict' an interpretation only for sentences that have already been used in acts of communication observed by the Researcher, whereas most sentences uttered by people are novel ones. A satisfactory description of the language of a given community must provide a method for 'calculating' the meanings of all sentences that might appear in the communication acts occurring between members of the community; there are an infinite number of such sentences.

In pursuit of such a description, our Researcher will use the results obtained so far as an empirical base for theoretical hypotheses. The hypotheses will be about the set of morphemes in the G-ian language, the meanings of those morphemes and the set of syntactic structures (identifiable by suitable markers) admissible in the sentences of the language. For the Researcher is after the general principles of the segmentation of sentences into minimal units of meaning and rules that would allow him to establish the meaning of a sentence on the basis of both the meanings assigned to those units, and some observable relations that obtain between those units. So the sentences

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[3]There are many such sentences in the Researcher's language, but if they are all synonymous, any of them can serve as a translation. Sentences α and β, such that each of them axiomatizes set B in set A (i.e., $Cn(A + \{\alpha\}) = B$ and $Cn(A + \{\beta\}) = B$), can differ in meaning just in case the sentence '$\alpha \equiv \beta$' is non-analytic and belongs to A (we assume A to be a system). Thus, the Researcher will choose as his 'interpreter' a person who does not possess such beliefs.

interpreted earlier, independently of those rules and principles, will serve both as the Researcher's source of inspiration in the formulation of those rules and principles and as the first test of their adequacy. To wit, while composing his list of morphemes of the G-ian language, assigning a meaning to each morpheme (by pairing with it an expression — not necessarily a morpheme — of his own language), and building a catalogue of admissible syntactic structures of sentences of the language, the Researcher will take care that this 'linguistic machinery', applied to previously interpreted sentences, and assign to them meanings identical to those established earlier. Once he has formulated hypotheses compatible with all initial data, he will test those hypotheses (and correct them, if necessary) against new data: namely, he will attempt to predict, on the basis of his hypotheses, the meaning of previously uninterpreted sentences, and then he will confront his predictions with the facts, or with the output of the previously described method for interpreting the G-ian sentences independently of the hypotheses under consideration.

Having successfully conducted a certain number of such trials, the Researcher will consider his task to be complete: he has provided an empirically adequate description of the G-ian language that determines an infinite set of sentences and allows one to translate any sentence into the native language of the Researcher, or to interpret it semantically. Thus, he has assigned truth-conditions to all sentences of the language under investigation, he has discovered all the synonymies and entailments, and he has identified all analytic sentences.[4] He solved the problem of interrogative and imperative sentences as follows. He made the intuitive assumption that the meaning of a question (or command) is identical with the meaning of a declarative sentence whose acceptance disposes the hearer to utter an answer to the question (or execute the command, respectively). Thanks to this assumption, by constructing the tools to identify the meanings of declarative sentences, he has provided the resources to interpret questions and commands without having to treat them as separate types of expression.

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The conditions under which our Researcher pursued his cognitive goals stand in stark contrast to the natural work conditions of a linguist trying

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[4]Naturally, I am assuming that the Researcher's native tongue has itself been characterized in all those respects.

to learn and describe a foreign language. First of all, the actual researcher reconstructs the language on the basis of a sample consisting of notoriously ambiguous, often deviant utterances or sentence fragments (which, in actual acts of communication, are filled in by features of extra-linguistic context). Secondly, he cannot assume that the set of beliefs of a person who has just heard a sentence is a function of the person's earlier beliefs and the meaning of that sentence: after all, normal people often tell lies and jokes, gossip, recite poetry, preach sermons, lecture in philosophy, etc., so normal recipients of utterances do not always believe (everything) they hear. Thirdly, ordinary people, as opposed to the G-ians, are not blessed with total recall or the skill of making perfectly logical inferences, which is why, even when they do believe their interlocutor, the set of their beliefs differs from the set of the logical consequences of their previous beliefs augmented by adding the newly accepted belief. The upshot of this is that a researcher, unlike the Researcher, cannot rely on evidence of the recipient's beliefs as an indication of the meaning of the sentence received.

We must now ask: How does our utopian situation relate to the position of an actual linguist working in natural conditions? How do real-life linguists collect initial data — a finite set of interpreted sentences — that serve both to inspire and to test subsequent theoretical posits, which make it possible to interpret any of an infinite number of sentences of the language under investigation? Do they collect the data in a different way, or do they decode the foreign language according to some other principles, which do not require having such an empirical base?

It is clear that, in order to answer these questions, one cannot merely observe the researcher at work for a sufficiently long time, no matter how much attention one pays to the various aspects of the linguist's behavior, because the general principles governing his or her activities are not available in direct observation. Nor can one simply ask about them, for the researcher does not have to be aware of these principles — indeed, he or she rarely is. The job of a practicing researcher is to obtain correct results; the task of providing a reconstruction of how these results have been obtained, which reveals the methodological structure of a given field of study, rests with the philosopher of science.

Professional philosophers as well as linguists concerned with the methodological foundations of their discipline have proposed a number of competing theories in this connection. I shall briefly discuss some of them.

At one extreme, we have the view that it is possible to arrive at a complete reconstruction of an unknown language by relying solely on an

existing text, and the reconstruction can be accomplished by means of a series of algorithms, each solving a particular subtask (of isolating the phones or 'letters', of identifying the morphemes and sentences, of establishing syntactic relations between expressions in a sentence, and, finally, of defining the meanings of sentences and their component parts). In fact, it is not necessary that a researcher possess any additional knowledge about the text, including knowledge of any of its semantics, or about the speakers of the language in which the text has been formulated — about their needs, customs, beliefs, etc. This view goes hand in hand with the belief that providing a mathematical description of particular linguistic procedures amounts to justifying them, because it endows the corresponding concepts with exact meanings; of course, this is so on the condition that the procedures in question have been successfully tried out in practice (Apresjan 1971: 158-159).

This position is programmatic: so far, no such series of algorithms, capable of decoding a language together with its semantics, has been constructed. The hope that the program can succeed derives from the fact that several algorithmic methods developed in phonology, morphology and syntax yield satisfactory results when applied to a number of known languages.[5] However, the position's main shortcoming does not consist in an excessive optimism that is hardly warranted by the results obtained; rather, it is due to an incorrect assessment of the cognitive value of those results. Namely, all the linguistic algorithms to date rely on statistical regularities (of the kind: the most frequent letter occurring in the text is a vowel) observed to hold in various languages. The regularities are not explained by more general laws, however, and nothing supports the supposition that they hold for all languages: the known human languages do not constitute a representative sample of the class of all possible languages. Therefore, the mere fact that the algorithms in question yield approximately correct results when applied to several known languages does not make them scientific. Nor can they have any claim to being scientific methods on the grounds of the mathematics they employ (which, incidentally, is rather simple), for there is more to science than having precise concepts.

This negative assessment of the methodological aspects of these techniques does not detract from their usefulness as techniques rather than methods — with a limited scope of application, informed by a researcher's intuition that is grounded in his or her 'informal' general and professional

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[5]One interesting example is the algorithm for isolating morphemes developed by Harris (1955).

knowledge.

Let us focus for a moment on the possibility of constructing an algorithm capable of yielding a semantic description of a language on the basis of an isolated text. Indeed, the very proposition sounds like something taken out of a fairy tale: there is no evidence whatsoever that any regularities concerning the shape or spatial interrelations of linguistic expressions could serve as a basis for such an algorithm. On the contrary, the well-known conventionality of the connection between a sign and its meaning seems to speak against such a possibility. In order to establish the meanings of linguistic expressions, a researcher has to consider the role those expressions play as tools of communication, which is to say, he or she has to study the text 'in action'. It must be admitted that a vast majority of theorists share this view: only a handful of authors cling to the hope that one day we may discover methods for programming a machine that could decipher a text in Martian, should the Martians ever decide to send us one.

However, there are a variety of stances that one can take toward the issue of how directed observation of communication phenomena leads to the discovery of the meaning of linguistic expressions. According to one of the latest linguistic theories, what forms the basis of a semantic characterization of a language are statistically determined semantic regularities, which is to say correlations between expressions (sentences) and the conditions systematically accompanying their uses (Ziff 1960). One identifies a set of semantically relevant circumstances associated with a given sentence by eliminating as irrelevant the conditions that accompany any act of linguistic communication (such as vibrations of the vocal cords) and ignoring random correlations (such as between having a philosophical discussion and using the sentence 'Every bachelor is unmarried') by appealing to structural similarities between sentences. Then, in order to establish the meaning of a component expression, one compares this set of semantically relevant conditions with sets of conditions accompanying sentences that differ from the sentence under consideration only with respect to one component expression, and with sets of conditions associated with sentences containing that expression.

Critics of this account complained about the vagueness of the notion of accompanying condition and pointed to serious problems with eliminating semantically irrelevant conditions (Tartaglia 1972: 179-186). From a philosophical point of view, something else appears to be a much more fundamental shortcoming. Namely, the account relies on an assumption that there are statistically relevant dependencies between the meanings of linguistic expressions and the circumstances of their use. Clearly, sentences such

as 'This is a dog' do not raise any doubts in this connection. In the general case, however, the assumption is unacceptable for the simple reason that people do not only talk about objects and phenomena in their immediate vicinity, however broadly construed. The author of this conception is well aware of this: he predicts that it will be impossible to establish any semantic regularities for a considerable number of sentences, and recommends that such sentences simply be omitted. But what are the grounds of his confidence that, for any language, one can find a sufficient body of sentences exhibiting such regularities? Just like in the case of the previously discussed position, this claim is a generalization of observations about known human languages. In both cases, there is no general law to warrant this generalization; because the generalization is based on a non-representative sample of the class of possible languages, the procedure the generalization supports is methodologically unsound. Perhaps it would be profitable to count this procedure among practical decoding techniques, its use being fruitful on the condition that its scope of application be checked and delimited by the researcher's knowledge and intuition.

One might now ask: What type of semantic decoding procedures for natural languages would be immune to this kind of objection? Well, such arguments do not undermine methods based on dependencies that are guaranteed by the definition of the concept of meaning. Furthermore, it seems that, notorious as the various debates about the definition of meaning might have been, one can identify some dependencies that a vast majority of experts would regard as *ex definitione* semantically relevant.

One such dependency, with a caveat I shall formulate below, is the frequently emphasized connection between the meaning of a sentence and the conditions in which the sentence is assented to or dissented from. The method Quine devised for discovering the meanings of linguistic expressions that exploits the notion of stimulus meaning relies precisely on this dependency (Quine 1960:31f). Two sentences are stimulus-synonymous if and only if the stimulations (kinds of events) that prompt the speakers of a given language to assent to (dissent from) one sentence prompt them to assent to (dissent from, respectively) the other sentence. Assuming that the meaning of a sentence is determined by a pattern of stimulations prompting the speakers to assent to the sentence and a pattern of stimulations that prompt the speaker to dissent from the sentence, and drawing parallels of the kind described in Ziff's theory, discussed above, one can attempt to establish the meanings of a sentence's component expressions.

One of the most serious objections raised against this account is

the observation that stimulus-synonymy is a necessary, but not sufficient condition of synonymy in its everyday, intuitive sense (Tartaglia 1972: 145-146): if a person knows that the morning star is the same object as the evening star, then the sentences 'This is the morning star' and 'This is the evening star' are stimulus-synonymous for her; so if all the respondents know this, then Quine's criterion of synonymy fails. Therefore, one can only accept it on the condition that the criterion be applied when it is guaranteed that no extra-linguistic knowledge will interfere; alas, the condition is impossible to meet. Moreover, the criterion enables one to discover, at the very best, the meanings of linguistic expressions that are closely linked with sense experience: it is useless when it comes to sentences containing non-ostensive terms.

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Let us return to our utopia. The Researcher acted on the assumption that reception of a linguistic message brings about a change in the 'internal state' of the hearer, which we ordinarily call acquiring the belief that whatever the sentence asserts is the case. Given universal confidence in the interlocutor, the truth of this assumption would be guaranteed definitionally. We have also supposed that the Researcher has access to other people's beliefs: he can reconstruct those beliefs in his native language on the basis of the behaviors of the people under observation (and, perhaps, his knowledge about their system of values or the hierarchy of their goals). This last supposition seems to be very strong, yet it is very often relied upon in the humanities. In fact, it seems unavoidable given what we want to accomplish; the conception of stimulus meaning provides a case in point: without knowing our respondents' beliefs, we cannot establish the meanings of sentences, which the respondents assent to or dissent from in light of the types of stimulation we know.

How can we exploit our Researcher's methodological ideas if we waive the assumption of universal mutual trust? For, in natural conditions, a change in 'internal state' that corresponds with comprehending somebody else's utterance consists in a play of imagination rather than a modification of the set of one's beliefs: having understood a sentence, one realizes what would have to be the case if the sentence were true, but one can remain non-committal about its truth-value.

A linguist has very limited access to the sphere of mental lives of the speakers of the language under investigation (and, arguably, before he

can communicate verbally with them, he has no such access at all): in this case, the most he can hope to accomplish is to establish the meanings of ostensive expressions by way of applying criteria such as those envisaged by Quine. In his attempt at providing a complete semantic description of an unknown language, a researcher, it seems, has to start out by following in the footsteps of the Researcher: he has to work under the assumption that all the sentences whose use he has registered are assented to by the hearers, and then try to assess the influence of the utterances' reception on the hearers' beliefs. He will later verify and correct the tentative translations of sentences into his native language that were based on this assumption, discovering inconsistencies or incompatibility with new data, but as a starting point, this assumption is his only chance at success.

In fact, the assumption in question has a similar role in the semantic reconstruction of a language to that played by the supposition that no recorded utterance is deviant in syntactic description: a researcher's initial hypotheses regarding grammaticality rest on precisely this supposition; only later can any corrections be made that result in treating part of the collected language material as 'damaged goods'.

The practical successes of real-life researchers in describing the semantic properties of previously unknown languages seem to speak to the approximate truth of the initial assumption that people believe what they hear. Since naive people appear to be a minority, perhaps the majority are those who are earnest and accountable for what they say.

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