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Contents

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LITERAL MEANING AND IMPLIED MEANING IN LINGUISTIC COMMUNICATION

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The present article discusses how logic sees the issue of meaning in colloquial utterances, and to what extent the logical point of view can be employed in analyzing colloquial language. In my opinion, such a discussion is necessary. For it seems to me that logicians tend to apply their very specific analytical apparatus to matters to which such an apparatus is not fully appropriate, or is not appropriate at all. On the other hand, logicians share this tendency with scientists of all other fields who regard their scientific disciplines as the most important in the world and who frequently try to go beyond the competence directly related to their branch of knowledge. For instance, mathematicians do the work of linguists when they argue that the phrase *smaller half* is incorrect, whereas from the linguistic point of view it is in fact quite correct.

Let me begin with a memory from Wrocław, where I was working for a few years in the Department of Logic, at the Polish Academy of Sciences (PAN). During this time a man came to me asking to prepare an expert's report to the court. This expert's report was supposed to prove his innocence. My task involved demonstrating that the police had not found any stolen items in his farm-yard. According to the man, this alleged fact resulted undoubtedly from the documents of the case. He suggested I focus on the following sentence from the police search record: *No stolen items were found in the suspect's farm-yard, except for a pile of bricks measuring 3m x 2m x 1,5m.* The second part of the sentence had no influence on the first part, in my (obviously would-be) employer's opinion. For, since the first part clearly

and unambiguously states that *no stolen items were found in the suspect's farm-yard*, then there were no such items and that's the end of the story. Of course, I did not share this opinion and I did not take the case. However, the very idea to present such a task to me is a characteristic symptom of how the public perceives logicians. The public sees them as people who understand utterances on the surface and who categorize them mechanically, without a due insight into the context of the utterance and regardless of the intentions of the speaker. Anybody who took a course in logic run by a professional logician realizes that such an approach to the discipline does not comply with the actual state. The contemporary methods of logical analysis are very subtle and allow us to reach deeper, not only to the pure content of an expression but also to the content's modal status or tense status or epistemic status, etc. It seems thus that logicians are wrongly put on a par with superficial pedants without imagination. Where does this opinion come from? I suspect it has to do with the above mentioned notorious exceeding of the competence which can take different forms.

One of the symptoms — others will be discussed later — is over-sensitivity to the so called logical errors, since not always a logical error is an error in general. What is crucial here are various external theory-independent factors. Hence, discovering errors involves tact, moderation and common sense, not only the knowledge of logic. Let me again refer to an authentic story about the semantic high-life. A few years ago, during a break at a conference in Warsaw, a certain famous logician came to me and started complaining that people neglect basic laws of logic and ignore rudimentary norms of correct reasoning, which makes them talk terrible nonsense. To support his claim, he quoted a radio presenter who said that morning: *America is the biggest trade partner of Mexico*. At first, I did not understand what his point was. He was very surprised and explained to me that the hideous mistake was that Mexico itself lies in America. This event is an extreme example of a potential discrepancy between a logician's understanding of an utterance and a common person's understanding of the utterance. A logician focuses on the formal properties of a message, while other people aim at understanding the content. This process could be paraphrased as in Młynarski's song: the hearer, *disregarding the syntax of the sentence*, tries to understand what the speaker *has at his heart's entrance*. To put it shortly, errors are not a problem as long as they do not disturb in deciphering a message. On the other hand, in the described case the error is more than problematic. The criticized radio presenter would have to put a lot of effort to satisfy the requirements of logic. It would not even help to

say: *the UNITED STATES are the biggest trade partner of Mexico*, since, unluckily, the full name of Mexico is: the United States of Mexico. Similarly, the full name of "America" is: the United States of America (The fact that what is meant is North America and not South America is, unfortunately, to be deduced). Hence, it seems that the presenter should have said: *The United States of (North) America are the biggest trade partner of the United States of Mexico*. However, if he were expressing himself in such a pompous way, he would soon lose his job.

In logic, the content of a sentence is represented by the truth-conditions of the sentence. In more technical words, the content of sentence α is the set of all those possible words in which α is true; this definition was first introduced by Cresswell (1973). For a layperson, the following definition, equivalent to the previous one, could be a bit more comprehensible: *the content of an utterance is a set of all the information that the utterance entails*. Logical entailment (implication) is a key concept in logic. The fact that a certain set of sentences X logically entails a certain sentence β is symbolically represented by $X \vdash \beta$. I will not define the entailment relationship here, but I will give a simple example. The utterance *John is an internist* logically implies, among other things, the following sentences: *Somebody is an internist*, *John is either an internist or a cardiologist*, *If John is not an internist, than I am a priest*, *It is not true that John is not an internist*, etc. Sentences true in ALL possible words are called *tautologies*. Let me note that tautologies, if taken literally, add nothing to our understanding because they do not entail anything (except for other tautologies). Let us consider the following three tautologies:

$$p \vee \sim p,$$

$$p \longrightarrow p,$$

$$\sim p \longrightarrow \sim p.$$

Sentences built according to these schemes are informatively empty. It is intuitively apparent that somebody who says e.g. *It will rain, or it will not rain* does not forecast anything relevant about the weather. Similarly, somebody who says: *If it rains, then it rains*, or *If it does not rain, it does not rain*. These three schemes were not chosen at random and they will reappear later. Let us, however, return to the main thought.

According to the remarks presented above, the content of sentence α, symbolically $\mathbf{T}_l(\alpha)$, should be defined by the following pattern:

(1) $\mathbf{T}_l(\alpha) := \{\beta : \{\alpha\} \vdash \beta\}$.

Such a pattern, however, would be of only theoretical significance since the defined content would be much too poor, from both a practical and a logical point of view. The thing is that a heard sentence is never completely isolated and placed in a vacuum. Contrary, it always joins the huge system of information that we had even before we heard the sentence. This system, i.e. our general knowledge about the world, helps us reconstruct the content of a sentence. Thus, the above sentence *John is an internist* actually has more senses than would result from pattern (1). Our knowledge of general rules governing the world allows us to supplement the content with the following information: *John is a doctor*, *John graduated from a medical university*, *John is a man*, *John is an adult*, etc. The set of data used in the inferences of this type, i.e. the previous basic knowledge of the world, will be marked with **W**. Thus, the definition of the content of sentence α will be:

(2) $\mathbf{T}_l(\alpha) := \{\beta : \mathbf{W} \bigcup \{\alpha\} \vdash \beta\}$.

According to (2), and in contrast with (1), the content of a sentence is in principle subjective. For it is apparent that — with a fixed α – $\mathbf{T}_l(\alpha)$ is bigger, the bigger **W** is. Thus, the content of a certain sentence is richer to a person with broader initial knowledge and poorer to a person without broader knowledge. This interesting fact will be put aside, however, as there is, from the point of view of this article, a more significant property of pattern (2). The thing is that $\mathbf{T}_l(\alpha)$ covers only the elements of the literal content of sentence α (hence the index **l** in the symbol). However, in an actual verbal message the literal content is only one of the components of the content actually conveyed, and occasionally is the least important component. As far as an utterance in a natural language is concerned, the traditional formal logic has tools ONLY FOR ANALYSING THE LITERAL MEANING. Thus, if a logician uses the tools to utterances which are open to the hearer's interpretation, then they also exceed their competence.

Kemeny (1959: 6) wrote: "in our decimal notation just ten different digits suffice to express any number whatsoever quite conveniently. If we allow ourselves a few thousand precisely defined words, we should be able to express almost any idea clearly." This neopositivist program has not been pursued till today, half a century later. Also, nothing indicates it could ever be pursued. It seems that the time has come to admit that, as far as natural language and colloquial communication are concerned, logical semantics can only capture one tiny part. Outside logic, in linguistics and philosophy of language, differentiating between the literal and non-literal contents is, of course, nothing new. In contemporary bibliography, the distinction „literal

vs. non-literal" is rendered with other terms, e.g. what was *said* and what was *implied* (Grice 1975), *sentence meaning* and *utterance meaning* (Searle 1979), *conventional* content and *figurative* content (Sadock 1979), *explicature* and *implicature* (Sperber and Wilson 1986).

A trivial example of an utterance with implied meaning is *It's twenty to seven*. The sentence's literal content is simple and straightforward. Let us imagine, however, that it was uttered during breakfast preparations, in the dialog:

A: *I forgot to shop yesterday. Please go to buy bread.*

B: *It's twenty to seven.*

Here, the sentence *It's twenty to seven* means more or less: *there's no point in going — it's too early and the shop is closed*. The very fact that it is 6:40 is in this specific communicative situation not relevant. What is important is that the dialog participants will not have bread for breakfast, and this is, in general, the content of the utterance of speaker B.

It could be argued that the content elements of the above sentence *It's twenty to seven* could be detected by means of pattern (2). For the dialog participants know that the shop opens at seven. Since it is 6:40 — this information is included in the speaker's B utterance — speaker A infers that it is not possible to buy bread, at least temporarily. However, it is not that simple. Although, in principle, the above argument would be correct, the problem is that it would be of SINGLE-application, i.e. it would concern only this one case. Let us imagine that the same sentence was uttered by student S during the lecture of professor P; the lecture started at 5 pm and was to last one-and-a-half hours:

P: *...and I would like to discuss yet another important topic...*

S: *But, Professor, it's twenty to seven.*

This time the content of the sentence, and it is worth highlighting: the same sentence, is totally different: *you have already prolonged the lecture and it's time to end it*. In order to rescue pattern (2), it would be necessary to assume that we infer using some elements of knowledge but disregarding others, and we choose certain elements according to the situation. Indeed, it is so very often, and it is possible that such an approach could turn out to be fruitful. Taking such a perspective involves indicating the rules stating how the utterance itself and the utterance's context, jointly, suggest the hearer which specific fragment of **W** should be used in order to use pattern (2) in a given communication situation. Presumably, however, even far-reaching improvements would not result in pattern (2) having a universal application. At least two types of phenomena common to linguistic communication seem

to confirm that. First, it happens that non-trivial content is conveyed by means of tautological utterances. Since the literal content of such utterances is, by definition, empty, manipulating with set **W** cannot change anything in the case of tautologies, for — with a fixed **W** — EVERY TAUTOLOGY WOULD HAVE THE SAME CONTENT. Second, it happens that the actual content of an utterance not only does not follow from the literal meaning, but is completely contrary to the literal meaning. Also in such cases, pattern (2), even if seriously modified, would not have an application. Hence, we will look for an account of the non-literal content elsewhere. We will begin, however, with a few examples illustrating the communication phenomena mentioned above.

Let us for a moment consider again the tautologies mentioned earlier: $p \vee \sim p$, $p \rightarrow p$, $\sim p \longrightarrow \sim p$. If a division into more and less obvious laws of logic was possible, the three tautologies would be surely found among the most trivial ones. Despite their extreme lack of informativeness, under certain circumstances, sentences constructed in such a way can convey an important message, though it will not be the literal message. My wife once happened to use in a normal conversation a conjunction of all these three tautologies in a single utterance! It was: *You know, we either clean or we don't, when we clean, we clean, but when we don't, then we don't.* Let me remark in passing that the tautologicity of the utterance is striking only for a logician. All others, and to be honest also logicians who are not in their normal (i.e. criticizing) mood, will find an important and easily-inferred implied meaning in the utterance, i.e. that our cleaning is not systematic enough, but quite contrary — it is a matter of impulse. Numerous other tautologies have a similar communication effect: *If it is not allowed, then it is not allowed*, *A head is a head*, *Children are children*, *I am myself*. Under certain circumstances utterances constructed in such a way convey specific, relevant information on their extra-literal level, and hence their tautologicity, rightly, escapes the speaker's and the hearer's attention.

Let me point out that in all previous examples it was characteristic that the non-literal content supplemented the literal content, i.e. it was added. However, it happens to be so that the non-literal content completely contradicts the literal content and, consequently, the latter is rejected, for, of course, two contradicting pieces of information cannot co-exist. This is a typical feature of e.g. ironic utterances. Let us turn to the following textbook example of a dialog between student S and teacher T:

S: *Tehran is in Turkey, isn't it, teacher?*

T: *And Warsaw is in Armenia, I suppose.*

In the dialog, somehow paradoxically, the non-literal meaning of the utterance *Warsaw is in Armenia* equals the literal meaning *Tehran is not in Turkey*. Among the so called semantic means of non-verbal communication there is a considerable group of signals, e.g. the popular gesture called "Kozakiewicz's gesture," whose task is to reverse the literal meaning of a message. Such a non-verbal means was used in a TV commercial of the *Bosman* beer in which the actor utters: *Non-alcoholic beer*, and winks his eye ostentatiously, which apparently means that what is really being advertised is alcoholic beer.[1] This article, however, will focus exclusively on verbal means of non-literal content.

First, let us consider how it is possible for a sentence to convey other information than the one that is encoded in its literal meaning. Admittedly, it is not possible for a sentence treated *in abstracto*, i.e. not as a means of communication between people, but only as a product of certain grammar. When such an approach to the sentence is applied, then the only source of the sentence's content are the syntactic structures and dictionary meanings of the words used. However, when a sentence is not treated as a purely logical product, but as an UTTERANCE, i.e. as a tool of human communication, then the issue of content becomes multidimensional. According to Sperber and Wilson (1986), what is communicated are not words but thoughts. The essence of a communication act is not the semantic analysis of the utterance, but the HEARER'S UNDERSTANDING OF THE SPEAKER'S INTENTIONS. One interesting consequence of this property of human communication is that the hearer usually understands the speaker correctly, even if the latter makes serious syntactic and semantic errors (c.f. Tokarz 1994). The intellectual activity of the hearer interpreting the utterance produced by the speaker is not confined to the question of the meaning of words; generally, it is also comprised of at least some of the following questions:

Why did the speaker say exactly THIS?
Why did the speaker say it AT THAT MOMENT?
Why did the speaker say it TO ME?
Why did the speaker express it IN SUCH A MANNER? etc.

Actually, there are twice as many questions of the type since the word 'why' has been used in two senses: as a question of the CAUSE and a question of the AIM.

The distance between what the speaker is saying to what the speaker

[1] Trans. note: advertising alcoholic drinks is prohibited in Poland.

is thinking is long, and this is the distance the hearer must take. Shortly, the non-literal content emerges when we try to understand — not so much the SENTENCE as the HUMAN speaking to us. Usually, the following three elements comprise a fully and adequately reconstructed content of an utterance: (1) the utterance's literal content; (2) the causes for using the utterance in a given communication situation by the speaker; (3) the aim of using the utterance. Let us imagine that I tell my wife at some moment: *It's twenty to seven*, and the relevant component of the context is that we established that on this day we would go to the cinema to see a film starting at 7 pm. In this communication situation, the full content of my utterance is the following: it is 6:40 pm (the literal meaning of my utterance), it's high time we went (the cause of my utterance), my wife should hurry (the aim of my utterance). Under special circumstances one of the components (1)-(3) may be removed from the content actually conveyed. For example, when the sentence *It's twenty to seven* is an answer to the question: *What time is it?*, then the only communicated component is (1); and contrary, when somebody standing at a bus stop during a rain and snow storm says: *Beautiful weather, isn't it?*, then the components actually communicated are only (2) and (3).

Let me notice in passing that analogous elements comprise the understanding of all, not only verbal, human activity. In order to fully understand any human action, it is not enough to know what activities are involved in the action. For example, understanding farmers' blockage from January and February 1999 does not come to the bare fact of putting harrows and tractors on roads. We need to know what caused the action and what the aim was. In fact, without such information we do not understand anything. A certain story tells of how an omnipotent wizard, who came to our times for some reasons, wanted to know the most important landmarks of twentieth-century civilization. Among other things, he went to see a football match. Observing twenty men running hopelessly after one ball, he pitied them and sent them additional twenty balls from the sky. This, of course, caused a lot of confusion. The obvious cause of the misunderstanding was that the wizard exactly knew WHAT the players were doing, but he completely did not understand WHY they were doing this.

From a logical point of view, the basis for the implication used to reconstruct the content of a sentence is not so much the sentence's objective meaning as the fact that this very sentence was used (in a given communication situation). Of course, to decode a message the hearer uses their own general knowledge **W** which is comprised, among other things, of

the information about the present situation, i.e. the context of utterance. Let $\mathbf{U}_S\alpha$ stand for the fact that the speaker uttered sentence α in situation s. The pattern defining the content of sentence α, which this time will be marked as $\mathbf{T}(\alpha)$ without an index, relativized to a specific communication act will take the form:

(3) $\mathbf{T}(\alpha) := \{\beta : \mathbf{W} \bigcup \{\mathbf{U}_S\alpha\} \Vdash \beta\}$.

The undefined symbol, $\Vdash$ instead of $\vdash$, was used in order to highlight that the hearer interpreting utterances of a natural language does not make use of a purely logical implication, but employs various rules of pragmatic character only few of which have been satisfactorily described so far. The definition (3)'s parameters $\mathbf{W}$ and $\boldsymbol{s}$ emphasize the definition's subjectivity (the content depends on the hearer's knowledge) and relativity (the content depends on the context of utterance).

However, people do not look for some kind of implied meaning in every message. For example, we do not do this while listening to a radio news broadcast or a lecture on the strength of materials. In such cases the component $\mathbf{U}_S\alpha$ in the pattern (3) does not add anything to the general content of α, and hence $\mathbf{T}(\alpha) = \mathbf{T}_l(\alpha)$. This article, however, focuses on such communication situations in which implied meaning is present, i.e. in which $\mathbf{T}(\alpha) \neq \mathbf{T}_l(\alpha)$. These situations could be divided into three types, according to one of the following theoretical possibilities: (i) $\alpha \in \mathbf{T}(\alpha)$ and $\sim\alpha \notin \mathbf{T}(\alpha)$; (ii) $\sim\alpha \in \mathbf{T}(\alpha)$; (iii) $\alpha \notin \mathbf{T}(\alpha)$ and $\sim\alpha \notin \mathbf{T}(\alpha)$. In order to activate the mechanism of implied content search in the hearer, the utterance must meet certain specific requirements. Towards the end of the article, an attempt will be made to formulate such requirements for the sentences fulfilling criterion (i).

So far the terms *non-literal content* and *implied meaning* have been used interchangeably, understood as referring to a certain general phenomenon. However, the possibilities (i) — (iii) presented above indicate that there are at least three different types of utterance with implied meaning. Let the first one be *allusion*. Allusion does not ruin the literal meaning of a sentence, but supplements it. Hence the phenomena such as irony or metaphor, whose essence is to introduce senses in disagreement with the literal meaning, and even — in the case of irony - contradictory to the literal meaning, will not be referred to as allusion. The term *allusion* refers to such communication situations in which the information conveyed by α is accepted without reservation and $\mathbf{U}_S\alpha$ is treated as a source of ADDITIONAL information. To be more technical, these are situations of the type (i) in which $\alpha \in \mathbf{T}(\alpha) \neq \mathbf{T}_l(\alpha)$ and $\sim\alpha \notin \mathbf{T}(\alpha)$, that is, in principle, such

situations in which the content is expressed in the pattern:

(4) $\mathbf{T}(\alpha) := \{\beta : \mathbf{W} \bigcup \{\alpha \ , \ \mathbf{U}_S\alpha\} \Vdash \ \beta\}$.

Sentences of the second type are those, whose use in a certain communication situation, i.e. in light of the hearer's actual knowledge, suggests a content contradictory to what has been said literally. Such utterances will be referred to as *irony*. Formally, the term covers those communication acts in which $\sim\alpha \in \ \mathbf{T}(\alpha)$. An example of the situation in which an utterance entails its own negation is the use of a self-contradictory sentence, i.e. a sentence with a counter-tautological scheme. By this definition, if somebody utters a self-contradictory sentence (e.g. the popular *I am for and even against*) and does it consciously and not because of stupidity or fever, then the utterance is intended to be ironic or at least amusing. It is, then, one of many situations when analysing a sentence with a logical measure is inappropriate.

The third type of utterance with non-literal meaning will be called *metaphor*. Like irony, metaphor cancels the literal meaning, however not as much as to claim that the suggested implied meaning is a contradictory meaning. From a technical point of view, what is meant here are such communication situations in which $\sim\alpha \notin \ \mathbf{T}(\alpha)$ and $\alpha \notin \ \mathbf{T}(\alpha)$. Hence, metaphors cannot be sentences that are literally true. For there is no reason for the hearer to reject such sentences while reconstructing the full content. It seems that the hearer confronted with a metaphoric utterance searches for the MINIMAL modifications of the actual world that would save the truth value of the metaphor. These modifications concern only those aspects that are currently being discussed. Let us consider the following dialog:

A: *How is your wife doing*?

B: *Oh, she is made of iron.*

It is a commonly known fact that people, even wives, are not made of iron, but some organic substances, in which iron is present in trace quantities. Since A intended to ask about the physical condition of B's wife and not about the material her tissues are made of, A reduces the possible meaning of B's utterance to this one aspect only and finds the correct meaning effortlessly. Also, it is common to use universal quantifiers with a metaphorical intention, c.f.:

A: I have a terrible headache.

B: You ALWAYS have a headache.

Looking for a logical error in the use of the quantifier *always* would not make sense since the speaker B surely did not understand it literally.

The terms *allusion*, *irony* and *metaphor* have been given a purely

technical sense in order to differentiate three different communication phenomena. This sense, however, is not exactly the same as the colloquial one. For example, irony is usually expected to have a seemingly favourable form but an actually unfavourable content: "Generally, the definition of irony is cast in terms of opposition of a surface (friendly) to an underlying (disagreeable) reading of a statement" (Barbe 1995: 9). An utterance with an opposite characteristic (an unfavourable utterance interpreted favourably by the hearer) is also an irony (in our technical sense), though most probably it would not be commonly regarded as such. Pelc (1971) calls it *anti-irony*. By analogy, our definition of metaphor includes phenomena usually not included in the scope of the term, e.g. synecdoche, metonymy and hyperbole. Additionally, the definition is drastically limited. It covers only affirmative sentences whereas interrogative sentences, requests, orders, greetings, etc. can be allusions, ironies or metaphors as well. Due to the discrepancy between the intuitive and the technical sense, it would be perhaps safer to adapt different terminology, e.g. call the discussed phenomena as *utterances of the type A*, *utterances of the type I* and *utterances of the type M*. In accordance with the accepted definitions, utterances of the type A are those sentences which, in a given context, show more properties of colloquially understood allusion than colloquially understood irony or metaphor; by the same token, utterances of the type I are those which have more properties of irony than allusion or metaphor, and utterances of the type M are more similar to metaphor than allusion or irony.

Possibly, however, there was a good reason for such arbitrary terminology decisions presented earlier. For utter chaos in nomenclature prevails in the discipline, which will be superficially illustrated on the example of irony. Muecke (1969) refers to it in ironic words. He says that since others "have already quite adequately NOT DEFINED irony, there would be little point in NOT DEFINING it all over again." (Muecke 1980: 14) The classical definition originates from Aristotle, who referred to irony by means of an interesting term rendering *a reprimand through praise*. Some pragmaticians accept it to a greater or lesser extent, e.g. Grice (1975), and among the theoreticians of speech acts — Haverkate (1990) for whom irony involves suspension of the so called honesty condition. Here follows a typical definition complying with the Aristotelian conception: "[i]n irony, the relationship between what is said and meant is one of opposition: the speaker conveys a negative attitude toward something by professing to have a positive attitude" (Winner, Gardner, 1979). Others, in turn, e.g. Wilson and Sperber (1992) extend the scope of the term far beyond the traditional borders. For Barbe

(1995) irony is almost any expression whose meaning is not to be understood literally. This, of course, results in hopeless disputes if this or that specific utterance is ironic, or not. For example, let us consider four different verbal reactions uttered as a response to the fact that somebody has not closed the door:

(a) *You haven't closed the door.*
(b) *It is so nice that you have closed the door.*
(c) *I love sitting in a freezing draught.*
(d) *Polite people close the door, when it's cold outside.*

Whatever the theory, utterance (a) is not ironic, while (b) and (c) are. The attitude towards (d) is, however, theory-specific. For some authors — not knowing why — (d) is an ironic expression, for other authors — also not knowing why — it is not. The terminology decisions adapted in this article are at least quite unequivocal: the utterance (d) has properties of allusion, and not irony. Metaphors are also discussed in numerous works, e.g. Levinson (1983). However, it does not mean that their situation is satisfactory as, despite many attempts, this situation has not changed for the better since the times described by Ziomek (1990) in the following words: "all ancient and then classical stylistics dreamt about the taxonomy of metaphor." The present article is devoted to allusion which until now has not had a separate pragmatic analysis.

Philosophical-linguistic considerations on non-literal meaning usually view the issue from the perspective of either Searle's (1969) theory of speech acts, which examines e.g. the so called indirect speech acts, or Sperber and Wilson's (1986) relevance theory, or Grice's (1975) theory of implicature. In a way, the last-mentioned theory overlaps with the issues discussed here. The most general relationship between the classification adapted here and Gricean conversational principles is the following: violating the quantity and the relevance maxims almost always results in allusion. This relationship will be discussed in a greater detail later in the article. In turn, violating the quality maxim usually results in irony and metaphor. The manner maxim has a different dimension and does not directly relate to the three types of implied meaning presented here. For a conscious and intended violation of the manner maxim (with the assumption that the other maxims have not been violated) is always an attempt to depart from the literal meaning. The hearer's exploitation of the maxim actually leads not so much to the reconstruction of implied meaning as to the reconstruction of the intended fundamental content. Let us consider the following dialog as an example:

A: *Well, and how did Henry comment on Alice's last misbehaviour*?

B: *He addressed her using a five letter word starting with b.*

B's response is intentionally unclear and violates the maxim of manner. The ironic or allusive style is actually superficial because B's response is not meant to add anything to the literal meaning. It is meant to mitigate the literal content by removing vulgarity.

The cause for non-literal meaning can lie either in the utterance itself, or the context, i.e. in the external circumstances of the utterance. I will start with the bad news: I could not find any situational indicators of implied meaning. I am not able to give general characteristics of such external circumstances of a speech act in which non-literal content appears more often than in other circumstances. It seems that implied meaning has no chance to emerge e.g. when:

– the intelligence of conversation participants is low;

– conversation participants do not know each other;

– the situation involves being relevant (when signaling mood, emotions or attitude is secondary).

The above relations, however, do not take place. It is easily verifiable that people with a low level of intelligence make use of irony and primitive allusions, and do it often and very eagerly. A toilet cleaner, asked about the fee for using the toilet, will almost certainly not say: *Please refer to the price-list hanging on the door*, but will express the same content through an evident implied message: *The price-list's on door, but they doesn't know how to read*. Also, when somebody in a café approaches a stranger sitting at a table with a question if the seat is free, the stranger most probably will not directly say that the seat is not free but will react e.g. in the following manner: *It seems that the table over there is free*, whose non-literal content is naturally: *I do mind you sitting here*. Thus, nothing indicates that increase in intelligence and mutual acquaintance of the speakers increases the number of non-literal messages. At the most their subtlety increases. Non-literal messages are also present in situations when only relevant information is expected. There are simply no theoretical reasons for conveying such messages only by literal means. University lectures, textbooks, political commentaries, film and theater reviews include numerous expressions open to the reader's or the hearer's interpretation. A message of this type has even been included in the guarantee document of my *Rado* watch. It warns against cleaning the watch with sandpaper. Nobody would ever want to clean a watch with sandpaper and, of course, this warning should not be treated literally. The producer's aim of putting such information in the guarantee document was to imply that the product is practically indestructible.

It was Prof. Dariusz Doliński who let me know that psychology discovered a statistical correlation related to the circumstances of utterance: the worse the speaker's mood, the bigger the probability of using non-literal and hidden messages. Despite this regularity, according to available statistical data on using metaphors, non-literal stylistic figures are commonly used and are not occasion-specific. Gibbs (1994) quotes the results of Glucksberg's research which show that an average man uses about thirty million metaphors during their lifetime. According to Gibbs these findings demonstrate that — contrary to what Aristotle thought — "metaphor is not the special privilege of a few gifted speakers but is ubiquitous in both written and spoken discourse." (Gibbs 1994: 124). Thus, constructing general contextual characteristics of communication acts that convey non-literal content is perhaps not possible. Consequently, the article focuses rather on the properties of utterances conveying such content, and, to be more specific, it deals with the phenomenon called here allusion. Analyses of irony and metaphor will follow in separate articles.

As has already been noted, understanding a sentence involves explaining the reasons for uttering it. Interpretation processes in communication situations are similar to mental activities aimed at explaining any phenomena in the actual world, not only verbal ones. To initiate such activities, a given phenomenon must interest the observer. Under normal circumstances, people who experience common and expected phenomena do not need to analyze and explain. When I learn that e.g. a 95-year-old logician has died, then I treat it as a sad but natural fact that does not need an elaborated commentary. However, when I learn that a 28-year-old logician has died, then I feel a strong need to know the details and explain the causes. Shortly, people look for unusual causes only in unusual events.

When the hearer interprets a sentence, the potential implied content connected with the sentence emerges in the hearer's mind as a result of the intellectual process, whose essence is to explain the reasons for uttering this particular sentence. As has been pointed out above, to initiate the process, the utterance itself must be somehow unusual or unexpected. It is not the unusualness of the events described by the sentence that counts, but the unusualness of the fact that this sentence was UTTERED. It seems to me that in communication acts, when implied meaning is understood as the added content, what happens is actually the reverse of what might be expected. Namely, in very general and imprecise terms, the following regularity is valid — THE MORE SURPRISING THE EVENT DESCRIBED BY THE SPEAKER, THE LESS LIKELY IT IS FOR THE HEARER TO LOOK

FOR IMPLIED MEANING. Indeed, it is usual to speak about the unusual. People do not look for any hidden senses then because the literal meaning is sufficiently interesting. For example, the article heading: *Minister of industry arrested!* would certainly gain our attention and we would like to know more about such an interesting fact, but also we would certainly not analyze what was the intention of the author of this heading. Most probably, this author intended to title the article the way it was titled. Our intelligence and natural need for solving riddles can be evoked by trivial, common and self-evident things. Thus we might ask ourselves: if it is so obvious, then why is it being mentioned? This would happen e.g. when the heading read: *Minister of industry not arrested!* What is strange in the information is that it concerns a fact that is not strange as such. After all, it is more common not to arrest, than to arrest ministers of industry. This is what distinguishes this information from, theoretically, quite similar: *Blockage organizers not arrested!*. For organizing road blockages is illegal and being a minister is not. This example is authentic and worth elaborating on.

Some time ago in Silesia there was a trial about a so called coal scandal. The article I read presented in detail the most important facts concerning: the four suspects, manipulation of fake credits, the shortsightedness of the mines' management who gave thousands of tons of coal to whoever wanted it, etc. In short — a seemingly normal article, one of many. It would not be unusual at all if not the fact that at some point the author wrote — all of a sudden – that family members of the minister of industry and the minister himself WERE NOT ACCUSED in the case. Why was the minister mentioned? To construct the sentence, the journalist simply applied the phenomenon discussed in the present work: he used the mechanism of inventing additional non-literal content for the reader and informed the reader that the minister is one of the culprits in this case. The author did not risk writing it directly, however: such a slander could end in court, but expressed it "between the lines," which is legal. The interpretation mechanism is as follows: Four suspects were accused, which means that the remaining 39 999 996 citizens of Poland were not accused. The fact that somebody was not accused is usual; it would be unusual, however, if somebody was accused, so when the journalist wrote that the minister of industry was not arrested, then the information is true and trivial. By analogy, he could have written that, in relation to this case, Cardinal Glemp was not arrested. And it is exactly this obviousness that makes the message so unusual. Also, it makes the reader think what the REAL intentions of the author are and to interpret them: the minister is a thief and SHOULD have been arrested, but all these

courts and prosecutors are a clique, faceless bureaucrats, who even did not bring charges! The author of the article actually conveyed all this, but to avoid responsibility he did it in a cowardly, non-direct way, by means of the mechanism of generating implied meaning.

The difference in the degree of allusiveness between sentences is particularly well illustrated in one popular anecdote. One day the captain of a ship wrote in the ship's log: *Today is March, 23rd, the first mate has been drunk all day.* The following day, the first mate was on duty and got his revenge. He wrote in the ship's log: *Today is March, 24th, the captain has been sober all day.* The sentence written by the captain is very informative, its content is surprising as such and thus the REASONS FOR USING the sentence are not surprising, the sentence does not evoke any implied meaning. Contrary, the note of the first mate is not very informative and rather trivial in its literal sense, thus the sentence' presence is strange and thought-provoking. The reader will inevitably try to interpret the literal content of the note more unusually because only the unusualness of the literal sense may justify the sentence's presence in the ship's log. The reader will think about the reason why the fact that the captain was sober that day was so strange. And the answer will come.

Thus, the actual triviality of a message is one of the sources of implied meaning. Though not the only one. It relates to the Gricean maxim of quantity (informativeness). I will not discuss Grice's conversational maxims here as they are well known. I will, however, remind that the maxim of quantity says that the speaker should make their contribution as informative, and no more informative than is required for the current purpose of the exchange. The mechanism generating implicatures that relate to this particular maxim is triggered when the maxim has been violated either this or the other way, i.e. when the information quantity is either too big or too small. Only the latter possibility concerns the matter under consideration. The problem with Grice's maxim is that implicatures are admittedly generated in the hearer's mind but actually originate from the speaker's knowledge. Hence, the concept that the speaker provided too little information is used to denote that the speaker said LESS THAN (S)HE ACTUALLY KNOWS. The hearer very often has sufficient access to the speaker's information resources and can assess if the maxim of quantity has been violated. Consider the following dialog:

A: *How much did you pay for the car?*

B: *Less than I expected.*

It is obvious that B knows exactly, to the last penny, how much the

car cost. The literal content of the uttered sentence does not coincide with B's knowledge and, thus, the sentence generates an implicature. Most likely, that B does not wish to talk about it in detail. According to what has been said so far, B's utterance is an allusion. What the speaker knows, however, is not always known to the hearer. For example, how could we know what the journalist writing about the fact that the minister of industry was not arrested knew if the journalist did not mention it himself? In such cases, it seems, the rules for generating implied meaning are different.

The impression of surprisingly low information content triggering implied meaning is usually caused not by the hearer's comparison of the message with the speaker's knowledge, but rather by the comparison of the message with one's own knowledge, and possibly with what is common knowledge in the hearer's view. Here, the reasoning seems to be contrary to the rules on the exploitation of Grice's maxim. Uttering a trivial sentence is unusual in many communication situations and suggests that the speaker had some specific reasons to do it. To exploit Grice's maxim the hearer infers the following: *the speaker provided too little information, though (s)he knows much more; hence, the speaker wanted to express more than (s)he actually did*. In the example under consideration, the reasoning is different: *the speaker said something that is of little, or no, informative value; hence, the speaker knows more and wants me to know it, too*. The speaker's knowledge is not the starting point for the hearer, but the goal. And, indeed, it is an effort aimed at reconstructing the speaker's knowledge that generates the added content. The difference between the two is absolutely fundamental, for diametrically different implied meanings arise. In the first case, the added content is usually the following: *for some reasons I do not wish to tell you everything I know*. In the latter case: *I wish you to guess (or suspect) all I know*.

Explaining the mechanism of generating implied meaning within the theory of implicature brings another difficulty. It seems that there is no conversational rule that prohibits uttering trivial sentences of low informative value. Moreover, such utterances are even obligatory or recommended in some communication situations, e.g. in small talks, which are full of sentences like: *Nice morning, isn't it?*, *liver sausage is more expensive again*, *How elegant is your new jacket!*, etc. Such utterances are informatively redundant, because the hearer knows that the morning is nice, the prices of food have risen and (s)he is wearing an expensive jacket. It turns out, however, that sometimes — supposedly contrary to Grice's maxim of quantity — they are obligatory or almost obligatory, e.g. when we accidentally meet an acquaintance on the street. Actually, their function is to inform the other person that our attitude

towards them has not changed and that we are in a good mood; sometimes they are used to check if the other person is willing to have a longer or more down-to-earth chat. In my opinion, this is not really a counterexample to Grice's principle. There are two different lines of argument. The first line is that even if violation of the maxim of quantity is obligatory in a given situation, then it is only a violation. A trivial statement, even if made obligatory, is still a trivial statement and as such generates implicatures, for example those mentioned above. The second line of argument is the opposite and says that the above communication situations have nothing to do with the implied meaning *sensu stricto*. For when utterances of low informative value are obligatory, then also implied meaning itself is obligatory. In small talks it has been repeated for centuries and it is so obvious now that it is no longer considered the non-literal added content — it is considered a part of the fundamental content. It is possible to claim that the implied meaning of such utterances has been highly conventionalized. On the other hand, however, the phrase "conventionalized implied meaning" is self-contradictory as, by definition, implied meaning is not a part of conventional meaning.

The present article has discussed in detail only one source of allusion: the low level of informativeness of utterances. It has been emphasized, though, that it is not the only source. Thus, it is perhaps worth mentioning another popular technique of conveying added content, i.e. UTTERING A SENTENCE THAT STRAYS FROM THE SUBJECT OF THE CONVERSATION. This category encompasses a huge range of utterances, from those seemingly violating Grice's maxim of relevance to those violating the maxim drastically and unequivocally. Examples of the two extremes are presented below:

(I) Husband: *I'm hungry.*
Wife: *The fridge is not locked.*

(II) A: *Could it be that you don't believe in the Catholic Church?*
B: *Oh man, Russkies have won with Holland!*

Somewhere in between those extremes — between utterances of the (I) type, which barely stray from the subject, and utterances of the (II) type, which are extremely and intentionally irrelevant — is a statement of a famous tennis player Michael Chang, who at a press conference in 1996 was asked about the weak points of Pete Sampras, who then was the best tennis player in the world. The journalist asking the question most probably expected something like: *Sampras has a bad backhand*, *He has problems with concentration*, *He lacks motivation*, etc. Chang's reply was: *Sampras cannot cook well*. This statement was awarded the best statement of the year by

the American monthly *Tennis Magazine*. Also, it is a perfect example of a subtle allusion. The implied meaning is conveyed here by means of the information that – taken literally — is completely irrelevant.

Let us consider, finally, what the reasons for using the allusive style are. Theoretically, allusion violates not only — depending on context – the maxim of quantity or the maxim of relevance, but mostly the maxim of manner, much the same as irony and metaphor. For the interpretation of the allusive information is more difficult than the interpretation of the information conveyed directly. It seems then that allusion, according to Grice's theory, should not be employed without a good reason. Probably, the reasons for choosing this form of utterance are not clear even for the speaker themselves. As has been mentioned above, a non-literal message may be caused by e.g. a bad mood. What interests us here, however, are rather such situations in which allusion is employed consciously, as an element of a communication strategy. Reasons for an intended, conscious allusive utterance are different depending on whether it has a positive overtone, or a negative, criticizing overtone. In the first case, the speaker intends either to make the utterance more entertaining or to make the compliment less direct. In the other, far more common case, the reasons could be more complicated.

A very important imperative of human communication is the principle of making the utterances polite. It is questionable if the rule: *Be polite*, is a sub-maxim of the maxim of manner, or maybe a separate, fifth conversational maxim (c.f. Brown, Levinson, 1978). Direct criticism is usually regarded as tactless or even rude. Most probably, this is one of the reasons for choosing the allusive form of an utterance with a negative overtone. The addressee can e.g. ignore it, which would not be possible in the case of a direct and literal attack. Thus, it allows the hearer to save face (face saving strategy) and becomes conversationally acceptable. Allusion is also used when the actual content is aimed only at a few selected conversation participants. Then it functions as a code. Only those conversation participants whose initial information is identical to the speaker's can break the code. Another reason may be an attempt to avoid punishment. Although I doubt there are any such statistical data, it seems that this is the most common reason. The thing is that the final decision about the actual content of an allusion is made only by the hearer. Since it is the hearer's interpretation that adds implied meaning to the literal content, the speaker is free to disagree with such an interpretation any time. When the hearer explicitly shows that (s)he has understood the negative implications of the allusion and confronts the speaker, then eliminating the implied meaning will allow the speaker to save face, at

least to a certain degree. As an example of such a situation let us imagine the following scene: having delivered a conference paper I hear a comment: *Your presentation would be extremely useful for the first-year-students*. I could understand this as an allusion to the level of my paper. If I showed my dissatisfaction, the other person could reply that their intentions have been misinterpreted as what had been meant was a compliment: my paper about difficult and important issues was so well-organized and clear that even a first-year-student would understand it. Since the interpretation of the implied meaning relates to the intention and not the facts, it is not possible to objectively decide whether we are dealing with a malicious allusion or an accidental blunder that is considered malicious only by the over sensitive hearer. Here also strict logical criteria cannot be directly helpful.

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THE COGNITIVE AND COMMUNICATIVE FUNCTION OF LANGUAGE[1]

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Introduction

Language has two fundamental functions: cognitive and communicative. An analysis of these functions is frequently a method of looking for an answer to a question about fundamental properties of language. In philosophical reflection about the nature of language, these functions, and thus the properties of language revealed by the functions, are sometimes juxtaposed. The question arises: which of the functions — cognitive or communicative — is the fundamental property of language, which of them constitutes language as such. In fact, this question is a question of the nature of language, which contains an assertion of a fundamental, commonly noticeable dichotomy between two principal aspects of language, which is regarded by Dummett (1996: 185) as the opposition "between language as representation and language as activity." What is manifested in the opposition of these aspects is a dualistic character of language, which is sometimes expressed in the opposition between the cognitive function and the communication function. In either function, language reveals specific properties, which can lead to a better understanding of its nature.

The communication function emphasizes the dependence of the meaning of expressions on the context or intentions of the speaker. The cognitive function is related to the property of language that is used to express

[1]The article is related to a discussion about the issue of cognitive and communication functions presented in Strawson 1971; McDowell 1980; Strawson 1980; Dummett 1996.

certain objective states of matters, which is revealed in the possibility of determining the meaning by giving its truth-conditions (Strawson 1971: 176-180). What stands out here is a fundamental duality of language, which F. de Saussure captures in the distinction between language and parole, a distinction between language as a universal, objective and external-to-individual-consciousness structure of signs and its use in individual acts of perception or communication. It would intuitively seem that communication reveals an aspect of speech, individual acts of language use, while cognition requires a fixed structure of representation, universal to individual acts. On the other hand, cognition, understood as formulating certain thoughts about the world without uttering them, requires only an individual or internal language in the sense of idiolect. Interpersonal communication requires, however, an objective, universal sign structure. Assigning the properties of individuality and variability to the function of communication, and the properties of generality to the cognitive function is an oversimplification. Generality and individuality of meanings alone, together with the necessity of an over-individual structure and the actuality of its application, characterize both cognition and communication. It points to a similarity between the two functions, despite the previously noted differences. It seems that an analysis of the cognitive and communication functions — in the context of their differences as well as their similarities — may lead to a deeper understanding of the nature of language.

The question about the nature of language, raised in the context of an analysis of its functions, is a question about mechanisms of relationships between linguistic signs and their meanings. A search for these mechanisms often takes the form of a decision as to whether meanings are consequences of communication acts preserved by tradition, or result from a cognitive representation of the world in the conceptual structure. An analysis of the cognitive and the communication function may lead to such a finding, or point to the necessity of searching for other meaning-making mechanisms, underlying both functions of language and determining its fundamental properties.

Language as a communication tool

Interpersonal communication takes place mainly through language, although language is not the only means of communication. However, considering other sign systems used in communication, we notice that they can function only in the context of language, or that they are linguistically interpreted; for example, the system of road signs or other signs of a similar

type carries information due to the meaning that has been assigned to these signs via language (e.g. during lessons on road signs). It is possible to indicate certain simple messages, the so called natural signs (e.g. smoke from a fireplace as a sign of the presence of men), which carry comprehensible information for the addressee even without translating it into a linguistic message — yet, language is the fundamental and the most effective means of communication. E. Sapir states that language is the process of communication in every known society (Jakobson 1968: 697). An analysis of language properties in the context of the role language plays in communication, needs to cover all factors conditioning communication, i.e. internal properties of the message itself and the role of the speaker and the addressee (Jakobson 1968).

It seems that what is fundamental in understanding the essence of language are the properties of the message itself that reveal themselves in communication. According to Peirce's classification, signs used in linguistic communication are symbols.[2] Symbols are signs in which meaning is not given by the relation of resemblance or indication, but is linked with the carrier of meaning by means of convention. The two fundamental properties (which is also pointed out by R. Jakobson) are the generality of meaning and the conventional relationship between meaning and the carrier of meaning.

Linguistic signs and their meanings are acquired in the process of language acquisition. In order to interpret a linguistic sign accurately, it is necessary to know its meaning. Communication reveals that a sign itself, being a message, is three-faceted. A sign used in a message (in most communication processes) represents for the addressee not the speaker's state of consciousness, but the state of matter — external to consciousness and language itself. In communication, signs are usually used to convey specific subject contents between the speaker and the addressee. The initial condition of communication is a representative character of the carrier of information. Thus, representation underlies the communicative function of language, it is its necessary condition. It is reflected in the structure of message. A message that is a linguistic sign is not a simple element, but a complex relation, in which Ch. S. Peirce differentiates three elements. Besides the physical form of the carrier of information, i.e. a sign in a narrow sense, the relation comprises the meaning and the object of a sign.

A three-element structure such as this is, according to Peirce, a universal structure of representation that is a necessary condition of both cognition

[2]Cf. the classification of signs according to Peirce (1931-1935: 143-144).

and communication. That a message is three-faceted is reflected in the triadic character of representation.

The object of a sign, present in this structure, corresponds to the fact that a message refers to something external, extra-linguistic. The possibility of interpreting the object through linguistic content is not exhausted by the predicative properties of the object. There is a certain existential element involved, which, in representation, is the referring of the content to something extra-linguistic.[3] The denotative function is the one that guarantees that we can communicate about the external objective states of matter. The fundamental role in representation is played by the sign's meaning which is the message's content that refers to an object. It is indeed due to the meaning that signs can be carriers of content. Linguistic communication requires meaningful symbols, thus it is not the function that constitutes their meaning.

In order to understand communicative capacities of language, it is indispensable to understand its capacities for representation, as well as the nature of representation. Representation is not a simple mapping of external world structures onto structures of signs. Besides reporting and mapping capacities, language has creative capacities. They are present in all three elements of representation.

Firstly, in the domain of the physical structure of language itself. In the process of language acquisition we learn not only parts of expressions, such as particular words or simple sentences (Quine 1960: 13-17). We also learn grammatical rules that allow creating many complex structures out of simple units. R. Jakobson states that only signs that are symbols have the capacity to create complex structures with meaning. Hence, it is not possible to create structures such as sentences in the system of only indexical and iconic signs. A multitude of utterances with the same meaning reveals how creative language is when it comes to choosing the carrier of meaning.

Secondly, creative properties of language are present in the domain of the object of representation. It is not only about the fact that the direct object of representation is an object in the sense of an internal object of a sign, i.e. it is a certain creative and aspectual conceptualization of an external object (Krąpiec 1985: 88-89). An external object is captured in linguistic signs not only in an aspectual but also general way. The object of a sign has the nature of a class, it is abstract. According to Jacobson,

[3]The authors who pointed to the need to introduce the concept of an object of a sign in accounts of sign processes were, together with Ch. S. Peirce, K. Twardowski (1965: 20), and L. Wittgenstein (1958: 20).

it is the fundamental property of linguistic signs. The generality of their meaning, in the sense of referring to the object of representation, is the basis of language's universality, its usefulness in describing a situation of whatever variety.

The properly generic meanings of verbal signs become particularized and individualized under the pressure of changeable contexts or of nonverbalized but verbalizable situations. (Jakobson 1968: 707)

In a specific communication act, general meanings acquire unequivocal, context-specific content. An individual current meaning of an utterance is a derivative of the language's fundamental general meaning and context of the utterance.

It is worth pointing out that what can be represented in language are not only external objects, but also fictional objects, mental constructs and speculations.

[T]here is one substantial type of syntactic structure which only natural or formalized languages are able to generate, namely, judgments, general and especially equational propositions. It is this asset that language deploys its supreme power and significance for human thought and cognitive communication. (Jakobson 1968: 708)

Thus, generality of the object of representation is the foundation of the cognitive function of language.

Distinguishing that representation is three-faceted it is necessary, thirdly, to point to the possibility of creative interpretation in language, i.e. of creating new content and new references to objects. Peirce, when he was differentiating signs in terms of their interpretive strength, defined symbols as signs with an open interpretive context. Indeed, this open interpretive context together with a reference to a general object are the conditions that facilitate any situation represented by language, be it real, individual, general (abstract) or fictional.

The creative component, present in the interpretation included in the message's structure, generates a question about the adequacy of contents conveyed in messages in relation to represented objects or states of matter. Among the three intra-sign functions distinguished by Peirce: signifying, meaning and use, the latter function seems to be especially important for the process of communication. It is a relation between meaning and the carrier of meaning. This relation reflects the possibility of representing the content of consciousness in the structure of message which is external to consciousness. Through such a representation, the linguistic content of consciousness may be confirmed in the exterior world. Thus, communication's fundamental pos-

sibility of conveying linguistic contents is inevitably related to the structure of message understood as a sign. M. Bense's model additionally shows that representation may be a multi-stage chain process that links a sign system with the context and the information addressee.

The speaker and the addressee are very important elements of the process of communication. An analysis of the communication process with regard to the speaker allows for the singling out of language properties that are ignored in an analysis of the message alone. Fundamental issues arise, such as information coding and the relation between general meaning and the individual meaning of particular messages. Uttering a sentence, the speaker utters it for somebody, for an addressee, in order to convey a particular message. P. F. Strawson emphasizes that the communicative intention (Strawson 1971: 171-173) alone is important as it can be a meaning-constructive element of the message. In some situations, the message's content is reduced to the intention alone, e.g. when somebody speaks an unknown language, we understand only the communicative intention, but not the message's content. From the point of view of the speaker, however, the intention concerns not only the bare fact of communicating, but also the communicated content. The speaker has an intention to communicate a certain content and uses such words that express this content. The question Strawson poses is: is the communicative intention a sufficient meaning-constructive factor for linguistic signs? The fact that communication takes place even at a pre-language level seems to weaken the thesis. Many species of animals convey messages by means of specific behaviors. These behaviors are usually indexes, they point to, for example, food or danger. They are evoked by and refer to a particular situation, yet they have a certain degree of generality. They are general in the sense that sign behaviors are innate to a given species and are not diversifiable, they are common to all members of the species. A commonly understood signal (within a single species) represents a given situation classified to a specific category, e.g. danger. The classification is instinctive, nonetheless it seems that the object of such a sign is general, namely that it is any danger.

Pre-language and non-linguistic communication takes place among humans as well. In the face of danger, a scream, even when the speaker and the addressee do not speak the same language, is an understandable signal. In this case, the intention clearly seems to be a meaning-constructive element of the signal. Intention and clear situational context give a scream, which is an index sign, the meaning of a warning. The meaning of iconic or indexical signs can be deduced from the extra-sign context of their use. Is the mecha-

nism of assigning meanings to symbols the same as in the case of indexes and icons? In order to realize the intention of conveying a message, the speaker chooses words and grammatical forms from the existing and familiar linguistic system. The utterance is not a known or memorized linguistic formula. Most utterances are creative in nature, i.e. they are constructed in accord with the speaker's aim (intention) from familiar words and according to semantic and grammatical rules. Now, Strawson's claim that intention is meaning-constructive may become less convincing. It seems that the speaker, who is in a particular situation or has specific beliefs and an intention to communicate them, chooses such linguistic signs whose meanings represent the content the speaker wants to convey. The meaning of a linguistic utterance, although not reducible to a sum of the meanings of individual words, is a system function of these meanings. Intention is not, in the case of symbols, the only meaning-constructive factor. Quite the opposite: linguistic communication requires meaningful symbols.

Hence, the system of representation seems to be something that logically precedes communication.

What is an essential element of communication with regard to the speaker is the issue of the relation between thought and language. This relation can be understood twofold: either language is a code for thoughts (i.e. there are "bare" thoughts which are recoded into linguistic expressions in the process of communication), or language is a tool of thought (i.e. words embody thoughts; in order to exist, thought requires representation). Dummett believes that:

(. . .) the most important feature of language is that it serves as a vehicle of thought. It is not necessary, in order to adopt this standpoint, to deny that unverbalized thought is in principle possible (. . .). It is not necessary, either, to deny that thought is possible for creatures who have no language in which to express it. It is necessary only to believe that thought, by its nature, cannot occur without a vehicle, and that language is the vehicle whose operation is the most perspicuous (. . .). (Dummett 1996: 171)

In this sense, thinking becomes communication.

It is indeed true that to describe someone as communicating with himself is to obliterate the whole distinction between using language as an instrument of communication and as a vehicle of thought. (Dummett 1996: 185)

In this way it is visible that communication is a peculiar form of representation and a peculiar form of cognition. Hence, it is difficult to indicate the borders between communication and cognition or representation unequivocally.

Another issue related to the discussed context is the relation between what would seem to be a purely communicative, individual, contextual meaning and general meaning. It is the relation between language and speech that occurs in every real communication act. Which component is fundamental for meaningful communication acts? It would seem that what is essential in every such act is single information. Yet communication requires an addressee who understands. It does not concern only linguistic messages; any information message requires an ability to receive and interpret it by the addressee. To interpret the content of a message, additional information is needed. It is either something that the addressee acquired previously (e.g. knowledge of the meaning of signs) or something that is conveyed by the context of the utterance and deduced from this context by the addressee. Hence, language cannot be reduced to a sum of speech acts, although it occurs only in these acts.

In this way, we reach another aspect of communication, the communication with regard to the addressee. It differs from the communication with regard to the speaker, in which the interest lies in translating thought into language, thus reflecting thought — or rather the content that the speaker wants to communicate – in meaningful linguistic signs; let us call it: coding the content into linguistic expressions. The addressee's task is exactly the opposite — it is recoding words into the content of their own mind. Every communication act involves both coding and decoding thoughts by the speaker and the addressee. What re-appears here is the issue of the relation: general — individual (actual). For what is it that the addressee does when hearing a sound or seeing an inscription? The addressee interprets them as linguistic signs and associates them with their meanings. Yet these meanings need not be identical with the speaker's meanings. The mechanism of acquiring language as described by W. V. O. Quine assumes the existence of stimulus meaning. We acquire language when a linguistic expression can be associated with a stimulus. Our sensory reactions to a given stimulus are the content that we assign to the simplest expressions, such as "red" or "rabbit." Our sensory impressions correlated with the stimulus, for example, of seeing a rabbit, are individual in nature. Hence, individual meaning in the sense: an impressionistic image of a rabbit, is individual in nature. However – as Quine argues — the expression's objectivity lies in that, in the situation of acquiring language, we associate the name not with our sensory impressions but with an external stimulus. Even if somebody perceives colours in a different way (but sees differences between them), and, in the process of language acquisition, has associated the word "red" with the impression

this colour evokes in them, then this person will always call ”red” whatever is red. It allows us to communicate about the external world as if passing over differences in individual impressions. Impressions are still an individual or subjective meaning which is the internal content, an impressionistic representation of external stimuli. Besides this representation there is a verbal representation that facilitates a systematic and direct association of stimulus content with linguistic content. The fact that similar stimuli always evoke similar reactions of our senses is a sufficient condition for an objective linguistic representation.

However, not all words and expressions of a language are acquired by reference to a direct stimulus situation. Most words are acquired by reference to other words and the context. According to Quine's theory, the source of language's objectivity lies in the possibility of indirect reference to a primitive stimulus situation. Somebody who knows the language and hears a word, interprets it with reference to the specific stimulus situation, and hence, acquires knowledge about the world and not about own or the speaker's internal states. A linguistic expression (let it be ”red” again) may cause that the person adds a certain impression that is subjective and different for every individual. This impression, however, is not relevant for communicating cognitive content and most messages have nothing to do with impressions. When we hear and understand the word ”red,” imagining redness is not a necessary condition. Even when we are thinking about something red, imagining it is not necessary. A linguistic representation facilitates using words without reference to the individual content of impressions or sensory images.

On the other hand, however, the individuality of meaning — which is revealed in individual communication acts and which is due to the fact that every addressee interprets a given sign in a slightly different way, in accord with own knowledge, both stimulus and linguistic — points to a direct relation between meaning and individual cognition. It also points to an irreducible relation between linguistic meanings and the whole of cognition, also extra-linguistic cognition.

Thus, what is the ability of understanding (i.e. of assigning meaning to received linguistic messages) ultimately about? Is it a replacement of linguistic information with the stimulus information associated with it the process of language acquisition? Not all sentences can be interpreted with direct reference to stimulus situation. Such an interpretation of understanding would be too narrow. Understanding is obtaining (assimilating) a message's subject information. It comprises recognizing the message as a meaningful

linguistic message and interpreting its meaning. Both of these stages require the addressee to have knowledge that facilitates understanding. This knowledge is acquired linguistic competence.

It is also worth noticing that a message may be a source of cognition of new subject contents for the addressee. It is not a coincidental or secondary effect of a message. Communication is aimed at cognition. Hence, it is inevitable to state that communication, which requires cognition and indeed requires linguistic cognition, is itself a cognitive process supplemented with a social aspect. In this process, information comes directly from the natural environment, and as if at second-hand, from other members of society.

An analysis of the communication function with regard to the speaker and with regard to the addressee shows that representation plays an important role as it is a necessary condition for intersubjective communication of subject contents. Further, such an analysis shows that language — understood as a universal objective structure of signs that facilitates both individual discursive thinking and communicating subject contents — is irreducible to communication acts. The considerations presented above show that there is a mutual dependence and co-conditioning between both functions, and thus it is not possible to clearly separate and juxtapose them.

Cognitive conditioning of language

Language in the cognitive function is, above all, a tool for obtaining, processing and storing information about the external world, which is indispensable for a man to survive and function in the surrounding. The basis of the cognitive function is its capacity to represent the external world (Buczkowska 1997a). Yet an analysis of the structure of representation, which, according to Peirce, is a three-element sign relation, does not fully account for all cognitive properties of language, in particular, it is not sufficient to explain the object meanings and references of expressions. The function of representation facilitates a cognitive use of linguistic signs. The fundamental component of representation is meaning, which, according to Peirce, is the interpretant. Assigning meaning to signs involves additional information that facilitates interpretation. The information may be of a diverse nature and origin. For example, language acquisition/learning consists in gathering information which helps to assign meaning to sounds and inscriptions. What is fundamental in the case of linguistics signs which are symbols is the conceptual interpretation of sensory impressions created as a result of interactions with the surroundings. What is the origin of the information that is essential to a linguistic interpretation of external stimuli, then? Are there

intralinguistic mechanisms that eliminate interpretations that are cognitively wrong?

The structure of the sign itself, which corresponds to the structure of representation, allows us to differentiate the already mentioned relations of object reference, meaning and use. Each of these relations, as it cannot be explained within the framework of language itself, points to external, extra-linguistic conditioning of the cognitive function of language (Buczkowska 1997b). This function is related to the process of information flow and information gathering in the structures dedicated to this purpose.

Language understood as an innate cognitive structure that allows accumulating and gathering information about the surroundings is investigated by K. Lorenz (1997). That certain fundamental linguistic structures are innate is proved by observations of language acquisition.[4] Acquisition of a specific-language is, as if, a fulfillment of an innate program triggered by the process of linguistic education.

[...] We do not learn to think, we learn the symbols for things, like a vocabulary, and the relationships between them. What we have learnt we then set into a preformed framework without which we would be unable to think (...) (Lorenz 1977: 187).

The innateness of language is a sign of language's nature and uniqueness, a sign of a certain irreducibility of language to only pre-language cognitive

[4]K. Lorenz quotes the description of the acquisition of linguistic skills by a blind and deaf seven-year-old girl, Helen Keller (born in 1880), presented by her teacher Ann Sullivan. This case is unique and, unfortunately, unrepeatable due to the uniqueness, which lies in the fact that damage to the central nervous system cut off the senses of sight and hearing without damaging the brain. Helen was exceptionally talented and her teacher described the whole process of teaching in detail. This girl, totally cut off from the experiences of the senses of seeing and hearing, learnt the language of words together with abstract concepts on the basis of messages fingered on her hand by means of the finger alphabet. Using this method, she learnt to read without the ability to speak. On the very first day of teaching she made a mental association between the form and the obtaining of a desirable object. At first, she did not differentiate between the object of action and the action. She touched the objects she was learning about and, as a result of these experiences, she could separate symbols of things from symbols of actions. What Lorenz highlights is the ease of which to understand the very rule of symbolizing and the ability to almost immediately associate the signs fingered on the hand with external situations, which initially covered both actions and objects of these actions. Helen's language learning was very rapid, as if it were natural. Her teacher compared the process of Helen's learning to the process of a bird's learning to fly — she seemed to have been fulfilling an already existing program. The author refers here to Chomsky's theory which assumes that conceptual thinking is universally innate.

capacities. Language is a new structure that offers new cognitive opportunities. According to Lorenz, conceptual thinking, which is human-specific, is prepared by nature gradually; its particular elements appear already in earlier stages of evolutionary development. Language already originates in the first forms of acquiring information used by the simplest organisms in order to survive. It is not possible to understand the cognitive function of language without referring to these cognitive biological mechanisms which condition language. For language includes fundamental, pre-language mechanisms and structures of gathering information.

According to the mentioned author, the biological process of adaptation is the process of acquiring knowledge; knowledge that is understood broadly as useful information. This process of acquiring knowledge is two-sided. Along with innate information, which is in the genome and which determines the structures of the organism and their functions, there is temporary information, which concerns the environment and food resources which is extremely important for the individual's survival.

Lorenz's analysis of the cognitive process with regard to the structures and methods of gathering and accumulating information in pre-language cognitive structures allows us to apply his distinctions to an analysis of language properties. In this way, language being a cognitive structure may be perceived, by analogy to Lorenz's suggestion, as a two-level structure of gathering information. The first level is the innate linguistic structure, which conditions acquisition of linguistic competence. It is an adaptability structure, permanent and universal for the whole species. Language (in Quine's sense), understood as a general super-individual sign structure, is a tool of obtaining temporary information. Information gathered in language is relatively stable.

Obtaining temporary information and its later interpretation takes place through a general super-individual structure, in individual acts of using this structure. In relation to individual experience, it is a stable structure; on the other hand, as it is not innate, it undergoes slow-paced modifications and adaptations. Not being an innate structure, language is not fully conditioned by species, nor by individuals. It is an intermediate structure between the individual dimension of obtaining information and the innate and universal cognitive mechanism. Language has an individual dimension, but exceeds it and becomes a super-individual and social structure. By the same token, an analysis of cognition necessarily introduces the aspect of communication.

According to Lorenz, there is a precise, complex, innate program that determines the ontogenetic development of speech. The most important

element of the program is the specific readiness to associate a concept with an arbitrarily chosen symbol, thus an innate capacity to represent (discussed in the example of Helen Keller) as the readiness to name objects and actions. There is an innate program for the noun and for the verb, and thus we have an innate capacity to symbolize activity independently of the object concerned. It seems that what is also indispensable is innate information that one should acquire language (words) from a member of the community sharing their tradition and not create one's own vocabulary. What underlies language acquisition, then, is the program, determined by phylogenesis, according to which every child constantly undergoes the reintegration of innate conceptual thinking and vocabulary passed on by tradition.

Conceptual thinking results in the process of culture development. Lorenz assumes that the man of culture appeared during the phylogenetic development, and believes that the process did not end with the rise of culture. This approach leads to conclusions which may be supported by observation. The author claims that there are certain universal norms of social behaviour, which implies the assumption that they are innate. According to N. Chomsky, language is of a similar nature: all people of all cultures have certain innate structures responsible for thinking, which determine the logic of thinking and the logic structures of language. These structures are the result of the pressure of selection imposed not by communication but by logical thinking. For there is unity of language and conceptual thinking, in the sense that, in the interaction between thinking and speech, structures responsible for thinking developed a higher degree of precision and variety.

Lorenz's conception of language as a system of accumulating information points to a system method of cognition, in which language plays a crucial role. Language, however, is not a self-contained and totally independent structure, but is a specific system subordinate to the whole of cognitive structures, tied with numerous relations to other elements of the cognitive system. Relations essential in the process of language creation, such as sign representation or associating the cognitive content with the external reality, appeared in evolutionary development long before the linguistic structure and are its necessary, though not sufficient, condition. Language, understood in such a way, is a tool for obtaining and accumulating information about the surrounding which is essential to survive. It is a tool so diversified that it allows not only to perceive the external world through senses, but also to obtain more complex, already interpreted and specialized information. Information of such a type is provided by the function of communication. This function is subordinate to cognition but it opens cognitive capacities

to new areas of available information.

Such an approach indicates that the relationships between the cognitive and the communication function of language should be looked for on the grounds of the system relationship of language and the whole of cognitive structures and their functions.

Cognition and communication as information processes

While analysing both the cognitive and the communication function of language, we notice that these functions are mutually conditioned and dependant. Linguistic communication involves a specific cognitive structure that facilitates conceptual cognition as well as representation of cognitive content in the language system. This system is aimed at communication, but also exists thanks to communication, whereas linguistic communication expands cognition, and allows other members of community to benefit from the knowledge. It does not seem reasonable to regard any of these functions as more important or determining all fundamental properties of language. The relation between the two functions shows a systemic dependency. They have a similar sign structure of representation, and both participate in processes of data gathering and processing.

Lorenz's considerations may suggest an approach for dealing with the mutual dependence between the cognitive and the communication function, presented in the above analysis. Describing the development of cognitive capacities in species evolution, Lorenz points to the fact that the biological process of information gathering is a process of adaptation, and — what is very important — that this process is two-sided. The information that determines stable structures and functions of an organism is stored in a genome. Yet, there is also temporary information that determines particular current behaviours. Between these two sides there is a close interplay, which Lorenz calls positive feedback. Language is a system that pursues this two-sidedness of gathering information: in permanent cognitive structures and in association with them corresponding processes whose aim is to gather temporal information and to react on it.

In such an approach, the innate linguistic structure is a fundamental structure of information gathering. Acquired information, stored permanently in this structure, constitutes a system of a particular learned language with stable syntactic and semantic rules characteristic of that language. This system is included in the whole cognitive mechanism and cannot function without it. A relationship between particular words and their meanings is

created in the process of learning, but the meanings and their physical-object references result from a pre-linguistic capacity to represent and this conditions language. The structure of referents is governed by the function of representation. Representation requires interpretation, that is additional information, whose source, in the process of interpreting sensory impressions in the form of concepts, is the innate linguistic structure. The information stored in this structure creates — together with the temporary information that is acquired individually during the process of language acquisition/learning as well as sensory experience — the structure of a learned language. In this approach, language is a cognitive system, it is a representation of our knowledge and this knowledge itself at the same time. What is fully conscious, what is current knowledge, is linguistic in nature. It does not mean, however, that all cognition is linguistic in nature. There are numerous pre-linguistic representations of iconic or indexical character (according to Peirc's classification), which are not linguistic signs themselves but a base, a condition for linguistic representation. This strong, systemic, almost organic relationship between language and the whole cognitive system is visible in certain small but clear individual differences between meanings, or perhaps shades of meanings, associated with various concepts. What has been called an idiolect, an individual language that is a variant of a language in a universal sense, reflects the influence of individual experience, individual perception of world on understanding socially acquired/learned language.

The system of gathering information, that is language, is an open system ready to constantly supplement new information. On the other hand, it is a relatively permanent system with stable structures, which does not undergo changes whenever any new temporary information emerges, although, single temporary information may be regarded as cognitive information and may expand specific stable structures. An interpretation of temporary information is influenced by already accumulated knowledge, and thus requires an input of previous information invested into stable cognitive structures, including language structure.

The process of gathering information in various cognitive structures is multistage. From the innate cognitive structure with innate information, through the acquired structure of learned language, to temporary information acquired in individual cognitive acts. The innate linguistic structures include a significant part of information that facilitates acquiring and using language, and determines many of its properties. The capacity to represent is a necessary condition not only for language but also for cognition that understands the external world. Due to the capacity to represent we gain

the possibility to operate with signs. The external information, interpreted by the sensory apparatus, becomes a source of sensory cognition of objects. Something that is seen, heard or touched for a moment can be remembered and compared with another sensory image, which can result in differentiating classes of objects, and in regarding an object as a class representative. In the process of language learning, the process of further representation is employed. Bense calls the latter semiotizition of sign. This process consists in representing the world of sensory images by means of a system of symbolic signs. This is a social process which involves interaction between people. It begins early in the life of every human being and hence it is difficult to describe it precisely from the student's perspective. Quine, however, highlights that the basis of language learning is an association of a sound (or a written word) with a stimulus that reaches our senses, for example associating a sound with an optical perception (visual stimulus) or, as in the case of the blind and deaf girl, an association of a touch of an object with a touch of the teacher's fingers writing the word on the girl's hand. The possibility of touching an object became a basis for reference of linguistic signals to the object. Language learning takes place not in isolation but in the context of action, in the context of being in the world and receiving various external stimuli. The chain of representations starts with external stimuli, and goes through their sensory representation, to further representation in the form of language's concept system. Language learning involves creating both language functions: cognitive and communicative. Learning a word is creating a verbal representation of the external world, thus it is a cognitive function. It is also a transition to a higher cognitive level, from impressions and particular sensory images to abstract content whose correlate and representative is word. What is taking place is a combination of information gathered in two different processes: information acquired in the course of evolution and included in the cognitive structure, and information acquired socially in the course of learning. Language acquisition is something more than learning the names of objects and actions, or acquiring syntax and grammar; language is a cognitively captured "image" of the world. Language, being a system of symbols, is included in the whole cognitive system through their sign nature. Through the level of meanings and physical-object references, language becomes a multi-level cognitive system. Jakobson defines language as a system of systems. However, it is also important that language itself is a sub-system of a bigger cognitive system. Its cognitive functions result from a systemic relationship with the whole of cognitive actions, and in particular with sensory perception and interpretation.

If we understand language as a system of signs, a system of representation, we can notice that language users mostly think in language. There is no reason to claim that thinking takes place only in language, however some operations, i.e. deduction or proposition formulation, seem to require language. Perhaps, this could be illustrated by the language of mathematics, which allows long mathematical proofs and complex mathematical analyses due to the possibility of operating with symbols. Knowing mathematical concepts, their content and the rules governing them, without using their external representations in the form of written symbols, we would not be able to carry out many mathematical proofs or complex analyses. The basic mathematical concepts, such as the concept of quantity, number, operations, etc, perhaps, do not need linguistic representation – yet such a representation allows us to use them in more complex operations. Similarly, a representation of concepts in the form of linguistic expressions facilitates their more complex use.

Language becomes a tool for thought. It is such a cognitively functional tool that, in fact, it is difficult to imagine concepts not represented by words. A conscious use of concepts is possible through their linguistic representations. It is not possible to imagine "bare thoughts," although, as mentioned before, all thinking does not necessarily take place only in language.

The system of language is a cognitive system also in a different sense. It is a model of reference for sensory information received from the outside. In the input, this information is captured in linguistic structures, it is linguistically interpreted. The openness of the system consists, among other things, in a possibility to add new representations if the information cannot be interpreted within the already existing system of representation. One of the new possibilities is to distinguish among sensory information forms that are linguistic representations. Linguistic signs are the source of linguistic information associated with them. Their interpretation takes place on several levels of linguistic structure. They are recognized as linguistic signs of particular meaning. What is cognitively fundamental is the object-related information on the semantic level.

The system of language in the function of an operational system is a way of obtaining temporary information and of reacting to this information. It is a form in which we interpret information obtained from the outside, as well as a tool of conscious interaction with the surroundings. Only a process such as this is a complete function of representation. A complete relation of representation includes interpretation. For a representative represents something for something else, e.g. for another element of linguistic structure, or for somebody, e.g. for another participant in the communication process.

Representation, thus, is complete in the function of use of signs as representatives of cognitive content. The function of use allows a linguistic expression that represents the content to express the content. Such a possibility of expressing the content, in a system exterior to the mind, gives language a new dimension. This is the dimension of not only representation, but also action.

A three-element sign relation, which is a schema of representation, reflects both the cognitive and the communicative function of language. The schema of representation, reflecting relations between particular elements of relation, creates a system with feedback. This allows language to be regarded as a result of cognition, as well as to indicate dependency of cognition and language seen as a tool of cognition. Using the linguistic structure to represent sensory cognition results in that perceiving the world becomes partially determined by language (Whorf 1982), and the possibility to represent the content, meanings through linguistic expressions allows us to verify a cognitive structure such as language. Linguistic expressions, facilitating deduction and taking action, are verified precisely in these actions. The only form of checking the adequacy of linguistic representation and the validity of cognition is the action based on this cognition. One of the forms of this action is communication.

The question whether language is a toll of cognition or communication — even in the form: is language a representation, or action? — leads to a conclusion that language is a system fulfilling both of these functions to the same extent. None of these functions itself constitutes language. Their cooperation is systemically conditioned and governed by processes of obtaining information.

Conclusions

The above analysis of the cognitive and the communicative function of language allows several conclusions to be formulated which concern both functions and their mutual relationship as well as the nature of language.

The cognitive and the communicative function of language show many mutual relations. Although a strict marking off of both functions is impossible, the present analysis assumed that cognition is primarily a process of gaining and gathering information in stable cognitive structures, while communication is a process of exchanging this information with other language users, which led to the observation that these processes overlap. Linguistic communication requires meaningful symbols, while cognition achieves a full

dimension of representation only in its linguistic form. Communication, similarly to cognition, takes place at a pre-language level. At this level, individual communication acts acquire indexical meanings, dependant on the context of the utterance. Such indexicality or contextuality, even if preserved by tradition, does not explain, however, the origins of language as a system of abstract signs that are objective with regard to individual communication situations and have general meanings. The analysis of communicative function with regard to the speaker shows that there is a relationship between this function and both cognition (in the sense of content conveyed in the message), and not necessarily cognitive action (such as a reaction to information). From the point of view of the addressee, communication is cognition, both on the level of perception of the physical form of the message, and interpretation of the message's content. Perception of the message, however, has very often an extra-cognitive dimension in the form of action caused by the obtained information. Communication reflects a certain dualism: aspects of generality and individuality. A similar dualism can be observed in the cognitive process which links a relative stability of obtained-information structures with indexicality of cognitive acts and actions. The similarity between cognition and communication, indicated by Peirce and Bense, as the similarity of structure can be supplemented with their belonging to the same process of obtaining information.

The conveyed analysis of language functions allows us to formulate conclusions about the nature of language. Language is primarily a tool to obtain information: both permanent and temporary. What helps us obtain and store temporary information is the stable structure of language, acquired in the course of social learning, and correlated with the content of pre-linguistic cognition as well as with innate information contained in the innate cognitive structure. Language is the most complex and effective from the known cognitive structures. Cognition, however, is not a function for its own sake. As observed by Lorenz, cognition is a function purposefully aimed at increasing the possibility to survive, and as such is governed by the general overall functioning of the system. This functioning is not only a mechanic reaction to information obtained as if from the perspective of a passive observer. What is a significant feature of human action is that it is purposefully aimed at obtaining information which is as important as obtaining energy. This is the reason why, among the whole of actions aimed at obtaining information, we can notice increasing complexity and specialization accompanying evolutionary development. The systemic incorporation of language into the whole of cognitive structures, pointed out by Lorenz,

allows us to indicate pre-linguistic conditions for the capability to represent, thus pre-linguistic elements of meaning or object-reference. Language, as a structure governed by a bigger system, fulfills its functions only within this system. Similarly, its nature can be understood only with reference to the whole system. Language, as a system of exchanging and processing information, precisely in the function of communication, exceeds individual cognitive experience, giving cognition a new social dimension.

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ANAPHORA — LOGICAL METHODS OF INTERPRETATION

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In what follows, we will discuss several solutions to the anaphora problem, all drawing on different logical methods. We will look closely at the ideas developed by Webber (1979), Kamp (1981) and Dunin-Kęplicz (1983-1986), who use the following theoretical frameworks for producing their solutions to the problem of anaphora:

for Webber (1979) it is the predicate calculus with elements of lambda expressions, or, as she herself puts it: "extended restricted-quantification predicate calculus representation,"

for Kamp (1981) it is the *Discourse Representation Theory* (DRT) — a universal semantic theory developed by Kamp, which used to be particularly popular among AI theorists,

for Dunin-Kęplicz (1983-1986) it is a particular type of non-monotonic logic (Reiter's default logic, 1980).

We will also mention works by other scholars like Bosch (1983) or Hobbs (1976-1985), but we will not dedicate as much space to them as we will to the previously mentioned theories. We will also omit game-theoretical semantics (Hintikka and Kulas, 1985), that is, the contemporary logical theory which devotes much attention to the anaphora problem, only because it was already

discussed separately in the article "Game-theoretical semantics" published in volume 24 of *Studia Semiotyczne*.[1]

1. BONNIE WEBBER'S FORMALISM

The formalism proposed by Webber (1979) received great acclaim, especially among those scholars preoccupied with anaphor resolution who study automated natural language processing.[2] This is because Webber made a major step forward in terms of two issues. Firstly, she created a formal method for writing down what the text (discourse) makes available to anaphora. Secondly, she described procedures based on these notations in such a way so that when a given anaphora is being interpreted the one and only antecedent of the anaphor always appears among all the different representations. Webber put in a great deal of effort to recreate what is in the text and what can be later referred to. However, she devoted less attention to the method of choosing the right referent for an anaphor from the entities evoked by the discourse.

Webber was considering three types of English anaphora: definite pronouns (or, their *de re* interpretation, that is, the case of identical reference), "one"-anaphora and verb phrase ellipsis. Particularly interesting is her approach to the first group of anaphoric expressions, which is why we will dedicate considerable space to describing these pronouns and we will be less concerned with the other types of anaphora. It is generally impossible for us to thoroughly discuss Webber's entire theory (1979) in this article, due to the disproportion between the length of her work and the limited space we have for recreating it.[3]

According to Webber (1979), a natural language understanding system should be able to create an adequate discourse model, which can be modified as new data is acquired. The model ought to include i.a. representations of discourse entities. For that reason, we assign "invoking descriptions" or IDs to the entities that appear in a discourse for the first time. Every ID (representing an object, a set, a predicate, a pattern, an event, a description

[1]Cf. also Fall (1988), chapter 4. This paper refers directly to chapter 3 of that work.

[2]Webber's ideas (1979) were developed mainly by the University of Pennsylvania, Philadelphia. For example, Schuster (1986) generalized Webber's approach in order to interpret references to events and actions. Crouch (1987) applied Webber's theory to computational interpretation of anaphora.

[3]Webber's paper is presented with a varying degree of precision by many authors, e.g. Hirst (1981: 73-80), Carter (1986: 30-32), Schuster (1986: 30-31).

etc.) may be the antecedent of an anaphoric expression used in a discourse later on.

Webber (1979) assumes that the first operation performed by a system is sentence parsing, which leads to producing the sentence's parse tree. What follows is a semantic interpretation, resulting in extended restricted-quantification predicate calculus representations. Also, at that point, anaphor resolution takes place,[4] but the process differs depending on what kind of anaphoric expression is used in a sentence.

1.1 DEFINITE PRONOUNS

Let us consider the following example:

(1) *Wendy bought a crayon.*

Webber (1979: 64)

The semantic representation of this sentence is:

(2) $(\exists x$: Crayon) . Bought *Wendy,* x,

which is a particular case of

(3) $(\exists x$: P) . Fx, where P stands for any given predicate and Fx for any given sentence with a free variable x.

A rule for constructing appropriate IDs (an "ID-rule") states that a sentence S, with a semantic representation type (3), evokes a discourse entity represented as:

(4) $e_i\ \iota\ x$: P$x \wedge$ F$x \wedge$ evoke S, x, where:

e_i — any label assigned to ID,
ι — a definite operator.

The ID-rule is used for the purpose of sentence representation, always starting with the leftmost term in the formula. Thus, the first ID evoked by sentence (1) will be:

[4]Precisely speaking, a semantic interpretation may occur on two levels: on the first level only the syntactic and the lexical information is used, while on the second one there takes place the resolution of verb phrase ellipsis, of the ambiguity of quantification scopes, of pronouns, definite descriptions etc.

(5) e_1, ι x: Crayon $x \wedge$ Bought Wendy, $x \wedge$ evoke (1), x.

We can read it as "the crayon mentioned in sentence (1) that Wendy bought".

After we identify the first discourse entity e_1, we may use it to form a new representation of sentence (1):

(2') Bought *Wendy,* e_1

The ID-rule is re-applied. This time, if Wendy has not yet been introduced into the discourse, that is, if there is no ID associated with her, a new discourse entity will be evoked, e.g. e_2 (= "a person named Wendy"). The representation e_1 must then be updated so that it indicates that e_2 refers to Wendy.

Now, let us take a look at another, much more complex example:

(6) *Every boy gave a girl he knew the peach she wanted.*

Webber (1979: 74)

One of the possible interpretations of that sentence is that "he" is bound by the quantifier "every boy," and "she" is bound by the expression "a girl he knew." We then obtain the following semantic representation of sentence (6), in which λ stands for the abstraction operator:

(7) $(\forall x{:}\mathrm{B})(\exists\ y{:}\lambda.(u{:}\mathrm{G})[\mathrm{K}\ x,u])$. Gave $x,y,\iota\ z{:}\lambda(v{:}\mathrm{P})[\mathrm{W}\ y,v]\ z$,

where: B = *boy*, G = *girl*, K = *knew*, P = *peach*, W = *wanted*.

Applying the ID-rule to sentence (7) evokes the first discourse entity e_3 = "the set of (all) boys:"

(8) $e_3\ \iota\ x$; maxset(B)x, where:

maxset(B) is a true predicate if and only if its argument is a set encompassing the entire truth spectrum of predicate B.

Re-writing (7) using e_3 gives us:

(9) $(\forall x{\in}\ \mathrm{e}_3)(\exists\ y{:}\lambda(u{:}\mathrm{G})[\mathrm{K}\ x,u])$. Gave $x,y,\iota\ z{:}(v{:}\mathrm{P})[\mathrm{W}\ y,w]\mathrm{z}$.

It now becomes possible to identify the next discourse entity, e_4, as "the set of girls each of whom some member of a set who knew her gave the peach she wanted:"

(10) e_4 ι y:maxset($\lambda(u$:G)[($\exists$ $x \in$ e_3) . K x,u $\wedge$ Gave x,u,ι z:$\lambda(v$:P)[W u,v]z $\wedge$ evoke (7), u])y.

One more discourse entity was evoked by sentence (7) is e_5= "the set of peaches, each of which was the peach that some member of e_4 wanted:"

(11') e_5' ιz:maxset($\lambda(u)$[($\exists$ $y \in$ e_4) . $u = \iota$ w:λ,(v:P)[W y,v]w])z,

or in a slightly modified version e_5 = "the set of peaches such that some member of e_4 wanted that peach:"

(11") hspace15pte_5" ι z:maxset($\lambda(u)$[($\exists$ $y \in$ e_4). $\lambda(v$:P)[W y,v]u])z.[5]

This analysis has touched upon quite a complex example. Now, let us consider three more out of all the general cases discussed by Webber (1979: 27-96) in a brief but organized manner. For each case, a structural description (SD) will be provided and followed by the appropriate ID (or IDs), as well as a specific exemplary sentence with its semantic representation and the discourse entities evoked (e_i).

1.1.1 INDEPENDENT EXISTENTIALS

SD: !($\exists$ x:C) . Fx {$\wedge$ |x| = n}, where:
! — the left end of a clause
$|x|$ = n — cardinality of the set x
{...} — optional elements in the structural description
Fx — sentence in which the variable x is free
ID: ι x: Cx { $\wedge$ $|x|$ = n} $\wedge$ evoke Z,x, where Z — sentence
(12) *Three cats ate the pizza.*
(R. 12) ($\exists x$:set(Cat)) . Ate x, ι y:Pizza y $\wedge$ $|x| = 3$
e_1 ι x: set(Cat)x $\wedge$ Ate x,ι y:Pizza y $\wedge$ $|x| = 3$ $\wedge$ evoke (12) "the set of cats, mentioned in sentence 12, who together ate the pizza."

1.1.2. DEFINITE DESCRIPTIONS

[5]In the second version of e_5 it is not explicitly revealed that each peach was the only peach desired by some girl. This information is already contained in sentence (7), but Webber (1979: 75) choses to retain its redundancy in e_5.

SD: $\iota\ x$: Cx
ID: $\iota\ x$.- Cx
(13) *I saw the cat which dislikes Sam.*
(R. 13) Saw I, $\iota\ x$:λ(u:Cat)[Dislike *u, Sam*] x
e_2 $\iota\ x$:λ(u:Cat)[Dislike *u, Sam*] x
"the cat which dislikes Sam".

1.1.3. DISTRIBUTIVES

SD: !($\forall\ x$:C)
ID (two at once):
prototype — x:C
set — $\iota\ x$:maxset(C) x
(14) *Each cat that Wendy owns dislikes Sam.*
(R.14) ($\forall x$:λ(u:Cat)[Own *Wendy, u]) .* Dislike x, Sam
e_{3a} x:λ.(u:Cat)[Own *Wendy, u*]
"the prototypical cat that Wendy owns"
e_{3b} ι x: maxset(λ,(u:Cat)[Own *Wendy,u*])x
„all the (the set of) cats that Wendy owns".

The necessity to evoke both of these discourse entities can be supported by the fact that there exists two possible continuations of sentence (14):

(14*'*) *IT skulks in a comer when he is around.*
(14*"*) *He is not too fond of THEM either.*

Carter (1986: 31)

1.1.4. SOME DIFFICULTIES POSED BY ANAPHORA INSIDE SENTENCES

The method proposed by Webber is effective when applied to anaphors which refer to entities evoked by other (previous) sentences. However, there are often cases when a reference is made within the same sentence, just to mention Geach's donkey sentences. For that reason, Webber suggests[6] that we process all simple sentences of a discourse separately. Moreover, expressions containing the so-called bound anaphora ought to be treated as conditional sentences (*If... then...).* That way, the interpretation of the sentence about donkeys (cf. Webber, 1979: 79-80) is correct. Another difficulty lies in the ambiguity of certain sentences like:

(15) *Someone was using each telephone on HIS desk.*

[6]Which Hirst did not notice in his review (1981: 75).

Webber (1979: 47-48)

Such a pronoun may be resolved in the previous part of the discourse, in which case we would have to replace the pronoun in sentence (15) with the corresponding entity before proceeding to a syntactic analysis. Secondly, it may be correct to assume that the pronoun "he" is co-referential with the quantifier "someone." The third option is that we form a vague ID, in which some entities are not completely specified (cf. Webber 1979: 48, 95), hoping that the following part of the discourse provides us with the necessary clarifications. Notice that, in theory, this makes it possible to interpret cataphoras.

The first two possible interpretations of sentence (15) may be illustrated by the following contexts:

(15') "HIS" refers to a previously-mentioned individual:

John had to make a call. He was understandably upset then, when he saw that someone was using each telephone on his desk. His response was to call them all ninnies.

(15") the "bound variable" interpretation:

Someone was using each telephone on HIS desk. HE was trying unsuccessfully to make a conference call.

Webber (1979: 48)

1.2. "ONE-ANAPHORA"

The name "one"-anaphora used by Webber (1979) can be somewhat misleading,[7] as it is supposed to refer to all substitutes for a description in a noun phrase, e.g.:

(16) *Some cotton T-shirts are expensive but not the ONE Wendy gave Bruce yesterday.*

(17) *Wendy bought some cotton T-shirts. The largest ∅ she gave to her father.*

(18) *What is the half-life of* U_{239}?

[7]Hirst (1981: 75) preferred the term introduced earlier by Nash-Webber (1976) — descriptional anaphor.

What is IT for K_{40}?

Webber (1979: 97)

It is easy to notice that this anaphora in Polish is represented by either ellipsis or pronouns and so we have no lexical equivalent of the English word "one".

Webber (1979: 117) also gives the name "one"-anaphora to the *de dicto* anaphora, which some linguists and logicians called one of the "pronouns of laziness."[8] To remind you what kind of pronoun occurrences are meant here, I shall quote the example given by Karttunen (1969):

(19) *The man who gave his paycheck to his wife was wiser than the man who gave IT to his mistress.*

Webber claims that similarly to representing the antecedents of pronouns (IDs discussed in section 1.1), there is also the possibility of a logical representation of descriptions. She does not, however, provide as detailed and elaborate a solution as it was done for pronouns (specifically, for their *de re* occurrences). But we must certainly take into consideration at least these two remarks:

1. If an expression like "a cotton T-shirt that Basia gave to Janek" occurs in a sentence, it opens up the possibility of making references to different antecedents, which, in this case, would be fairly detailed descriptions of the shirt. Hence:

T-shirt — T-shirt
cotton T-shirt — $\lambda(u$:T-shirt)[Cotton u]
T-shirt that Basia gave to Janek — $\lambda(u$:T-shirt)[Gave *Basia, Janek,* u]
etc.

Therefore, it must be possible to break down the full description that appears in a sentence into smaller components (using the above formula).

1. In addition to syntactic information conveyed by the arrangement of the components of the description (as in a)), the possibility of referencing is also influenced by semantic factors. For example, homonyms usually evoke only one of its possible meanings, not others (cf. Hirst 1981:76):

(20) *A thief can pick locks in thirty seconds, while John has been growing his ∅ for a few months already.*

[8] E.g. Geach (1962), Karttunen (1969), Partee (1972), Hintikka and Carlson (1977).

In this example, the beginning of the sentence evokes one meaning of the word "lock" (as in "fastening device") and it is not easy to guess that the ellipsis (∅) refers to a different meaning of this word ("hair").

However, one may use different meanings of a homonym but it is usually done for humorous purposes:

(21) — *Chcemy żyć w POKOJU! [We want to live in PEACE!]*

– *Ja wolałbym dwa ∅ albo i trzy ∅. [I would prefer two∅ or three∅.]*[9]

(22) *My brother thinks both rhododendron PLANTS and chemical ONES pollute the atmosphere.*

Cornish (1986:30)

The basic difficulty with "one-anaphora" is that there are no rigorous methods of distinguishing its pronominal realizations from cases when a definite pronoun is used (cf. section 1.1.).[10] It is also unclear how to identify ellipses, because it is usually difficult to determine where a surface indicator of the sentence's semantic structure is missing when using formal methods only. In this respect, the Polish language is perhaps even more complicated than English.

Up to now we have been focusing our discussion of Webber's work (1979) on the antecedents "present in the text", that is, ones that were lexically identifiable. But Webber (1979: 118-124) also devotes some attention to *non-explicit descriptions*, to which we can also refer by using "one-anaphora." According to Webber, it is impossible to limit *a priori* the devices used for such non-explicit descriptions, since, in short, they depend on highly complex factors of pragmatic nature. Nevertheless, she lists three types of expressions, which form fairly homogeneous groups. Firstly, there is the *strained anaphora* (the term was proposed by Watt (1975)). The second group of non-explicit antecedents includes existentials like:

(23) *Some cotton T-shirts are expensive.*

Wendy gave (a black) ONE to Bruce just yesterday.

Webber (1979: 120)

[9]The Polish word "pokój" is a homonym — it means "peace" or "room" [translator's note].

[10]In Polish, the situation is analogous, if not more complicated. Bearing in mind how many roles can play the pronoun "to."

The last type of non-explicit anaphora discussed by Webber (1979) refers to generalizations implied by lists of objects that are similar in some respect. Notice that a correct interpretation is always correlated here with general knowledge:

(24) *I know about Advent, Bose, AR and KLH, but about Japanese ONES, you'll have to ask Fred.*

ONE = ? speaker, speaker producer?

Webber (1979: 123)

1.3. VERB PHRASE ELLIPSIS

The last type of anaphora discussed by Webber (1979: 125-168) is *verb phrase ellipsis.* We will not devote much attention to that, for such expressions are not commonly recognized as anaphora. In her approach to verb phrase ellipsis, Webber draws on Sag's theory (1976),[11] which touched upon the logical phrase structure and the deletion of some constituents from this structure during sentence transformation. In Sag's view (1976) in its logical form a verb phrase is represented as a single structural constituent, the use of the abstraction operator λ, e.g.:

(25) *Betsy loves Peter.*

Betsy, $\lambda(s)$ [*s love Peter*]

Webber (1979: 126)

According to Sag, the ellipsis of a verbal phrase is possible if its logical representation is identical to that of another, syntactically permitted verbal phrase, which almost always means, in this context, that a complete verbal phrase occurs before the ellipsis. For example, sentence (25) may be continued as follows:

(25') *Jane does ∅ too.*

Jane, $\lambda(s)$ [*s love Peter*].

Webber's and Sag's approach allows us to interpret correctly even more complex cases. Let us just mention the so called *sloppy identity:*

(26) (a) *Garth beats his wife.*

[11] Acc. to Sag — Verb Phrase Deletion (VPD).

(b) *Fred does ∅ too.*

Ross (1967)

Sentence (b) in the example (26) is ambiguous, which is shown in the Level-1 representation[12] of sentence (a) — cf. Webber (1979: 133-134):

(R.26$_I$) *Garth,* $\lambda(r)$ [*Beat r, wife-of*(*HE*)].

In a Level-2 semantic analysis, the verbal phrase in sentence (a) may have two possible interpretations:

(R.26$'_2$) $\lambda(r)$ [Beat *r, wife-of*(*PRO=Garth*)]

or

(R.26$''_2$) $\lambda(r)$ [*Beat r, wife-of*(r)].

The former representation means that some r beats Gath's wife, while the latter means that r beats his own wife. These two possible antecedents of the omitted verbal phrase in sentence (b) reflect the ambiguity of this sentence.

Here we are skipping many details of the solution proposed by Webber. Let us only add that she was also considering issues that arise when dealing with existential quantifiers, e.g.:

(27) *At the party I met a famous Boston author and Wendy did ∅ too.*

∅ = met that (another) famous Boston author.

Webber (1979: 140)

Webber (1979: 142-149) was also looking into the issues of negation, plural form and ellipses that refer to verbal phrases that are not connected with the subject. The latter case can be illustrated with the following sentence:

(28) *Betsy wants Peter to read everything that Alan does ∅.*

$$\varnothing = \begin{cases} read \\ want\ Peter\ to\ read \end{cases}$$

Sag (1976)

Using Sag's notation, sentence (28) has two possible representations on the level of logical sentence structure. In the representations cited below, I marked those constituents which are identical to the omitted constituents. According to Sag (1976), these marked constituents may be actually omitted

[12] See footnote 3.

in the discourse:

(R.28*'*) *Betsy,* $\lambda(x)$ [*x want* {($\forall$y : *Alan,* $\lambda(w)$ [***w* read *y***]) *Peter,* $\lambda(z)$ [***z*** read *y*]}].

(R.28*"*) *Betsy,* $\lambda(x)$ [***x* want** {($\forall y$: *Alan,* $\lambda(z)$ [***z*** want {**Peter,** $\lambda(w)$ [***w* read *y***]}])

Peter, $\lambda(q)$ [***q* read *y***]}].

After some adaptations, Sag's theory (1976) allowed Webber (1979) to single out many different antecedents of verb phrase ellipses. However, she demonstrated that in more complex instances we should abandon the assumption that a sentence has a single correct "logical form". We must also take into account the inference process, which may become visible on the level of „logical form", e.g. when we form a new predicate out of simple predicates that occur in different formulae:

(29) *I can walk and I can chew gum. Gerry can* ∅ *too, but not at the same time.*

Webber (1979: 163)

∅ = *walk and chew gum.*

A rule schema required in this case would look as follows:

(RW.29) *y,* $\lambda(r)$[P *r*] $\wedge$ *y,* $\lambda(s)$[Q *s*] $\rightarrow$ *y,* $\lambda(t)$[P *t* $\wedge$ Q *t*],

where P, Q are predicates.

Furthermore, Webber (1979) discussed syntactic restrictions imposed on ellipsis by i.e. sentence structure, active or passive voice, negation or tense. She also listed (1979: 157-162) the basic requirements for resolving verb phrase ellipses by a natural language understanding system. We will only mention one, namely, that we must resolve verb phrase ellipses before resolving definite pronouns.

1.4. SUMMARY

Webber (1979) argued that her solution has many advantages, yet ("in contradistinction to some other AI workers"; Hirst 1981: 79) she did not ignore its flaws. One of the advantages is that she considers many different anaphoric expressions (which even this article proves). Moreover, the formalism proposed by Webber allows us to produce correct representations of all these various potential antecedents of anaphoric expressions. She uses

devices derived directly from common logical notations, thanks to which her formalism gained the accuracy that is characteristic for logic. Webber's work (1979) is also often praised for providing a satisfactory solution to problems with anaphora that result from quantification.

Webber's work (1979) was strongly motivated by the recognition of practical needs of natural language understanding systems. Therefore, here notation is easily translatable into popular programming languages, especially Lisp, which, like Webber, uses lambda-notation for predicates. But at the same time, Webber's solution is well-founded in solid theoretical frameworks.

However, the main flaw of this solution is a result of Webber's very assumptions. Namely, she was trying to specify "in advance" that what the text makes available for later anaphoric references. Despite the above-mentioned variety of potential antecedents "spotted" that way, it seems unlikely that they will all actually be revealed, since it would require truly prophetic skills (on the part of both the human and the computer resolving anaphors). Nominal anaphora are a much simpler case than prosentential anaphora, but the latter are not taken into consideration by Webber, as it would require allowing complicated issues like — the structure of discourse (in two aspects, namely: long-distance references and anaphors referring to content carried by long text fragments). On the other hand, Webber's approach (1979) introduces difficulties (already discussed in section 1.1.4) connected with anaphora inside sentences.

Overall, it needs to be stressed that Webber's work was a highly important factor in the development of computational linguistics. This young branch of science has developed extremely fast. Webber's text was applied theoretically and practically by other scholars. At the same time, the impact of this analysis is not restricted to computational linguistics only — it's been taken into consideration by some other logicians interested in semantics. It is also listed e.g. in the bibliography to the work by Hintikka and Kulas (1985) who are not directly involved in natural language processing.

2. HANS KAMP'S DISCOURSE REPRESENTATION THEORY

We will now focus on Discourse Representation Theory (DRT) introduced by Kamp in 1981. The basic thesis of this innovative semantic theory is that the meaning of an utterance should be interpreted within units larger than a single sentence. The understanding of a discourse is based on the ability to create its adequate semantic representations. Whether these representations

are correct is in turn verified by a mechanism which ties DR Theory to the model theory known since Tarski.

Kamp (1981: 318) does not consider the research on anaphora to be very significant ("However useful some of this work may have been, I have the impression that its theoretical significance is rather limited"). However, it is precisely the inter-sentential anaphora which serves to justify why DRT goes beyond the boundary of a sentence — a boundary which until recently was only natural for logicians in their research on linguistic utterances. So for example Spencer-Smith (1987: l)[13]states that there is no reason to consider the following examples as essentially different from each other only because there a full stop mark appears in one of them:

(30) *Pandora has a jar. ∅opens it.*

(31) *Pandora has a jar and ∅ opens it.*

Spencer-Smith (1987: 2) proves with these examples that individual words have a double function in a discourse. On the one hand, they participate in the meaning of bigger units (sentences) through relations between individual words and the actual world. On the other hand, words are in mutual cross[14] relations which bind sentences to bigger semantic units of meaning. Anaphora is a distinct manifestation of the second type of relation.

2.1 RELATION BETWEEN DR THEORY AND OTHER SEMANTIC THEORIES

Before we start discussing one of the aspects of DRT — its relationship to definite pronouns — we would like to mention its relation to other semantic theories. A very similar approach to anaphora, as that of DRT, was presented by Heim (1982, 1983) in the so called File Card Theory. The DRT has sometimes been presented as a continuation of the semantic and logical tradition started by Montague (1973), for example in its attitude to anaphora (e.g. anaphoric pronoun – Kamp (1981) and verb phrase ellipsis — Klein (1984)). There are also tangent points between DRT and the so called

[13]In relating basic Kamp's concepts of DRT (1981) we are going to use Spencer-Smith's book (1987) since his conceptualization of this theory is newer and it arose, as the author admits, under the influence and in constant confrontation with the creator of DR Theory.

[14]A similar standpoint was presented by Łachwa (1986) and can be recalled here.

situation semantics — Barwise and Perry (1983)[15] and the game semantics — Hintikka and Kulas (1985). The authors of the latter theory (1985: 111) emphasized some connections with DRT e.g. in regard to anaphoric pronouns. They did not omit to mention that their theory is superior to DRT (but without presenting any thorough argumentation).

It is possible to point out mutual influences between the DRT and some fields of knowledge which lie outside traditional logical semantics. So, for example, it is impossible to deny the importance of Kamp's concept for computational linguistics. Spencer-Smith (1987: 2), on the other hand, assures us that DRT found inspiration in Karttunena's work (1976). There were some attempts at computational implementation of some elements of the discussed theory (e.g. Johnson and Klein 1986; Guenthner and Lehmann 1983). Spencer-Smith (1987: 2) also mentions the spreading of ideas from DRT to cognitive psychology.

2.2. ANAPHORIC PRONOUNS IN DRT

The fundamental DRT idea is based on a consecutive application of the principles which transform sentences into *Discourse Representation Structures* – later referred to as DRS. Similarly to the original Kamp's work (1981) and to the Spencer-Smith's article (1987) we are going to focus on a discourse consisting of a sequence of declarative sentences uttered by the same speaker. The aforesaid principles of building DRS function "descendingly," determining what is the influence of each single component of the sentence on the meaning of the whole discourse. After considering all elementary (in syntactical sense) components of a sentence, we pass on to the parsing of the next sentence.

Presently we are going to show how DRS are built, using as an example an analysis of a simple discourse (30). The structures which represent the meaning of a discourse are often presented by DRT in box notations. The contents of a box could be described as a partial model, developing along with the discourse (Spencer-Smith 1987: 3). The initial situation can be marked as follows:

Pandora has a jar.

[15] "The approach (i.e. DRT) also has an affinity with Situation Semantics — the two theories have influenced each other — and may one day see the fruits of collaborative research between them" (Spencer-Smith, 1987: 2).

Names and indefinite expressions are in a way treated similarly in DRT, that is to say they introduce to a discourse some reference markers or discourse referents. For example, the process associated with the word *Pandora* leads to an intermediate DRS, where x_1 is a reference marker:

x_1
x_1 = *Pandora* x_1 *has a jar*

An analysis of the indefinite expression *jar* leads in turn to the formation of a complete DRS of the first sentence of the example (30):

(30_1)

x_1, x_2
x_1 = *Pandora* *jar*(x_2) *has*(x_1, x_2)

We can see that the proper name is connected through the introduced marker (x_1) to a concrete individual object. And the indefinite expression introduces a marker (x_2), referring to the object which we know to be a jar. The last of the predicates in (30_1) completes the list of conditions to be fulfilled in the outside world in order to make this representation true.

At the initial stage of its analysis the second sentence of the example (30) allows us to complete the DRS with the following additional elements:

(30_2)

x_1, x_2, x_3, x_4
x_1 = *Pandora* *jar*(x_2) *has*(x_1, x_2) *opens*(x_3, x_4)

New individual terms which appeared in the discourse (in our case — the ellipsis and the pronoun from the second sentence (30)) could refer to new objects. So in (30_2) new reference markers have been introduced: x_3 and x_4. However, "pragmatic factors"[16] — as they are usually laconically called in various DRT overviews where similar examples to (30) are analyzed — make it natural to equate markers x_1 with x_3 and x_2 with x_4. A comment about the solution offered by DRT shall be made further in section 2, but for the moment let us assume that this equation is indeed natural. In this case we obtain a simplified DRS model which contains the statements from the discourse (30). We can record (sketch) this DRS as follows (cf. Spencer-Smith 1987: 4):

(30)

$x_1,\ x_2$
$x_1 = Pandora$ $jar(x_2)$ $has(x_1,\ x_2)$ $opens(x_1,\ x_2)$

The DRS in box (30), obtained as the result of the analysis of the discourse (30), constitutes — according to Spencer-Smith (1987: 4) — a model of a fragment of the actual world, since the box (30) contains a set of reference markers initiated by the discourse and a partial set of relations between these markers.[17] An additional advantage of this type of construction, says Spencer-Smith (1987: 4), is the fact that the language used in DRS "is a logically perfect language." The essential idea which lies beneath this phrase is that the external form of an expression in such a language corresponds directly to its semantic contents. So the DRT idea

[16]Usually the examples which illustrate DRT are chosen in such a way that the "new" reference markers in fact somehow "naturally" equate with some "old" markers. In those examples you need only to consider differences in grammatical gender of linguistic phrases which introduced the reference markers. Spencer-Smith (1987: 4) analyzing the example (30) wrote as follows: "It is non-systematic, pragmatic factors which tell us — in this case, on the basis of gender information, the absence of any other appropriate antecedents, etc. – that*, = x_3, and $x_2 = x_4$." Behind the word "etc." in the above mentioned quotation there is a number of very complex problems omitted by both the theory discussed here and other contemporary semantic theories.

[17]Spencer-Smith refers here to Webber (1983: 334—335).

converges here with the solution suggested by Montague (1973), who defined truth conditions directly as a fragment of the English language which he analyzed.

A reference to Montague's idea was very clear in Kamp's article (1981) which was fundamental for DRT and where the author quoted the principles of making DRS for a fragment of English language very similar to that of Montague. In the present overview of DRT we are not going to present the principles leading from natural language expressions to DRS, although, for the examples examined here, those principles would not have to be very complicated. For an accurate evaluation of the discussed theory it is essential that the principles of transformation for the consecutive sentences of a discourse into a Discourse Representation Structure are correct. Such evaluation is rather difficult though, because, as Spencer-Smith (1987: 2) put it, "the theory is broad enough to tolerate considerable disagreement about details." On the one hand, the possibility of arriving at various conclusions about details is an advantage of the discussed theory. But, on the other hand, in its practical application, this theory often requires some complementary elements. The creators of computational implementation of DRT fragments (cited in section 2.1) surely feel it most acutely.

In order to emphasize even more the opinion of the author of this article that DRT is in a way incomplete, let us quote Spencer-Smith (1987: 5) again:

As we have already seen,[18] *it is assumed that the recovery of DRSs (Discourse Representation Structures) can only be partially specified by an algorithm. DR theory leaves room for the operation of general pragmatic factors, such as Relevance, in the recovery of prepositional content — in the resolution of anaphora and ambiguity, in determining the restrictions on quantifiers, and so on.*

Besides the issue of creating DRS principles, to which we have just dedicated some time, the second major problem — for DRT as a semantic theory — is an adequate theory of truth. But before we turn to this subject, we would like to point out, as Spencer-Smith (1987: 5) did, that DRT allows us to distinguish two discourses, which despite the identical truth conditions create different pragmatic effects on subsequent utterances. It is the case e.g. of the sentences: *Exactly one of the ten bells was missing* and *Exactly nine of the ten bells were in place*. They construct each an entirely different scene (which is taken into account by a proper DRS) for the following pronominal

[18]When analyzing a discourse analogous to (30) [author's note].

reference: *IT was under the sofa.*

2.3. THE DEFINITION OF TRUTH IN DRT[19]

The definition of truth in DRT is always formulated for DRSs in relation to the model which is to be understood "traditionally" i.e. as a pair consisting of set U — called universe or the model's domain — and function F, which interprets simple predicates of language J in the set U. Let us have language J and model M = ⟨U, F⟩.

As it could be noticed in section 2.2, in order to create a DRS (e.g. D) some reference markers have to be chosen and relations between them defined (in the course of the analysis of discourse). It could shortly be noted thus:

$$D = \langle Z,\ R\rangle,$$

where:

Z — a set of reference markers chosen for DRS D from any nonempty set V,

R — a set of relations in DRS D $\quad (R \subset \overset{n}{\underset{i=1}{X}} Z, n \in N)$,

So R is a set of predicates specified in elements, pairs of elements, sets of three etc. of the set Z. The creation of a DRS is a procedure in which subsequent discourse sentences are to be analyzed and elementary components extracted, so we can safely presume that R contains solely simple predicates of language J.

Let us have a part function: f: V $\mapsto$ U and assume denotation M $\vdash_f D$ (Spencer-Smith 1987: 5), which we can interpret in several ways e.g.: "function f verifies DRS D in model M" or "function f is an immersion of DRS D in model M" or "f is a function which immerses DRS D in model M."

DEFINITION 3.1:

M $\vdash_f D$ $\underline{def}$ $[Z \subseteq \text{dom}(f)\ ] \wedge [\forall \text{R} \in \text{R} : \langle x_1, x_2, \ldots, x_n\rangle \in \text{R} \rightarrow \langle f(x_1), f(x_2), \ldots, f(x_n)\rangle \in \text{F(R)}]$.

[19] Truth definitions for DRS given in various overviews do not always fulfill all the criteria of accuracy. As is the case especially with Spencer-Smith (1987: 5), who leaves out many things for the reader to guess. The wordings of section 2.3 of this dissertation come from its author. They are however directly inspired by articles from Kamp (1981), Klein (1984), Spencer-Smith (1987).

Finally we can define what it means that DRS D is true in model M (in regard to model M). For this fact let us assume the denotation $M \vdash D$.

DEFINITION 3.2:

$M \vdash D \underline{def} \exists f: V \mapsto U \wedge M \vdash_f D$.

DRS D is true if there exists a function f which immerses the discourse in model M. The function f is here a kind of isomorphism, which we can be seen from the definition 3.1, especially if we consider that:

$[Z \subseteq dom(f)] \leftrightarrow [\forall x_i \in Z : f(x_i) \in U]$.

Let us follow now how the definition of truth formulated above for DRS applies to the case of discourse (30). The representation (box 30) is true in model $M = \langle U,F \rangle$ (in short: $M \vdash$ (b.30)), if and only if there exists a function f that:

1. $\exists\, a, b \in U : f(x_1) = a, f(x_2) = b$,

2. $a \in F(= \underline{\text{Pandora}})$, i.e. a is Pandora,

   $b \in F(\underline{\text{jar}})$, i.e. b is a jar in model M,
   $\langle a, b \rangle \in F(\underline{\text{opens}})$, i.e. a opens b,
   $\langle a, b \rangle \in F(\underline{\text{has}})$, i.e. a has b.

Simple predicates of a language J used in the DRS are underlined above, while on the right side a situation is described that should be valid in the model's domain for the DRS (b.30) to be true.

2.4. DRT AND THE TRUTHFULNESS OF A DISCOURSE

We have defined above the truthfulness of discourse representations which are created by using the principles of DRT. It is hard to deny the accuracy of this definition. But what can be said about the truth or falsity of discourses themselves? Spencer-Smith (1987:5) presents in this with respect to the following opinion:

Since it is propositions which are directly true or false, truth should be defined primarily for DRSs (Discourse Representation Structures); a discourse CAN THEN INHERIT[20] *the truth value of the DRS it gives rise to within a context.*

Such a position seems, however, to be too optimistic. It arouses no particular controversy in simple cases as the one in discourse (30). The translation of natural language expressions into predicates used in the

[20] Author's underlining.

representation (box 30) was in fact very natural. In various studies of DRT it is often emphasized that the translations should be natural. But it remains obvious that some formal language is used for predicates in DRS (let us say, language J). Otherwise, the reference to model theory would be completely off the mark. Therefore, the question arises whether the DRT applies to strict methods of natural language translation into aforementioned language J. The answer to this question has already come earlier (at the end of section 2.2). Spencer-Smith (1987: 5) stated in the cited passage that the principles of making DRS are defined only partially and make it possible to assume various approaches to the so-called pragmatic factors. The boundary between pragmatics and semantics, however, is very unstable, and what Spencer-Smith considered an undoubted advantage of DRT, in the context outlined here may well pass for a defect. While the DRT can determine whether the representations generated by its means are true or false, it generally does not give any tools to extend the results to the discourses — the cause of these representations. Unless the person who seeks to apply the Discourse Representation Theory, formulates it in a very accurate manner, liable for verification, the rules of transformation of discourses into DRS, expressed in the language J. But then the credit would be largely given to the "implementer," and the theory discussed here would have to be considered only as a source of inspiration. Perhaps this would be a sufficient argument for the usefulness of Kamp's (1981) proposal.

2.5. DONKEY SENTENCE OR GENERALIZED QUANTIFICATION IN DRT

In Section 2.3, we have shown how indefinite expressions, proper names, as well as pronoun references to them are treated in DRT. Presently we are going to demonstrate the relation of DRT to universally quantified expressions, which diverges from the above model. In this model indefinite expressions had existential power i.e. they caused the creation of a single reference marker. In generalized quantification, as in conditional expressions "the idea developed by DRT is that a supposition introduces a certain condition of the world, perhaps an indefinite one, and any way to achieve this condition should be considered as satisfactory" (Spencer-Smith 1985: 7). To illustrate this idea, we use a well-known example of Gaech's:[21]

(32) *Every farmer that owns a donkey beats it.*

[21] See: Kamp (1981), Klein (1984). Spencer-Smith (1987: 7-10) analyzes a few other examples of conditional and quantificational expressions.

The problem in this example consists of the providing of a universal meaning to the indefinite expression donkey. This indefiniteness can be seen immediately in the English version of that example, in which the phrase ***a*** *donkey* appears.

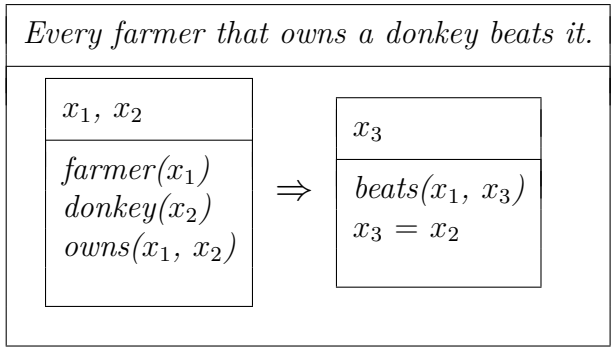
A correct interpretation is obtained in DRT by binding DRS $D(\mathrm{P}) \rightarrow D(\mathrm{N})$ with the implication $\mathrm{P} \rightarrow \mathrm{N}$, where $D(\mathrm{P})$ is a representation of the predecessor P, and $D(\mathrm{N})$ is a representation of the successor N. $D(\mathrm{P})$ introduces a context for the interpretation of the discourse associated with the successor N and it can be any context, as long as it is associated with the contents carried by predecessor P. In this way, the required generalization of the interpretation of indefinite expressions is obtained. These facts are included in the following definition of the verification (immersion) in the model M by the use of a function f of implicational and universally quantified DRS:

DEFINITION 3.3:[22]

$\mathrm{M} \vdash_f [D(\mathrm{P}) \rightarrow D(\mathrm{N})]$ $\underline{def}$ $\forall g [f \subseteq g \wedge \mathrm{M} \vdash_g D(\mathrm{P}) \rightarrow \exists h [g \subseteq h \wedge \mathrm{M} \vdash_h D(\mathrm{N})]]$.

For the example (32) we obtain the following DRS (Klein 1984: 166):

(R.32)



So in the representation above, the box on the left introduces conditions carried by the predecessor (*a farmer that owns a donkey*), and the second box contains the contents of the successor (*beats it*). In accordance with Definition 3.3 these could be any farmer and any donkey owned by this farmer which correctly determines the truth conditions for a sentence (32). Please note that the solution of anaphoric pronouns is given "from the outside."

[22] After adjusting Spencer-Smith (1987: 7) notations to earlier assumptions.

2.6 SUMMARY

We are not going to discuss solutions offered by the DRT to other traditional problems with which logic deals.[23] For our purposes the description given above of the issues directly related to pronominal anaphora is definitely sufficient.

We pointed out that the Discourse Representation Theory has more to say about discourse representations than about the discourses themselves, for it does not strictly formulate all the rules that would lead from the original expressions in natural language to their representations. It seems that this last task will be for a long time (and perhaps forever) based largely on intuition. This problem concerns all contemporary semantic theories equally.

Being familiar with only one aspect of the DRT, the author of this dissertation does not feel able to give a full assessment of the solutions offered by this theory. The fact that it has huge popularity, especially in the circles engaged in natural language processing, speaks for itself. This theory is general enough to be applicable in a variety of uses. It should be noted, however, that it does not offer particular solutions — it is rather a framework for interpretation, with many empty spots, which should be gradually filled on one's own, when the need arises.

As for the interpretation of anaphora in DRT, all we can do is to agree entirely with two sentences uttered by Schuster (1986: 17): "There is no explanation in the DR Theory that indicates how the referents are chosen." And in another place on the same page: "In general, DRT provides us with a nice structure for handling anaphoric links in discourse but it fails to go into the interpretation level."

At the end of these reflections on the Discourse Representation Theory, we would like to draw attention to the essential convergence of the methods — in regards to the interpretation of anaphora and definite descriptions — offered by the DRT and game semantics.[24] The external appearance may deny this kind of suggestion, because these theories use different means to present their results (those means are more elegant in the case of DRT). However, in both cases different formalisms hide essentially convergent intuitions, at least in the opinion of the author of this dissertation. We do not have space to penetrate deeper into the issue, but we indicate its presence and leave it

[23] Apart from the issues discussed above, Spencer-Smith (1987) dealt with the relationship between the unit terms and the attitudes, as well as with the passage of time in discourse. Klein (1984) was interested in verb phrase ellipsis.

[24] See footnote 1.

for the reader to consider. Similarities of this kind have already been noted by Hintikka and Kulas (1985: 111), but they did not pick up the discussion and one could say that they "fobbed off their opponent." It seems that from the other side — from the DRT side — there are no references to game semantics whatsoever.

3. NON-MONOTONIC LOGIC ACCORDING TO BARBARA DUNIN-KĘPLICZ

So far, we have covered a very fine and well-grounded formalism proposed by Webber (1979) and a theory developed by Kamp (1981), which enjoys considerable success among those interested in semantics and logic. It is now time to discuss yet another interesting idea. Idea seems to be the right word to describe the proposal put forward by Barbara Dunin Kęplicz (1984). The idea, which we will explore in a moment, was basically to use non-monotonic logic (precisely speaking: Reiter's default logic (1980)) to determine discourse referents, thus, i.e. to resolve anaphora. Dunin-Kęplicz and Łukaszewicz (1986) provide numerous examples which support the argument that non-monotonic reasoning is often indispensable.

3.1. BASIC PRINCIPLES OF REITER'S DEFAULT LOGIC

Our review of the key ideas in Reiter's default logic (1980) is based on the paper by Dunin-Kępicz and Łukaszewicz (1986), which is sufficient for our purposes.

Reiter's (1980) default logic was inspired by the highly popular frame concept formulated by Marvin Minsky (1975). The aim of Reiter's theory was to model (imitate) arguments based on incomplete premises, as this is the way we tend to draw conclusions in everyday life — by making use of the usually incomplete set of information items that we have available and by assuming that a sentence is true if there is no apparent evidence to the contrary.

A typical example of default reasoning is that birds can fly. If we know that a is a bird, we are likely to assume that a flies. But once we learn that a is a penguin or an ostrich, we will immediately drop our original conclusion. In default logic it is represented by the following rule (a default):

$bird(x) : \mathrm{M}\ flies(x)\ /\ flies(x)$,[25]

[25]Obviously, normally, two completely different predicates may appear on both sides of the slash.

which reads "if x is a bird and if there are no facts to contradict that x flies, than x flies." Later we will be calling such rules "D-rules."

In Reiter's approach (1980) D-rules are complementary to axioms and together they form a D-theory (a default theory). In other words, a D-theory consists of a pair (A, R), where A is a set of formulae in the first-order predicate calculus (that is, the set of axioms of the D-theory), whereas R is a set of D-rules. D-rules extend the possible consequences of a given theory by sanctioning conclusions which are not necessarily true but there is no apparent reason to reject them. The set of formulae derivable from a given D-theory is called its extension and it can be interpreted as a set of beliefs about the world defined through the D-theory.

3.2. PREDICATE CALCULUS IN THE INTERPRETATION OF ANAPHORA

After looking into several instances of simple discourses, Barbara Dunin-Kęplicz (1984) came to the conclusion that Reiter's default logic is actually a better tool for anaphor resolution than the traditional first-order predicate calculus. The basic assumption was that it is possible to represent both the content of a discourse and a certain amount of general knowledge by means of logical formulae. In all of the examples, the latter was represented in a very simplified manner. Let us consider her first example (Dunin-Kęplicz 1984: 159):

(33)(a) *John and Peter are friends.*

(b) *It is Peter's birthday.*

(c) *His FRIEND gives him a present.*

It can be represented as follows:

(34)(a) *friend* (J,P)

(b) *birthday* (P)

(c) $\exists x\, \exists y$ (friend$(x,y) \wedge$ *present*(x,y)).

Meanwhile, general knowledge is represented here by a formula which requirements seem all to strict. In this formula, it would probably be better to call the relation marked as "friend" a "true friend:"

(35) $\forall\, x\, \forall y\ (birthday(x) \wedge friend(y,\, x) \rightarrow present(y,\, x))$.

But let us just assume for a moment that (35) raises no doubts. In such case, it is possible to find a substitute in formula (34)(c), namely: $x = John$, $y = Peter$, which allows us to interpret correctly the pronoun in sentence (33)(c). In order to do so, we must use (34)(a),(b) and (35).[26]

Another example given by Dunin-Kęplicz (1984: 159) describes a slightly more complex situation:

(36)(a) *John, Mark and Peter are friends.*

(b) *It is Peter's birthday.*

(c) *Mark doesn't give Peter any present.*

(d) *His FRIEND gives him a present.*

The logical formulae to represent this discourse are similar to the previous ones:

(37)(a) $friend(M,P)$

(b) $friend(J,P)$

(c) $friend(M,J)$

(d) $birthday(P)$

(e) $\neg\ present(M,P)$

(f) $\exists\, x \exists y\ (friend(x,y) \wedge present(x,y))$.

If we assume the same general knowledge (the one provided by formula (35)), we have a contradiction, since (35) combined with (37)(a),(d) leads to (g) *present*(M,P), but (37)(e) contradicts it. Hence, we are unable to interpret correctly either formula (37)(f) or the pronoun in (36)(d).

That is where Dunin-Kęplicz attempts to rely on Reiter's default logic instead of predicate calculus. But before we proceed to the discussion of her solution, let us ask ourselves what caused the failure evident in the

[26]However, we must take into account some additional factors, which ought to be included in the so called "general knowledge," that is, that the relation "friend" is symmetric and that variables are restricted to the elements "activated by the discourse." The author does not address this issue until further in her article.

previous analysis. Are the formal tools used there the only ones to blame? Perhaps they were faulty, but there is at least one more reason. And that is the far too strict formulation of „general knowledge" in (35). In a case like this, predicate calculus offers limited possibilities to maneuver: we can only replace universal quantifiers with existential ones. The most reasonable formula would be:

(38) $\forall\, x\, \exists y\, (birthday(x) \wedge friend(y, x) \rightarrow present(y, x))$.

This time, on the other hand, we could consider our "general knowledge" to demand too little from the relation "friend." But it surely allows us to interpret the pronoun in (36)(d) correctly. Notice that (38) plays a crucial role in this interpretation. If we were to omit this formula, we would have five more possible substitutes in (37)(f), namely: anyone but $x = Mark$, $y = Peter$ (assuming that the relation „friend" is symmetric and the relations „friend" and „present" are irreflexive).

3.3 DEFAULT LOGIC IN THE INTERPRETATION OF ANAPHORA

An unquestionable advantage of default logic is that it allows us to represent the "general knowledge" discussed above in a manner that is more compatible with our intuitions. Dunin-Kęplicz (1984: 160) describes this "knowledge" using the following formula:

(39) $birthday(x) \wedge friend(y, x)$: M $(present(y, x))$ / $present(y, x)$,

which can be read: "when x celebrates birthday and y is x's friend, and if nothing forces us to think otherwise, we may assume that y will give x a present".

Let us go back to example (33). Dunin-Kęplicz's (1984: 160-161) solution is based on the tools offered by default logic — after taking into account the property of the relation „friend" and the fact that $x,y \in (John, Peter)$, formula (39) combined with (34) leads to the activation of only one D-rule (out of a possible six):

(40) $birthday(P) \wedge friend(J, P)$: M $(present\ (J, P))$ / $(present\ (J, P))$.

Therefore, the D-theory in question (see 3.1) has only one extension which includes

$present(J,P)$.

x = John, y = Peter, which is a correct resolution of referents in sentence (33)(c).

The resolution of sentence (36)(d) is very similar, with the exception that, in this case, two D-rules out of nine possible ones are activated: one = (40) and the other takes the same form, except that M(Mark) replaces J(John). The latter default is however in conflict with other "beliefs" – especially with (37)(e), which accounts for its ultimate rejection. In the end, we get the same extension as in the previous example – *present(J,P)*.

Dunin-Kęplicz (1984: 162—165) also explores one more example:

(41)(a) *John, Mark and Peter are friends.*

(b) *It is Peter's birthday.*

(c) *Only one of his friends gives HIM a present.*

As it turns out, this discourse can find a satisfactory resolution in the scheme proposed by the scholar only after some additional facts have been taken into consideration. Some extensions of a relevant D-theory (produced the same way as it was previously but with more D-rules at stake) contain both *present(J,P)* and *present(M,P)*. Even though Dunin-Kęplicz (1984: 162-165) discusses quite thoroughly the reasons for such a state of affairs, we do not have here the necessary space to get into detail. Again, as we already mentioned before, the problem lies in our treatment of "general knowledge". For conclusions to be correct (so that they include only *present(J,P)* or only *present(M,P)*), they must be drawn only on the basis of those extensions which encompass the totality of the knowledge that Dunin-Kęplicz called "negative." What is meant by this is e.g. that we must exclude all facts which do not stem directly from the text, even though they do not contradict it, such as the fact that e.g. John celebrates his birthday on the same day as Peter or that Mark is getting a present but for an entirely different occasion. According to Dunin-Kęplicz (1984: 165), this procedure resembles our method of drawing conclusions in everyday life.

It seems that by dropping not all, but only some of the possibilities which are not explicitly revealed in the text, we act against our intuition – the lack of "complete" negative data distorts the conclusion (Dunin-Kęplicz 1984: 165).[27]

[27] A translation from Polish.

By the end of her article, Dunin-Kęplicz (1984: 165—166) offers an example that cannot be resolved with her scheme:

(42)(a) *John, Mark and Peter are friends.*

(b) *It's Peter's birthday.*

(c) *None of his friends give HIM a present.*

Yet, she does not provide us with any explanation. It seems that her failure resulted again in a misrepresentation of „general knowledge", since its key component — formula (39) — is in contradiction with (42)(c). Even though default logic is definitely a better tool for representing arguments from everyday life than the predicate calculus, it proves to be still not flexible enough. Notice that sentences for which it was difficult to find the right substitutions were in breach of those D-rules that were supposed to be used in the process of anaphor resolution. Therefore, if it was possible to interpret pronouns and simultaneously modify D-rules — depending on the content of the analyzed phrases — then perhaps such a mechanism could produce the correct results for the examples proposed by Dunin-Kęplicz (1984). However, this would already be some "second-order non-monotonicity".

3.4. ON THE NEED TO CONSIDER NON-MONOTONICITY

Dunin-Kęplicz and Łukaszewicz (1986) point out that it is necessary in a workable natural language understanding system to take into consideration the phenomenon of non-monotonicity. In everyday life, we are continuously dealing with inferences based merely on partial premises. In case it turns out that our conclusions are conflicted with the newly acquired information, we immediately verify our previous conclusions using the new, complete data. We are mentioning this, because this procedure is sometimes also used to resolve anaphora.

It can be best demonstrated by the following example, which does not even require a comment:

(43') *Peter$_i$ was sitting in a room. When John$_j$ entered the room he$_j$ seemed nervous,*

but

(43") *Peter$_i$ was sitting in a room. When John$_j$ entered the room he$_i$ seemed nervous. John always makes him$_i$ nervous.*

A modified version of Dunin-Kęplicz and Łukaszewicz's example (1986: 505).

4. A BRIEF REVIEW OF TWO MORE METHODS OF INTERPRETING ANAPHORA

Out of the numerous, more or less formal methods of anaphor resolution, we have decided to discuss two more: the theories by Hobbs (1976-1985) and Bosch (1983).

4.1. JERRY HOBBS'S USE OF COHERENCE

The first method of resolving anaphora proposed by Hobbs (1976) — by means of syntax only — made use of the limitations of pronouns and noun phrases established by many transformational-generative linguists. Hobbs himself (1976) called this approach naive, even though it worked well with most (275/300) anaphoric pronouns in the samples taken from original English texts. Hobbs (1976) proposed a method which was supposed to improve the results. However, in order to achieve this goal, he deemed it necessary to refer to semantic factors, precisely: to use the coherence relations that can be found in every text.

As the title of section 4 suggests, we will present Hobbs's ideas (1976) very briefly. We are going to use only one example (Hobbs 1979b: 78-80), but adopting the simplifications made by Hirst (1981: 83-84). Assume that a natural language understanding system is supposed to cope with two sentences containing a pronoun reference:

(44) *John can open Bill's safe. HE knows the combination.*

Obviously, syntactic methods cannot provide us with any clues whatsoever regarding the referent of pronoun "HE" or the description "the combination." Hobbs is very demanding of the system that is to resolve this anaphor. He expects from such a system to have a vast knowledge of the world. In this case, the least it has to know is how to open safes.

According to Hobbs (1979b: 79), the representation of the first sentence in example (44) should look as follows:

(45) $can(John, open(Safe))$.

The abovementioned knowledge of the world leads us to the conclusion:

(46) $know\ (John,cause(do(John,ACT)\ ,open(Safe)))$,

in other words: "John knows some action that he can do (ACT) to cause the safe to be open." Meanwhile, the representation of the second sentence in example (44) is:

(47) $know(HE,combination(COMB,Y))$

"someone (HE) knows the combination ($COMB$) to something (Y)."

Once we apply our knowledge about combinations, we come to the conclusion:

(48) $know(HE,cause(dial(COMB,Y),(open(Y))))$

"HE knows that entering the right combination ($COMB$) into Y causes Y to be open."

In Hobbs's view, recognizing the strong similarity of representations (46) and (48) leads us to the conclusion that a relation of coherence between sentences (45) and (47). In his article, Hobbs calls this particular relation, the Elaboration relation. At the same time, we identify the anaphoric pronoun HE with John and Y with Bill's safe.

Thus, Hobbs (1976) suggests that resolving anaphora is to some extent a by-product of the recognition of coherence relations between consecutive sentences in a text. It seems that the procedure described through the above example cannot be easily generalized, since there are very many and very complex coherence relations that ought to be taken into account during anaphor resolution. For that reason, the system's general knowledge, as postulated by Hobbs, can hardly be called moderate.

4.2. PETER BOSCH'S SEMANTIC APPROACH

The problem of anaphora is only one of the key issues in the quite coherent semantic approach developed by Bosch (1983), but since we lack the necessary space here, we will discuss this scholar's ideas very briefly.

Bosch (1983: 64-104) favors the procedural approach to the process of language understanding. Fundamentally for him is the concept of "context model" (CM).[28] Context models are models (representations of models),

[28]Bosch himself (1983: 64) accepts both possibilites.

which the sender and the receiver create in their minds on the basis of the surrounding environments. An environment must be understood broadly — it includes both the external world and linguistic utterances. A context model is the basis upon which the interpretation of an utterance is built. For example, our understanding of utterance W consists in transforming a context model CM_i (in accordance with utterance W_i) into a context model CM_{i+1}. Even though Bosch himself does not specify what he means by utterance, that is, how often a change in context models occurs, we might assume that it happens after each and every sentence (probably a simple sentence).

Bosch's context models are similar in their content to discourse representation structures proposed by Kamp (see section 2). They are similar on the level of the very concept, but they differ radically in terms of the formal tools they use to represent discourse content. Also, Bosch's (1983: 71) definition of truth resembles that offered by Kamp (1981) — see section 2.3. — and it does not refer to a sentence but to a created context model. In Bosch's words (1983: 71):

The issue of truth is thus shifted from the relation between sentence and model to the relation between the model and whatever is supposed to be a model of. In other words, we do not consider the truth of a sentence with respect to a model, but PRESUPPOSE[29] *it. Truth is at issue, however, at a different place: it re-enters in the guise of the notion of faithfulness of the CM with respect to a particular world or environment.*

In the process of transforming a context model into its successor, we use e.g. *Background Knowledge.* It is, according to Bosch (1983: 67), a set of procedures and information items, which proved useful in transforming context models and which, precisely because they are so commonly used and so useful, are remembered as subroutines. Background Knowledge can also be updated, but much less often than it happens with context models. Stereotypes play a major part here, as they fill in the blind spots of our knowledge, they provide information items which are necessary for creating a context model but do not appear in the discourse directly.[30] Bosch (1983: 68) also claims that differentiating "background knowledge" from "linguistic knowledge" cannot be justified,[31] since "linguistic knowledge" is not constant

[29] Author's underlining. Is this approach justifiable enough? A few remarks on that issue can be found in section 2.4.

[30] References to Minsky's frame concept (1975) are obvious here.

[31] Bosch (1983: 231-232): "Linguists, by and large, seem to assume some such dis-

at all. All languages change continuously while being used. On the other hand, effective communication between people who speak different dialects proves that it is possible to adapt to changing communicative requirements.

Bosch (1983) introduces the above-described idea of a discourse model in order to define the concepts of context dependence, deixis and anaphora. These utterances E_i which can be interpreted without referring to a discourse model Bosch calls nonreferential (independent from the context). That is the case, e.g., with reflexive pronouns. Meanwhile, anaphora and deixis are referential. According to Bosch (1983) an expression is anaphoric if and only if it needs to be interpreted in the context of some other element present in the preceding context model CM_1. And if an expression needs to be resolved against elements which were not present in the preceding context model, but which are present in the currently created context model CM_{i+1}, then we are dealing with deixis.[32]

We have already mentioned in this section that Bosch's idea of context models (1983) and Discourse Representation Structures by Kamp (1981) are essentially converging. It also seems that the two theories are both inspired by the needs of natural language understanding systems. In consequence, there is no point repeating the assessments presented in section 2., since they apply to both Discourse Representation Structures and context models. What seems original and most valuable in Bosch's concept (1893), in my view, is his convincing approach to the process of understanding linguistic expressions (including the process of resolving anaphora).

5. SUMMARY

In this article, we omitted only one other semantic theory that gained popularity in logic as well as in computational linguistics — situation semantics by Barwise and Perry (1983). However, anaphora is not a chief concern of this theory and Barwise's work (1985), preoccupied with anaphora from the perspective of situation semantics, is practically unavailable. We did not discuss Heim's concept (1982-1983), although it is often mentioned

tinction as between knowledge of fact and knowledge of the language. We regard the distinction as spurious. Also the knowledge that English verbs end in '-s' when in the third person singular is of course a matter of fact, no different in status from the knowledge that in Britain one drives on the left and overtakes on the right, or that footballs are made of leather."

[32]Thus the defined distiction proposed by Bosch received a lot of criticism from Tasmowski and Verluyten (1985), who I consider "counterexample experts." However, they discuss only peripheral uses of pronouns in Dutch.

in the literature on the subject, since it can be seen as a variant of Kamp's Discourse Representation Theory (1981). Among Polish scholars, Janta-Połczyński came up with some interesting semantic theories based on the discussion of several popular natural language processing systems created in the mid-1970s.

This review seems to bring us to the conclusion that, in the end, logical methods — even the ones that postulate using more flexible approaches or imitating everyday life arguments — prove insufficient for a complete interpretation of anaphora. Yet, formal solutions are indispensable, especially if we take into consideration the needs of natural language processing computer systems. The key is a skillful combining of logical methods with those that take into account pragmatic factors. Webber's paper (1979), discussed at the beginning of the article, can serve as a pretty good example. Also Kamp's Discourse Representation Theory (1981) is a very appealing interpretative framework to many practitioners, but it must be completed according to one's needs. The importance of non-monotonicity as a discourse property is stressed by many authors, i.e. Dunin-Kęplicz and Łukaszewicz, but at the same time non-monotonicity poses many problems — to logicians as well. What best testifies to that are the foregoing attempts to use solutions referring to non-monotonic logic as they can hardly be called fully satisfactory.

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Aleksy Mołczanow

SEMIOTICS OF QUANTIFICATION IN LIGHT OF THE IDEA OF DEGENERATE SIGN

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It is a popular view that standard predicate logic, also known as first-order predicate logic, or quantification theory, paints a fairly adequate picture of quantification, and that some of its flaws may be remedied with time by the appropriate recalibration of its conceptual framework and logical tools. To this end, the story goes, one would need to develop its superstructure — a theory of branching quantifiers, among others, — and further elucidate quantification through game-theoretic semantics (GTS) of Hintikka, based on Henkin's theory of quantifiers, and the concept of language-games offered by Wittgenstein. But whether ideas proposed by Hintikka contribute real value to quantification raises serious doubts. The same pertains for treating first-order predicate logic as the quantification theory proper.

Although almost universally accepted, this view seems to be unsubstantiated, both with regard to practical details (introducing branching quantification to logical apparatus through GTS), and, primarily, in the very idea it advances (using predicate logic as an explanatory tool for quantification). It is not only because those trying to explain quantification in ethnic and formal languages have so far been left empty-handed. It also raises methodological and substantial concerns.

It seems that methodological roots, or sources, of the problems caused by the linguistic and logical description of quantifiers can be traced back to the well-known remark made by Wittgenstein in his discussion with Waismann and Schlick where he stated that each syntax is arbitrary and

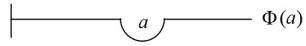
no syntax can ever be justified. According to Wittgenstein, this entails that it can be grasped exclusively as a system of the rules of the game (Wittgenstein, Schlick 1979: 104-105). The context of this discussion[1] leaves no doubt that Wittgenstein never identified syntax — understood as a system of certain rules of the game — with its justification. To the contrary, he obviously treated both these notions as mutually exclusive. It is thus difficult to justify quantifier syntax by the mathematical theory of games and conceive Wittgenstein as a proponent of a quantifier syntax theory. This is so because the man himself used the notion of language games in a purely metaphorical manner, alongside another notion he called "forms of life", to introduce a wholly different idea, namely that there cannot be justification for the syntax of language as such. Hence, GTS can never really deliver the explanation it promises. It cannot even be treated as an attempt at justification of syntax since any new type of explanation[2] developed within the theory is basically limited to an explanation of certain logical operations of reducing the existing formal logical syntax of quantifiers to model-theoretical interpretation (Hintikka, Sandu 1997: 363-364), or rewriting two-dimensional notation for Henkin's quantifiers as a linear one (Hintikka, Sandu 1997: 366-367) – which by no means can serve as an explanation by which, and in what manner, is this syntax justified. So, contrary to the popular view proposed by Hintikka, GTS cannot be regarded as a serious theory of quantification, since it is merely an interpretive superstructure of the existing formal logical categorization of a quantifiers' syntax. On the other hand, in GTS (or, more precisely, in the theory of logical syntax, to which we apply GTS to produce semantic interpretation) quantification syntax is merely a question of the order of quantifiers and their interconnections. Also, one forgets that Frege, despite his reservation that

[1]Particularly revealing is the fragment of discussion with Waismann and Schlick from 19th June 1930: "The essential thing is that syntax [i.e., logical grammar] cannot be justified by means of language. When I am painting a portrait of you [meaning here, Friedrich Waismann] and I paint a black moustache, then I can answer to your question as to why I am doing it: Have a look! There you can see a black moustache. But if you ask me why I use a syntax, I cannot point at anything as a justification. You cannot give reasons for syntax. Hence it is arbitrary. Detached from its application and considered by itself it is a game, just 1ike chess" (Wittgenstein, Schlick 1979: 104-105).

[2]On the ability of his theory for producing new types of explanation Hintikka writes the following: "This reliance on strategies rather than move-by-move rules is in evidence in the game-theoretical definition of truth outlined above. Thus one way in which game-theoretical approach can be developed is in the direction of new types of explanation" (Hintikka, Sandu 1997: 365).

quantified content is the sole exception from the rule of arbitrary division of logical content into function and argument (Frege 1972: 127-128), treated his expression of generality not as an element of the content, but as a kind of punctuation mark that divides general content stroke and particular content stroke, i.e. a division mark between the general content and particular content.[3] He used it to build complex concepts, not as a part of a complex concept built in such a way. Quantifier syntax in its common formal logical understanding can be at best likened to a mutual arrangement of tools during the construction of a house, which, after the house is built, are neither its component, nor explanation of the position or correspondence of its parts indicated on the architectural plan. On this understanding, an explanation that GTS allegedly provides to complement our knowledge regarding logical syntax would serve as a sort of instruction given to the workers on the construction site, rather than indispensible insight into the internal plan of the building that each of the household members would have to master to move freely around the house. In their original understanding, mutual positioning of quantifiers are therefore regarded as a syntax of judging function that is analogous to Fregian assertion[4] rather than syntax of the elements of logical content *per se*. This is so because forms occurring in such syntax will always refer to values, not logical contents. In the case of single quantifiers, where order is hardly a question, no syntax is at stake unless one considers an explicit connection of the content with what is not part of content but rather a part of its valuation. All GTS does to explain the notion of quantification, and consequently its syntax, boils down to a mere replacement of commonly known quantifier idioms: "for each x it is true that ..." and "there is at least one x such that it is true that ..." with a more complex but clearly synonymous terminology. It works under the same

[3] "[...] by putting something different each time in place of the German letter; when we do this, the concavity in the content stroke disappears again. The horizontal stroke situated left of the concavity in



is the content stroke of [the assertible content] that $\Phi(a)$ holds, whatever we may put in the place of a. The horizontal stroke to the right of the concavity is the content stroke of $\Phi(a)$, and here we must think of a as replaced by something definite" (Frege 1972: 130).

[4] Therefore I think it is not accidental that Frege stated: "For example, instead of ⊢ X(a) we may put ⊢ a X(a) when it is done the concavity must be placed immediately after the judgement stroke" (Frege 1972: 132).

valuation scheme of propositional content represented by the same kind of syntax. This terminology allows us to transform the scheme "*S* knows of at least one x such that *F(x)* is true" into a superstructural scheme "*S* has a strategy of finding *x* such that *F(x)* takes value <<true>>."

Wittgenstein's account of syntax as a specific, separate and unjustifiable thing, thus comparable with any given game, is directly rooted in the formalistic conception of foundations of mathematics and is indirectly linked with the Kant's philosophy where it is claimed that form is completly content-independent. One can find its equivalent in contemporary linguistics in the so-called idea of autonomous syntax, and, more broadly, in semiotics, which since Morris has divided into syntax, semantics and pragmatics, with each domain autonomous and independent from the other. But it is not the purpose of this paper to expose historical roots and split hairs over metaphysical aspects of Wittgenstein's philosophy. It seems a great deal more important to explore the semiotic foundations of quantification, and demonstrate the ability of the modified concept of degenerate sign, introduced by Peirce, to justify the quantifier's syntax. This will undermine the "arbitrariness of syntax" thesis crucial to Wittgenstein's philosophy, and, as a consequence, challenge the validity of both the generativist concept of autonomous syntax and Morris' tripartite division of semiotics.

I shall first address the issue by critical examination of the procedure followed in the above scheme, namely that of analytic explanation via definition where definiens and definiendum are mutually reversible. This is precisely what Hintikka does when he explains or justifies the concurrence of linear and branching quantifiers in terms of mathematical game-theory, whereas tha latter finds its justification in the very same concurrence. This is hardly a surprise, as Wittgenstein's idea is similarly tautological, eventually boiling down to the formula "syntax = language-game," where anything belonging to syntax of a language is a language-game, and all that is a language-game is a syntax of the language. The theoretical framework founded on this vicious circle can only produce a *linguistic* explanation which is patently tautological and specious, as it employs different terminology but under the same explanatory scheme. Introduction of the new terminology is of course justified in case of a synthetic judgment where it contributes a new cognitive value. But in case of purely analytic judgments, such a justification may miss the point, as new ways of referring to the same object does not necessarily entail a new sense or knowledge, as it remains only an alternative or pleonastic method of description. Such a theory functions thus as a superstructure for the first "level of explanation." and becomes

yet another layer of explanation that solves none of the problems but can succeed in disguising them with new words. It happens that the camouflage itself is passed as a solution and at face value it may appear to be so. One such superstructure with questionable value is the notion of sense (*Sinn*), introduced by Frege to semantic apparatus of his conceptual notation to complement the reference (*Bedeutung*), in a move designed to sort out issues that would be unsolvable only through the concept of meaning.[5] A similar thing was done by Tarski who introduced the notion of meta-language functioning on an equal footing with the language itself. The same idea drives the complementation of standard predicate logic with second-order predicate logic, or, alternatively, branching quantifiers, when linear quantifiers syntax theory fails to produce robust explanation of quantification.[6] This mechanism is pervading into other disciplines like linguistics where the theory of deep structure was developed. But, soon enough, its explanatory power wavers when confronted with the issue of quantification, prompting the introduction of the third level of explanation — the logical form. It is not difficult to notice a recurring theme here. In each of those cases a new level is introduced, a level that is presented as an explanatory tool for the lower level, now conceived in purely descriptive terms.

The workings of this analytical-tautological explanatory scheme may be exposed also, or rather primarily, in Frege's attempt to explain quantification by means of a general quantifier, introduced to logic on equal terms with variables that already for some time have been serving this exact purpose in arithmetic and algebra in formulas like $(a + b)^2 = a^2 + 2ab + b^2$. Except Frege's quantifier was elevated to the next explanatory level

[5]One should add here that Frege's distinction of *Sinn* and *Bedeutung*, made with regard to propositional expressions, perhaps would not be a tautology if TRUTH and FALSEHOOD were not identified with sign's referent on equal terms with purely physical objects. The problem here is not only whether treating "truth" as an object of logical investigations on a par with what really counts as an object in natural sciences can actually deliver philosophical justification or was introduced in a purely arbitrary manner. This solution was proposed because, insofar as conceptual notation could well do without it, it would not be able to derive from it an axiomatic system, thus contributing little as a logical tool.

[6]In that case exchangeability of those descriptions is made clear by the fact that the second-order logic and the branching quantifiers theory play identical role, mentioned by Hintikka in the following passage: "Putting these results together yields the conclusion that the set of valid sentences of pure second-order logic (and of the whole of finite type theory) is recursively isomorphic with the set of validities of FPO quantification theory. In this special but important sense, the whole second-order logic reduces FPO quantification theory" (Hintikka 1974: 173).

with generality resurfaced, this time not as a variable but rather as it's mirror reflection: second-order function (predicate). This begs the question whether this explanatory strategy is legitimate, as it may turn out that Frege's approach is a mere vicious circle, selling explanation that one would rather call camouflage designed to conceal problems emerging on a purely descriptive plane.

Leaving for now the range of the quantifiers, let us first turn to the most basic function of quantifiers as described by Hintikka: "If the idea of quantifiers as higher-order predicates is right, then a first-order existential quantifier prefixed to an open formula says merely that the (usually complex) predicate defined by that open formula is not empty" (Hintikka 1996: 69; see also Sandu 1994: 283)

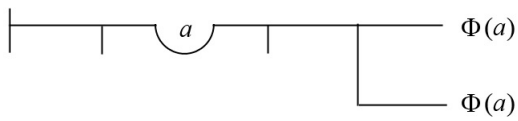
This is objectionable, and rightly so, as it is possible to prove that defining quantifiers in terms of second-order predicates is incorrect. By rephrasing Hintikka's statement into contraposition, one would be merely required to demonstrate that the consequent of this implication is not true, i.e. that the first-order existential quantifier prefixed to an open formula does not guarantee that predicate determined by this open formula is not empty.

To do this, we shall use the axiom

(1) $$\exists x(\mathrm{F}x \rightarrow \mathrm{F}x),$$

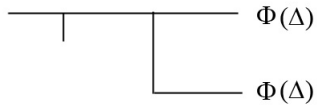
being an assumption of non-emptiness, which in Frege's notation looks like this

(2)



Since Frege suggests that "the horizontal stroke to the right of the concavity is the content stroke of $\Phi(a)$, and here we must think of a as replaced by something definite" (Frege 1972: 130), when certain fixed value of Δ is given as an argument, part of the formula positioned to the right from the concavity would look like this

(3)



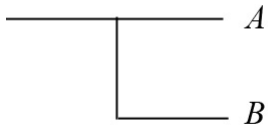
where propositional functions have a determined logical value. If so, in terms of logical content, (3) is identical with the following formula of classical propositional logic

(4) $\sim (p \rightarrow p)$.

From the equivalence of $p \rightarrow p$ and $p \vee (\sim p)$ one can infer that the negation stroke in (3) — as well as its equivalent negation mark in (4) which after substitution of $p \rightarrow p$ with $p \vee (\sim p)$ looks like this

(5) $\sim [p \vee (\sim p)]$

is nothing else than blatant violation of *tertium non datur*. In other words, since in Frege's notation:



is taken to mean that B is a condition of A, possibly read as "if B then A," adding the negation stroke to the stroke of conditional (implication) content in (3) renders it equivalent with what the implication itself negates, i.e. it becomes a proposition where it is always the case that the consequent is FALSE and the antecedent TRUE. Seen like this, proposition (3) seems to contain contradiction, namely that $\Phi(\Delta)$ as a function of one and the same argument is both false and true. It follows that the second negation introduced by the general content stroke (left side of the concavity) can never be interpreted as a negation of generality $\Phi(\Delta) \rightarrow \Phi(\Delta)$. For it to be possible there would have to be at least one instance of $\Phi(\Delta) \rightarrow \Phi(\Delta)$ that would be TRUE, which is however precluded because substitution with any specific argument by default renders $\Phi(\Delta)$ TRUE or FALSE, but never both at the same time. So we are left with just one possible option. If the judgment stroke in (2) nevertheless asserts that (2) is true, then $\Phi(\Delta)$ in (3), where a is substituted with a specific meaning of Δ, must be ascribed — due

to the negation of the law of excluded middle introduced by the negation stroke positioned on the concavity's right, thus violating *tertium non datur* – some third kind of logical value, distinct from truth and falsity.

This calls for application of trivalent logic in which proposition $p \vee (\sim p)$ is not tautological, such being:

(6) $$p \vee (\sim p) \vee [\sim\ (\sim p)],$$

which can be inferred from the table below (Moszner 1974: 19):

p	$\sim p$	$p \vee (\sim p)$	$\sim\ (\sim p)$	$p \vee (\sim p) \vee [\sim\ (\sim p)]$
1	1/2	1	0	1
1/2	0	1/2	1	1
0	1	1	$\frac{1}{2}$	1

To this end, let us examine all possible logical values of propositional variables and complex formulas (as well as equivalent predicates) present in (2) and (3). The results are compiled in the table below. The first column contains input data consisting of all possible values of the predicate functioning as the consequent of implication:

A	B					$B \rightarrow\ A$
p	$\sim p$	$\sim(\sim p)$	$p \vee (\sim p)$	$\sim\ [p \vee (\sim p)]$	$\sim\ \{\sim\ [p \vee (\sim p)]\}$	
1	1/2	0	1	1/2	0	1/2
1/2	0	1	1/2	0	1	1
0	1	1/2	1	1/2	0	0

We can now see that, for a number of reasons, the relevant explanation is produced in the second line. First, it is the only line where 1/2 value of $\sim p \vee p$ seems to be invalidating *tertium non datur*. Second, it is also where logical value of $B \rightarrow\ A$ is identical with the logical value of double negation of the law of excluded middle, i.e. $\sim\ \{\sim\ [\mathrm{p} \vee (\sim \mathrm{p})]\}$, and, consequently, with its secondary negation by the additional negation stroke on the left side of the concavity (Moszner 1974: 18). First and foremost, however, it is the only line where truth value for both those instances is truth.

As can be easily noted, the first and the third line of the table in question respectively present truth values for assumption that certain Φ exists and that no Φ exists. This proves that the first-order existential quantifier prefixed to an open formula may be applied only under the condition that the predicate specified by this open formula is empty. As it is, logical values returned in lines 1 and 3 mean that the crux of the issue here is not the existence or non-existence of objects characterised by Φ, but the effective lack of possibility to apply the procedure for determination of truth-value for $\Phi(\Delta)$, even if it was possible to establish objects for which $\Phi(\Delta)$ is true or

false. Embracing the graphic language used by Hintikka, one could say that it is the formula for assumption of non-emptiness itself that SUPPRESSES THE VERY POSSIBILITY of finding at least one such x for which (2) would be true, factual or actual existence of such notwithstanding. At this point one could be inclined to settle for a strategy which would at best render it possible to verify (2) in the empty domain. This, however, contradicts the general validity of (2) because the purpose of the whole endeavour is not limiting logic (as proposed by Andrzej Mostowski) to quantification laws that would be valid in all domains, including the empty domain (Grzegorczyk 1984: 152); to the contrary, one purports here to limit logic to quantification laws valid only in the empty domain while excluding all the others.

That problem of the general reference is unsolvable — be it by means of the free variable[7] on the basic level or through the quantifier on the additional level[8] — attests, it seems, to Frege's mistake of introducing a critical distinction at the very outset of *Conceptual Notation* and building it into logicism and mathematical logic as their core component. This becomes clear if one chooses to consider a different conceptual framework for expressing the notion of generality, or lack thereof. Such a framework is provided by Charles Stuart Peirce in his sign-*type* and *sign-token* distinction, with the former expressing generality, and the latter being a particular sign that, in virtue of its particularity, lacks generality as such. Further, this distinction serves well to illustrate why quantifier logic is limited to an immanently empty domain.

To do this, let us adduce a well-known definition of analyticity formulated by Quine: "Sentences are synonymous if and only if their biconditional (formed by joining them with 'if and only if') is analytic, and a sentence is analytic if and only if synonymous with self-conditionals ('if p then p')" (Quine 1960: 65). In regard to quantification structures, this definition formulates a condition for analyticity of the following proposition

(7) $\forall xFx.$

More precisely, it requires $\forall xFx$ to be synonymous with implication that is similar to one encountered in the assumption of non-emptiness, i.e.

(8) $\forall \mathrm{x}(\mathrm{Fx} \rightarrow Fx).$

A comparison of these two propositions shows that the sign of propo-

[7]Referential capability of which is limited to indication (*Andeutung*) and falls short of denotation (*Bedeutung*).

[8]Since, as proven by zero-one method analysis, binding a variable with a quantifier does not deliver the desired change in referential capability, which is immanent only to the free variable.

sitional function in (7) can be classified, in Peirce's terms, as type. This, however, cannot be said of signs of the same propositional function in a synonymous expression (8), where they signify specific specimens of a type, thus possessing the quality of a token. It follows that Quine's definition is in fact based on the assumption of synonymy between the type and the token. But this could only be possible if there was no difference between denotation and designation. Or under the condition that such a difference existed, but was negligible. This, in turn, would be possible only if both denotation and designation of the sign were empty.

When drawing conclusions from the above, it may be of note to remark that, flawed as it is, the choice of this critical distinction and using it for crucial categorization to underpin the whole theory — the theory of quantification, for that matter, — was by no means arbitrary. For it was made primarily to satisfy the ends pursued by conceptual notation, namely correction of imperfections occurring within the ordinary language, driven by a popular perception of its illogicality. Which begs the question whether the prime concern here is the illogicality of language itself, or maybe rather illogicality of certain approaches to the explanation of its internal, actual logic, not least to the explanation of the logic of quantification.[9]

To remedy this fundamental flaw — for we obviously deal here with the grave misconception of those basic distinctions — one apparently needs a thorough reconsideration of the conceptual framework used for explaining quantification. That there is no universally accepted notation of quantification, and that its validity is limited exclusively to the empty domain, is in itself a fairly good reason for an in-depth reconceptualization — although not through artificial, and thus largely arbitrary, means — of what may only be an apparent illogicality of language, thus bringing more insight and precision to the uncharted or poorly mapped territories of language.

There obviously is a need for closer examination of referential capability, so far in the theory of quantification explored with insufficient precision, and for justification of *type-token* dichotomy as the master distinction replacing the heretofore prevailing mathematical differentiation between the argument and the function (and consequently between the variable and the constant). This examination requires assuming essential identity of the sign and its referent, or denotation, without which the sign basically ceases to be a sign as such. Also, one cannot possibly eschew questions regarding the very

[9]Which resonates with the idea advanced by Otto Jespersen (who can be credited with introducing the notion of quantifier to linguistics) that language is not mathematics and thus works according to its own logic (Jespersen 1924: 331-332).

nature of sign reference, i.e. a connection between the constitutive properties of the sign with what functions as its denotation.[10] This should start with the simplest, most elementary and most obvious example of reference, understood here as a relation between the sign and what stands as its denotation. One such obvious example widely discussed in the reference literature is logical proper names. Although in this case elementary character of such relation seems undisputable, its nature is far from agreed upon and a source of much controversy. Viewed from a purely semiotic perspective the case in question may be found quite easily, this for obvious reasons being natural signs corresponding, in Peirce's terminology, to indicies.

When examining these kinds of signs, one must always bear in mind that for Peirce, indexical sign is either "REALLY CONNECTED" with its object, or INDICATES ITS OBJECT "INDEPENDENT[LY] OF THE MIND USING THE SIGN" (Peirce 1967, 3.361).[11] This twofold, or alternative, definition (it is either really connected with its object, or indicates its object independent[ly] of the mind using the sign) is conditioned by the fact that, on the one hand, it characterises an index as a natural sign; and on the other hand, however, describes it as an arbitrary or conventional sign. In other words, it recognises two categories of indices, or one index in two forms: that of 1) natural sign, and 2) conventional sign. In light of another of Peirce's distinctions, namely one between the real, actual dyad (composed of two phenomena or objects bound by cause-effect relation, as in the father and child example) and degenerate dyad (where relation linking the elements is not that of cause and effect, but of incidental character, as in father and adopted child example), this definition will also mean that relation between conventional indices and natural indices may be phrased in terms of opposition: degenerate sign/non-degenerate sign.

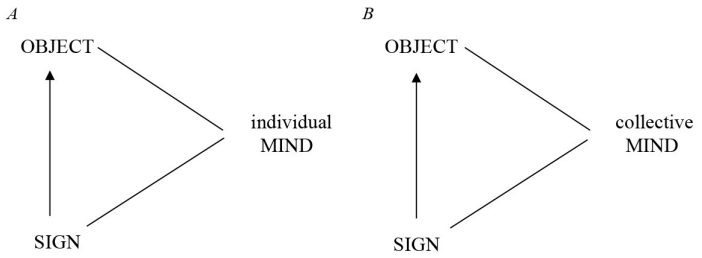
The category of degenerate sign seems therefore important for, first, understanding the crucial difference between natural signs and conventional signs, and second, explaining the essence of degeneration in conventional indices. Note that natural indices are in fact real, and mind-independent, dyads. That said, they remain signs, even if only potentially. No one will ever claim that smoke rising in some deserted place is not a sign of fire — causal relation in real dyad is not created in the moment it is evoked in one's

[10]It is therefore not by accident that Peirce defines logic as "the science of the conditions which enable symbols in general to refer to objects" (Peirce 1982: 175).

[11]It is also of note that around 1873 Peirce realized that apart from symbols, logic should also explore other types of signs, such as icons and indices; see Peirce 1991: 141-143, and Rotter 1999: 250.

mind.[12] The same goes for a dead language, which does not cease to be a language even if there is no collective consciousness capable of interpreting it or if it has not yet been deciphered. This can in fact be said of any language that is foreign to us — just because we cannot grasp it does not mean it has ceased to be one.

Closer examination of the second part of Peirce's definition reveals yet another kind of indice, functioning on equal terms with the two already discussed. This is possible thanks to conceiving signs-types as indices of a particular kind, showing a different character of mind-independence (more precisely, it is a different character of mind that the sign is independent from). It is a kind of an indexical sign, a sign-type, the use of which is clearly governed by the collective, not individual, mind — so when such an index is used by the individual mind it nevertheless does not govern it. Now, to give a precise account of Peirce's formula one needs to introduce a new type of user: a collective user, or a linguistic community using its unique linguistic code. Collective users, functioning on equal footing with the primary category of individual users, would also entail a new type of use of conventional signs. In that light, sign-type and sign-token, when considered in terms of their most rudimentary relation — a sign-object relation — look like this:



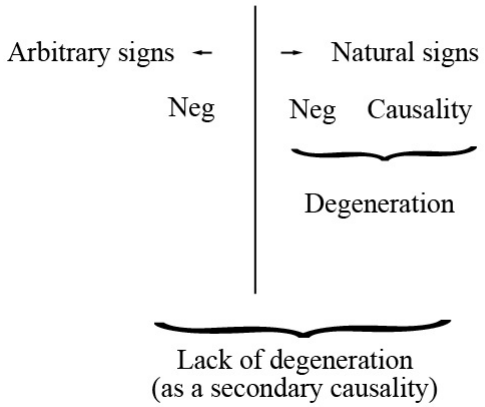
where A is a relation scheme for a concrete specimen (*token*), while B represents a relation scheme for a general sign (*type*). Distinctness of both of those schemata (links in B or A occur only INTERNALLY) indicates both token's independence from the collective mind and type's independence from the individual mind.

Since the relation of the sign-type can be explained by postulating its existence qua an index representing an instance of the other kind of degeneration, characterised by an independence from the individual mind,

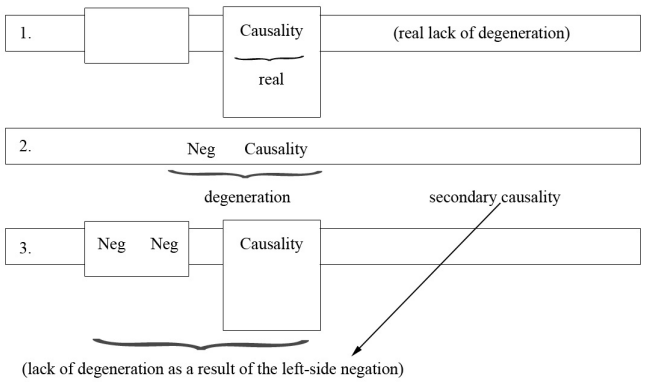
[12]This is similar to the claim made by Frege in his argument against psychologism where he argues that mathematical truths are not created at the moment we become aware of them, but rather exist independently from such acts of awareness,

it can further be possible to explain the internal nature of trichotomy characterising Peirce's genuine sign, and in doing so differentiating it from the basic and dichotomic degenerate sign. More precisely, it enables justification of the triad as a necessary constitutive feature of the genuine sign in the case of conventional signs, as opposed to natural signs. Let us first examine two rudimentary kinds of relations, i.e. a relation between two objects (or phenomena) where one is the sign of the other and relation where neither is the sign of the other.

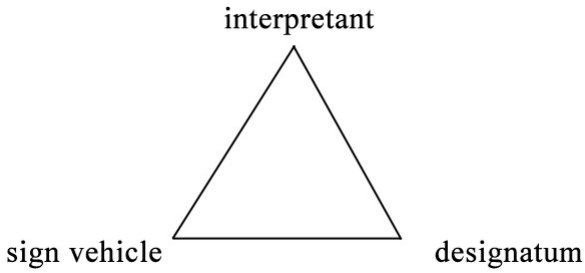
Following Peirce's definition, the first relation may be described as real and the other as degenerate. Assuming that the weak relation (the latter) and the strong relation (the former) are respectively primary and secondary, it is quite clear that the secondary character of non-degenerate (real) relation with genuine sign will negate the degeneration present in the primary relation. By extending this (negation of degeneration) to all signs, we arrive at the basic scheme where the difference between the natural sign and the arbitrary sign will boil down to the difference of how negation of degeneration is achieved:



As implied in the scheme above, the difference in the negation of degeneration in arbitrary signs rests on its reversed direction of negation of degeneration when compared with such direction occurring in natural signs. The content of the sign-object might be constituted through two kinds of negation:

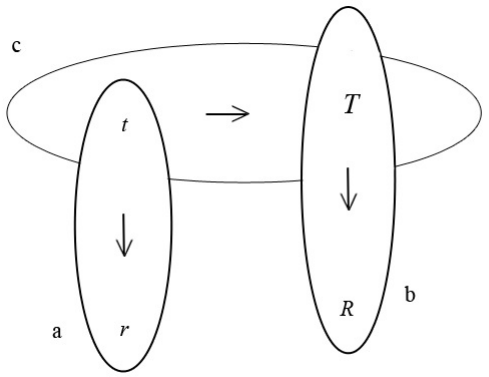


The second line represents the structure of degeneration, whereas the structure constituting the content of the sign-object link is pictured in the first (natural signs) and third (arbitrary signs) line. In the first line, the causal link between the sign and the object effectuates through a simple negation of degeneration (marked by the empty rectangle), while in the third line the sign is linked with the object in a *quasi*-causal manner through the left-side negation of degeneration, or a double negation of causality. In this manner, the notion of degenerate sign serves to explore different ways in which a physical vehicle of the sign is linked with the material referent of both the natural and arbitrary sign. This is of particular importance when explaining the nature of how the genuine sign is constituted, which in natural languages happens independently. This opens further opportunity for the examination of other degenerate relations in a complex structure of genuine sign, explained by Peirce by employing three categories, usually presented in the form of a semiotic triangle:

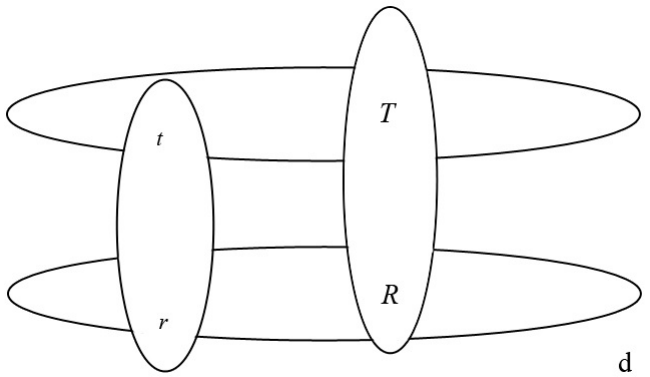


This is possible because for Peirce signs function not only as signs of objects and phenomena, but also as signs of other signs. Precisely in these terms one considers the token, which in Peirce's account also functions as a

sign of a general sign, conceived as a type. This third and additional relation, represented below as a horizontal plane, integrates two other degenerate relations into the one whole, demonstrating how arbitrary sign is constituted as a sign of natural (ethnic) language:



Two vertical dyads represent the relation of a) token t to its referent r; and b) type T to its referent R. An arrow in the horizontal dyad depicts relation c) of t to its second referent T. Note that it has the same exact meaning as the above-described left-side negation as it functions as a factor in derivative or secondary relation of causality which is constitutive of the arbitrary sign. Simultaneously, it functions as a logical implication, where t is the antecedent and T the consequent. This last observation is critical for understanding its essential identity with quantification, reflected in the referential function below:



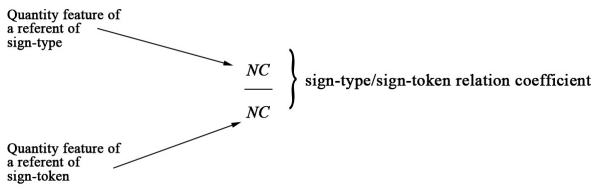
From the fact that d) functions as a projection of token/type relation one can infer that there indeed are close associations between the quantification

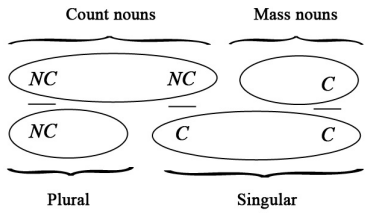
and the structure of reference, and, by the same token, constitutive structure of signs in natural (ethnic) language.

These conceptual inquiries exploring semiotic approach to quantification (leaving the grounds of formal logic in the process) finds support in the facts of natural language, which often cannot be explained by means of mathematical logic. This is most clearly seen in the so-called quantifier parallelism, which in English, for example, is expressed through quantifier pairings like *much/many*, *few/little*, *fewer/less*, etc. This is related to the so far unresolved problem of logical interpretation of sentences containing mass-terms, i.e. references to uncountable objects, like in "snow is white," the oft-cited example first offered by Tarski.

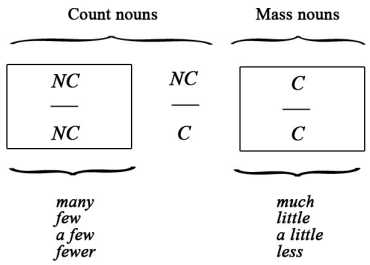
This account of quantification, based on Peirce's sign-token/sign-type distinction (as opposed to mathematical distinction between the function and the argument), as well as the notion of degenerate sign, serves well to elucidate the problem by refering to the difference, within the category of quantity, between the discrete and continuous. Taking into the account that words occurring with quantifiers cannot be divided into semantic units with their own referential index for token and type, but it is possible to distinguish in those words semantic units representing token or type, one may depict the results as follows:

Feature of a kind of quantity:
NC — non-continuous (discrete)
C — continuous





thus revealing structural symmetry determining interrelations occurring in the table above. By marking the elements of this configuration in the following way:



we can clearly see why it is so that quantifier parallelism occurs.

It has also become evident, for obvious reasons, that such quantification cannot be explained under the conventional framework of prediacte logic because the theory of quantification would first have to incorporate those two essential kinds of quantity. This, however, is not possible under Frege's logic because it would have to be based not on arithmetic, familiar only with discrete quantity, but on a mathematical discipline capable of integrating it with geometry, conceived as a scientific field dealing exclusively with continuous quantity. This issue still persists as one of the greatest challenges in modern-day mathematics.

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Anna Pietryga

SEMIOTICS OF THE DUNS SCOTUS LAW

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In writing about the semiotics of the Duns Scotus Law (which I shall henceforward refer to as the DSL), I shall begin with a presentation of the law itself and a brief biography of its author, as well as a discussion of those elements of its sign character which, being an expression of the language of logic, it evinces. The remaining part of the article will be devoted to those of its sign features which do not spring directly from the character of the language in which this law has been formulated, but on the contrary, constitute its specific property. That final part of my article can be summarized in the three following theses:

l. the DSL in itself does not unequivocally determine the function of material implication;

2. the DSL expresses the less intuitive aspect of material implication: its truth value when a false antecedent is given;

3. by putting a contradiction in the place of the false antecedent, the DSL presents this contradiction as a model falsehood.

The Duns Scotus Law affirms that from a pair of contradictory statements, accepted in the logical system as its thesis, arises every sentence of that system. Symbolically, it has the following form:

(l) $(p \wedge \sim p) \rightarrow q$ (conjunctive form)

or, equivalently, on the basis of the laws of exportation and importation,

(2) $p \rightarrow (\sim p \rightarrow q)$ (conditional form).

Formulation of this law is ascribed to a Scottish Franciscan named John of Duns,[1] known as Ioannes Duns Scotus, who lived in the late 13^{th}

[1]On the now cleared doubts regarding his place of birth, see Włodarczyk 1988:

and early 14^{th} century (1266[2]–1308). He lived a monastic life since early youth, completing his novitiate in 1280 (Łukaszyk, Bieńkowski, Gryglewicz 1989: 354). He taught, among others, at Cambridge, Oxford, Paris[3] and Köln[4], where he died and where is still venerated today.[5] A philosopher and theologian, honoured with the appellation of the Subtle Doctor (*Doctor Subtilis*) due to the exceptional finesse of his reasoning, in Church history he is remembered as a defender of the doctrine of the Immaculate Conception of the Virgin Mary.[6]

A number of works once attributed to Duns Scotus are now considered to be inauthentic. Among them is the commentary to Aristotle's *Prior Analytics*; its anonymous author is known as the Pseudo-Scotus (Włodarczyk 1955: 2 and 5ff, 1988: XVI). The law of logic discussed in this article can be found in Scotus's authentic writings, although only in its conjunctive form;[7] it seems, however, that it would be more appropriate to ascribe it to Pseudo-Scotus, whose analysis of this law and the related issues is far more thorough (Włodarczyk 1955: 64ff).

Analysing the Duns Scotus Law exclusively as a language sign on the level of some literalness, we may refer to the division of semiotics popularised by Charles Morris and speak of the syntax, semantics and pragmatics of

IX–X.

[2]Or 1265. See Włodarczyk 1988: XI.

[3]From where he was relegated in 1303 for refusing to sign the appeal of King Philip IV of France (Philip the Fair) addressed to the Ecclesiastical Council against Pope Boniface VIII. He soon returned to his post, but left Paris shortly after, probably again for political reasons. See Włodarczyk 1988: XII–XIII.

[4]All four places are mentioned by Włodarczyk (1988). *Encyklopedia katolicka* (Łukaszyk, Bieńkowski, Gryglewicz 1989) gives the exact periods of his stay at Cambridge (1297–1300), Oxford and Paris, overlooking his teaching and research work at Köln. Internet sources with which I am familiar mention a year's period of work in Köln, but are silent regarding Cambridge.

[5]The area of Nola in Italy is another centre of his cult. The process of his beatification was hindered by a rumour that he had been buried alive. This view, now considered groundless, initially caused much jubilation among his adherents. A grotesque 15^{th}-century commentary reads: "This is how sweetly and pleasantly that man passed away from life: from peace to peace, from sweetness to sweetness, from spiritual consolation to eternal joy. May the One who Lives grant the same to us" (after Błoch 1986: 92-93; translated for the purpose of the current article — translator's note). See Łukaszyk, Bieńkowski, Gryglewicz 1989: 354 and Błoch 1986: 87-97.

[6]Officially accepted as the dogma of the Catholic Church only as late as 8^{th} December 1854 (by Pope Pius IX). See Guitton 1966: 342–350.

[7]According to the list of theses of sentential logic in Duns Scotus, found in Włodarczyk 1955: 93ff.

this law. The syntax it uses is, of course, the syntax of the language of logic (i.e. sentential calculus), which is applied consistently; due to this, we are dealing with a meaningful expression. The semantics of the above formula is defined by the general rules of interpreting the expressions of this language;[8] on the basis of these rules it affirms that from a pair of sentences (in the logical sense) which are mutually contradictory arises any sentence which can be formulated in the same language. The pragmatics of the DSL can be defined by its concrete applications.

The above remarks refer to the DSL only as to a formula written in the language of a certain logical system and read in accordance with the rules valid therein. To present the issue of the semiotics of the DSL in an exhaustive manner, it is necessary to mention its other aspects, which are difficult to take account of in Morris's pattern.

There are at least three such aspects; they refer to the DSL's relation to:

1. the function of material implication;
2. the interpretation of this function;
3. the question of the place of contradiction in logical systems.

1. THE DSL'S RELATION TO THE FUNCTION OF MATERIAL IMPLICATION

The currently accepted interpretation of the material implication functor was known already in Antiquity due to Philo of Megara, although it was a matter of some contention (Łukasiewicz 1961: 182-183, Bocheński 1993: 29-30); in fact, also in the writings of Duns Scotus and Pseudo-Scotus some ambiguities related to those contentions are found, but Pseudo-Scotus, as opposed to Duns, attempts to organize and clarify them (Włodarczyk 1955: 19-30). It is worth recalling that both the first axiomatic formulations of logic and the first matrices defining the semantics of truth-value functors appeared in modern Europe only towards the end of the 19^{th} century (Roberts 1973: 131).[9] Earlier, therefore, the role of theorems in interpreting functors appearing therein was more essential.

[8]The question of the character of the relationship between the inscription, being a material substrate of the sign in question, and its meaning is interesting. I have in mind the iconicity of inscription postulated by Peirce; according to this postulate, expressions of logic should be formulated in the form of graphs (Roberts 1973:123ff).

[9]Bocheński remarks that Peirce, to whom the invention of the truth-value matrices is ascribed, "found them in the Megareans"; yet in the same text he uses the example of Philo's *versus* Peirce's definition of material implication to illustrate parallels between various logicians' independent achievements (Bocheński 1993: 33 and 29).

The appreciation of the role of theses proposed by various branches of scholarship in determining the meaning of the signs appearing in those branches (terms, symbols etc.) is due to the French conventionalists, who pointed out the fact that theses of a given field can serve as a substitute for the explicitly formulated definitions. In particular, the axioms of logic may impose certain meanings of given functors.[10]

Given the stipulations of the two-value extensional logic, which postulates the following points:

1. logical functors are (with the exception of one-argument negation) two-argument truth-value functors, unambiguously specifying the course from the two values ascribed to the arguments to the single logical value ascribed to their combination,

2. the system considers two logical values, 0 and 1 (traditionally correspondent to falsehood and truth),

there exist sixteen possible interpretations of two-argument functors, of which two (the *verum* and the *falsum*) are trivial.

Sometimes the interpretation of a functor is determined by a single formula. This is precisely the case of the formula which asserts that truth results from everything (the so-called Law of the Antecedent):

(3) $\quad p \rightarrow (q \rightarrow p)$,

which is a law of logic only if the arrow is interpreted as an implication (or as the *verum*).

The case of the DSL is different. It is easily seen that the implication formula of the DSL, which contains only one two-argument functor, is fulfilled (given the established negation[11]) not only by the material implication (and the *verum*), but also by the alternative. Also in the conjunction form, in which we are dealing with two two-argument functors, establishing the interpretation of one of them in a free manner does not unambiguously determine the interpretation of the other, with the exception of the cases where the imposed interpretation is the *verum*.[12]

Therefore, in neither of the above-mentioned forms does the DSL unambiguously determine the function which would constitute the interpretation of the $\rightarrow$ symbol.

[10]On the related proposal of Hilbert and Bernays, cf. Marciszewski 1987: 18.

[11]It must be added that the implication form of the DSL was used by Hilbert precisely as an axiom of negation (he treated the Law of the Antecedent as one of the axioms of implication); cf. Kolmogorov 1971: 418.

[12]The relationship between the interpretation of both the functors is illustrated by the tables below (numbers in the Table 1 correspond to columns in Table 2):

$(p \oplus \sim p) \otimes q$

2. THE DSL AND THE INTERPRETATION OF THE FUNCTION OF IMPLICATION

The DSL pertains to the least intuitive aspect of the truth-value function connected with implication: its value for formulas with a false antecedent. This issue might be considered to be lying outside the scope of considerations proper to logic, if we assumed that the exclusive domain of this science is the description of laws which can serve as infallible rules of inference and from true premises permit to draw, always and exclusively, true conclusions. Then, a logician would not be obliged to bother with inferences that begin from premises containing a material error; the appropriate truth-value function would only determine that for an implication to be true, not only the antecedent but also the consequent must be true. (The application of the laws of logic does not lead outside the set of true sentences.)

Usually, however, all four initial possibilities are considered in the description of the material implication function, similarly to the other truth-value functions. This approach facilitates generalizations, such as "truth results from everything" and "everything results from falsehood". The Law of the Antecedent expresses the first of those regularities by describing the cases of

$\oplus$	$\otimes$
0	3 7 11 15
1	3 7 11 15
2	15
3	15
4	15
5	15
6	3 7 11 15
7	12 13 14 15
8	3 7 11 15
9	3 7 11 15
10	15
11	15
12	7 11 15
13	15
14	12 13 14 15
15	12 13 14 15

p	q	$\times$	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	$\times$	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
1	0	$\times$	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	1	$\times$	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
0	0	$\times$	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

implication with a true consequent. The DSL reflects the other one, since it pertains to the consideration of all the implication formulas with a false antecedent as true. It therefore expresses the other side, or the other half, of the truth about the interpretation of the implication functor. This is, however, the more bothersome half, inasmuch as it is less compatible with the colloquial understanding of consequence.

This issue has long been raised by various authors. In justification for the logical matrix accepted for the material implication, a number of additional commentaries have been proposed, in the hope of bringing it closer to the general intuition.[13] Peirce compared implication to a not-strict inequality relation between logical values (a comparison especially useful in defining the implication function in multiple-valued logics); an analogous parallel pertains to the set-theory interpretation of the relation of result between (predicated) names (e.g. Keenan, Faltz 1985). A detailed analysis of differences between the colloquially understood conditional and the material implication was presented by Ajdukiewicz (1985),[14] who made the differentiation between what each of these expressions states and what each of them expresses.

Modal interpretations of the deontic type constitute a separate group of commentaries. A sentence of the $p \rightarrow q$ type is there "translated" as e.g. "To fulfil action p, you must have the permission q" or "If you do p, you must do q". In particular: "If you made a promise, you are obliged to fulfil it; if you did not make a promise, fulfilment of the given action is morally neutral".[15]

Another explanation can be proposed: when an implication with a false antecedent is formulated, the system of logic is being applied contrary to its purpose, which is to lead from true premises to true conclusions. Assuming

[13]Cf. the catalogue of didactic methods of introducing material implication, with an attempt at classification, in: Clarke 1996. Clarke mentions, among others, Korfhage's interesting interpretation of material implication related to programming languages, although he concurrently notes that this interpretation is not free from error.

[14]According to Ajdukiewicz, both the conditional and the material implication STATE that it is not concurrently so, as the antecedent says and differently than the consequent does; however, the conditional (in contrast to the material implication) additionally EXPRESSES the speaker's lack of knowledge regarding the possible falsehood of the antecedent or truth of the consequent, and his readiness to conduct an appropriate process of drawing a conclusion. The same topic is discussed in the article by Pelc (1986), which emphasises the importance of semantics in the case of implication, and pragmatics in the case of the conditional. For criticism of Ajdukiewicz's viewpoint, see Bogusławski 1986a. Cf. also the polemic of Jadacki and Bogusławski on the same topic, Jadacki 1986, Bogusławski 1986b.

[15]This last observation I owe to Prof. Jerzy Pelc.

every possible sentence to be true, the system is indeed lying; but it is doing this ostentatiously, thereby signalling that from now on it shall not be of much use, because in the given situation it refuses to cooperate.

3. THE DSL AS AN EXPRESSION OF THE LOGICIANS' ATTITUDE TO CONTRADICTION

In Duns Scotus's authentic works only the conjunctive form of his law is found, that is the formula $(p \wedge \sim p) \rightarrow q$.[16] Both its implicative form and any other thesis that would directly express the principle that "everything results from falsehood", are absent. Neither do those works contain a precisely formulated definition of implication (Włodarczyk 1955: 19) or, for that matter, the Law of the Antecedent.[17] This permits us to assume that Duns treated contradiction as a falsehood *par excellence*, by means of which the essential property of implication can be expressed. Pseudo-Scotus, however, making a distinction between the two forms of that law, clearly indicates that in the implicative form conclusion is drawn from a false sentence, whereas in the conjunctive form we are dealing with a conclusion drawn from the impossible (Włodarczyk 1955: 71),[18] and, in the light of this remark, Duns's thesis would probably not apply to falsehood at all. Yet the views of Duns himself permit us a moderate defence of our stance, since he asserts that "everything remains in the same relation to the truth as to existence" (Włodarczyk 1955:44).

Considering contradiction to be a model falsehood (or the model example of the impossible) is in line with a centuries-old tradition in logic, which demanded, and still demands, to unconditionally avoid contradiction.[19] The significance of DSL pertains therefore to several centuries of tradition in

[16] In Włodarczyk (1955) this formula bears the symbol Sz.4,4. All formula symbols below are from that work.

[17] Among the theses formulated by Duns Scotus there is, however, the thesis: $(p \rightarrow q) \rightarrow [(\sim p \rightarrow q) \rightarrow q]$ (Sz. 2,9.), written also in the conjunctive form (Sz. 4,19.).

[18] Cf. however Pseudo-Scotus's more liberal stance on the same point, *ibidem*, pp. 61-62.

[19] Aristotle's attempts to prove the principle of contradiction are worth mentioning; these attempts, which were futile, are commented upon by Łukasiewicz: "Whoever with great emphasis and self-confidence proclaims a thesis, not giving any proof, whoever IS ANGERED instead of giving argumentation, probably does not have strong enough arguments" (Łukasiewicz 1987: 38; translated for the purpose of the current article — translator's note); the case resembles the former geometricians' inability to abandon the Parallel Axiom.

logic and to its inflexible stance regarding this point.[20] The DSL gains this latter value due to the placement of the contradiction mark in this concrete context.

It needs to be added that the solution applied in the DSL makes it possible to put down the above-discussed property of implication in a symbolic way, and thus to avoid verbal commentaries such as: "If p is false, any other sentence results from it" (which in fact could not, of course, motivate Duns, who wrote down his theses in Latin). Among Duns's theses there is also a number of other formulas pertaining to the bothersome situation resulting from a false sentence, although in a much narrower sense: there, from a false sentence results only in a contradiction or a sentence earlier determined to be false. The meaning of those formulas can be summarised as "falsehood results only from falsehood". Among them are, for example, the following expressions:

(4) $(\sim p \rightarrow q \wedge \sim q) \rightarrow p$ (Sz.4,21.)

(5) $(p \rightarrow p \wedge \sim p) \rightarrow \sim p$ (Sz.4, 16.)

(6) $\sim q \rightarrow [(p \rightarrow q) \rightarrow \sim p]$ (Sz.2,8.)

The above theses are analogical to the proposal put forward by Kolmogorov, which he called the Contradiction Principle:

(7) $(p \rightarrow q) \rightarrow [(p \rightarrow \sim q) \rightarrow \sim p]$ (Kolmogorov 1971: 421)[21]

and similarly to this principle they remain silent regarding the "unlimited possibilities of drawing conclusions from falsehood". Their significance pertains more to the *reductio ad absurdum*, which contains, to use Czeżowski's phrase, an essential element of the "usefulness of error" (Czeżowski 1958).

Acceptance of the DSL means that no pair of contradictory statements, or any other formula with the logical value of 0, can be accepted into the logical system, for it threatens a "system overfill": the system becomes trivialised by accepting all the sentences possible to formulate in it as true. This approach excludes the possibility of taking account of, for instance, contradictory data derived from varying sources, in the system of reasoning. The first of the so-called paraconsistent logics[22] were constructed only towards the 1940's; there, the operation of the DSL is limited in various

[20]Limited only to the created world by some thinkers e.g. Pietro Damiani or Nicholas of Cusa, a point with which Duns Scotus clearly disagreed; see Włodarczyk 1955: 44-45, Nicholas of Cusa 1997.

[21]Kolmogorov presents this formula as a version of the Contradiction Principle possible to accept as an axiom in intuitionistic logic. This formula was indeed included in the list of axioms given by Heyting (Kolmogorov's text was written in 1925).

[22]See the pioneering work by Jaśkowski (1948).

ways,[23] which makes it possible to accept contradictory theses with no risk of the system exploding.

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THE TERM "PROBLEM" IN SCIENCE AND PRACTICE

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INTRODUCTION

In the last decades the term "problem" has been enjoying an increasing popularity across the board: be it in daily life (human problem), science (research problem), medicine (patient problem), engineering (structural problem), etc., everyone's involved in problem solving: a man on the street in his daily life, a scientist in a lab, a physician with his patient, a student at school and at home. This idea of "problem" and "problem-solving" pervades our daily life and is firmly grounded in our practices, so much so that no one seems to question what those notions really mean. Still, it's useful to explore and classify those concepts as they touch on many basic mental processes and crucial aspects of scientific research and practice.

For this reason, the concepts of "problem" and "problem-solving" were explored in psychology (Duncker 1945; Reitman 1965; Lindsay, Norman 1984), logic and methodology (Newell, Shaw and Simon 1958), information technology and artificial intelligence studies (Gilhooly 1989; Nilsson 1971), didactic studies (Polya 1945; Belikow 1989), etc.

Put shortly, the notions of "problem" and "problem-solving" are important because they reflect purpose-driven activity as it is represented in the human mind.

This paper seeks to examine and classify those concepts, as well as to apply the ensuing methodological insights to science and practice. The goal is to establish how people formulate and solve problems, but in doing so I do not draw on psychological studies, apply psychological methodology, or

explore the field of AI. As for the psychological aspect of these considerations, the paper aspires to be a descriptive study of what, it seems, we can learn from experience (of teaching, for example), observation of scientists and practitioners at work, and introspection. The approach proposed in this paper is methodological and model-driven, that is, problem-solving processes are presented as if the goal of the inquiry was to create a basis for their partial automation. Although this remains a distant perspective, the more immediate implications of this paper may come with the teaching of problem-solving procedures, for example via educational software.

My approach to the "problem" is not linked to, much less identified with, overcoming intellectual difficulties, which is a common way of how this notion is conceptualized. For example, Karl Duncker argues that "a problem arises when a living creature has a goal but does not know how this goal is to be reached" (Duncker 1945: 1). Instead, I propose to understand "problem" as a psychical state of the subject, in which he or she seeks to acquire knowledge through structured mental processes. It resonates withthe approach offered by Kenneth Gilhooly: "a problem exists when an information-processing system has a goal condition that cannot be satisfied without a search process" (Gilhooly 1989: 2). My paper, however, aligns more with natural reasoning processes than technical systems, and problem creation and problem–solving are not treated as processes based on search procedures.

CONSTITUENT PARTS AND TYPES OF PROBLEMS

A "problem" is a mental state consisting of three elements: knowledge in a certain area is deemed insufficient, realization of what is missing, and intent to remedy the existing insufficiency. Problem-solving can be defined as a set of mental processes that result in new knowledge when the initial knowledge is transformed into the desired knowledge. In other words, people may "have a problem" or "face a problem," if they feel their knowledge is insufficient and seek to remedy that shortcoming. Put differently, the problem consists of input (initial) knowledge, desired knowledge, and motives driven by emotional factors. By *explorandum* I mean the expected outcome of the problem-solving process, by *exploratum* I mean the actual outcome of such a process.

In its simplest form, the problem may be expressed as follows: "is object O, characterised by P, also characterised by Q?" One knows that object O has the property P, it is the input (initial) knowledge, but one desires to learn something more about O. To this end, one makes an assumption that

O has or has not a property Q and seeks to verify this hypothesis. The goal here is to articulate a judgment (proposition) which would authoritatively settle this issue one way or another, as in, for example "Q is a property of O" or "Q is not a property of O." This constitutes a problem's *explorandum* because one of those judgments (propositions) contains sought for (desired) knowledge that expands the input knowledge. As soon as the problem is solved, that is, one of the judgments is recognized as true, it becomes the problem's *exploratum*. The solution to the problem, which here takes the form of an answer to the question "is object O characterised by Q?," can come either as a result of a purely argumentative process or follow as an effect of observation. The former method is available if one knows a general theorem (or can derive it from other theorems) and knows how to conduct the appropriate reasoning. In this case, the general theorem may look as follows: "Any given object O (an O-type object) characterized by P is also characterized by Q," with the inference following the rule of detachment. The latter method consists in observations of O: one subjects it, for example, to a visual examination in order to verify whether Q is or is not part of the characteristics of O. In order to successfully complete the observation, one needs to know how to conduct the process and identify the phenomenon one seeks to establish.

In most cases, when one deems one's knowledge insufficiently comprehensive, followed by realizing one's need to complement it in a identified manner, these processes are related with factors external to the problem, that being the context, or, in other words, different problems (actual or potential) as well as other strivings and ambitions that one chooses to pursue. Usually, problem-solving is motivated by utilitarian reasons (although it may by driven by interest in the given topic) or used to guide behaviour. Problem formulation and solving is one of the fundamental areas of purposive activity where — as in any purposive action — thought processes are intertwined with motivations and emotions. Problem-solving effectuates primarily by thinking in a purposeful way, that being reasoning.

The notion of "problem" is sometimes used differently: in various spheres of life there are more or less typical situations in which people are solving similar problems. Here "problems" are taken to mean fragments of objectively understood knowledge, which relate to elements of input knowledge and desired knowledge associated with the given problem, also involved are the elements of general knowledge required for its eventual solution. Here, "problem" can be more or less identified with a "fragment of (general) knowledge." The meaning of the term is often understood to apply

to situations when reaching the final solution is a complex process. This would entail that the same mental state of two different people may have a different impact on their respective problem-solving capabilities. Such a possibility, however, is not discussed in this paper.

Problems explored in this paper, i.e. scientific problems and practical problems informed by scientific knowledge, can be classified in various ways. For example, they may be categorized according to their origin (physical, biological, medical, technical, artistic, etc. problems) or divided with regard to whether they occur routinely or not (standard and non-standard problems), degree of complexity (simple and complex problems), diversity of problem-solving strategies, etc. Problems can also be classified according to their practical or scientific character, solving methods, and the nature of *explorandum*. This classification is presented below.

There are problems concerning specific objects or events, occurring just once in a specific spatiotemporal setting, and objects or events that occur repeatedly in a number of spatiotemporal settings. Here, problems can be either SPECIFIC or GENERAL, belonging, respectively, to the domain of practice and the domain of science.

Varying degrees of generality can result from the initial knowledge (a point of departure) or the desired (final) knowledge constituting *explorandum*. (Hypotheses used to solve problems are always general). From this perspective, it is possible to distinguish four types of problems: 1) both input knowledge and desired knowledge isspecific. This situation is typical to practical problems (a relevant example was presented at the beginning of this paper); 2) both input knowledge and desired knowledge is general. Such problems usually appear in purely theoretical sciences; 3) input knowledge is specific while the desired knowledge is general. These problems are typical to empirical sciences; 4) input knowledge is general while the desired knowledge is specific. These problems are used to test scientific hypotheses and appear in practical activity.

Some problems can be solved by reasoning only, while others require additional observation. From this perspective, problems can be divided into PURELY ARGUMENTATIVE problems and OBSERVATIONAL-ARGUMENTATIVE problems.

By formulating and solving problems, people seek either greater insight into the outside world, other human beings, themselves or to justify behaviour (their own or others). New knowledge emerges upon solving COGNITIVE problems of two kinds. First, there are THEORETICAL problems solved by argumentative reasoning; second, there are OBSERVATIONAL

problems that require the aid of observation, called also SEMIOTIC problems. Solutions to both theoretical and observational problems leads to *exploratum* that takes the form of an indicative judgment (proposition): "it is so and so." Decisions that inform behaviour take the shape ofa directive orimperative judgment (proposition): "one should do this or that." Problems with such *exploranda* can be called PRAGMATIC problems (or projectional problems, although this particular phrase may be less fitting for etymological reasons, as the Greek *problema* means roughly the same as the Latin *proiectio*). Problem-solving activities can have two goals: either change within the external state of affairs in relation to the agent or observation. Problems with *exploranda* consisting of directives prescribing this first purpose can be called EXECUTORY problems, the other type of pragmatic problems can be called RESEARCH problems.

Results of problem-solving can be quite diverse: the *explorandum* may be expected to contribute new information, bring greater specificity or increase certainty. Under this division, there are EXPLORATORY problems that modify the content by introducing NEW INFORMATION or NEW DETAILS, and ASCERTAINING problems that increase the degree of certainty, reserved solely for cognitive problems.

The very idea of looking for something presupposes that we know what this something is. Thus, one needs to define clearly what is the goal of the problem-solving process. Each problem contains a question (see the example above) that defines the problem. The answer constitutes the core element of *explorandum*, which, depending on the formal structure of the problem, can be more or less specific. Apart from identifying the input knowledge, one determines what would be the acceptable addition to knowledge, that is, what is the scope of *explorandum*'s variability and which unknown ones can be put in place of variables. If the scope of *explorandum* is broad, the problem is OPEN, if it's narrow, the problem is CLOSED.

If open problems are formulated correctly, their solutions are either not specific at all (UNCONSTRAINED open problems) or defined only to some extent (ORIENTED open problems). *Explorandum* of unconstrained open problems answers such questions as "what is happening?," or "what to do?" In oriented open problems the scope of *explorandum* is limited to a class of judgments: any element of the class may prove to be a correct solution to the problem. In other words, *explorandum* explores such questionsas "what kind of object is that?,""what are the properties of the object?,""what activity should one perform?"

Closed problems have rigidly defined *exploranda* consisting of explic-

itly specified elements belonging to a certain class of judgments. They may be further subdivided into BROAD and NARROW problems. Usually, correct solutions of broad closed problems belong to a class consisting of several elements one can choose from, with problems answering such questions as "which of such and such phenomena occurs?" or "which of the available activities should one perform?" In narrow closed problems, correct solutions are limited to minimum, with *explorandum* answering such questions as "does such and such phenomenon occur?," or "should one perform this or that activity?"

To summarize, there are four types of *explorandum* classified according to the degree of its precision. When compared with the classification offered by Kazimierz Ajdukiewicz (Ajdukiewicz 1974), oriented open problems and broad closed problems correspond with complementation questions, while narrow problems correspond with decision questions. Open and unconstrained problems are not, it seems, addressed by Ajdukiewicz in his classification.

A problem's *explorandum* may consist of a single judgment or two or more judgments in the form of alternatives. These may also be more or less specific, as in some cases when the goal is to achieve certainty, which means that at the end of the day there can only be one judgment left. But when certainty is not the possible or desired outcome, a set of alternative judgments could be considered as the acceptable solution, along with a possible indication of their respective levels of plausibility. *Explorandum* may also have different levels of specificity, judgment(s) can be broader or narrower in terms of its semantic scope. Problems with single-judgment *exploranda* can be called SHARP, as opposed to FUZZY problems that may consist of several alternative judgments. Also, *exploranda* of sharp problems may include narrowly defined judgments, while fuzzy problems may have *exploranda* with a broad semantic scope.

It's not unusual that the *exploratum* at which one actually arrives is different to the *explorandum* that one projected. One may desire an unambiguous or narrowly-defined *explorandum*, but the problem-solving process can as well produce *exploratum* which includes a set of alternative judgments or result in broad semantics. The problem may be either considered as successfully solved (although with a different outcome then expected), or be taken as the starting point for a new problem, defined as an alternative or insufficiently precise *exploratum* of the original problem. In that case one often specifies conditions that must be met in order to consider the problem solved. In other words, the result of the solving process may consist of a

conditional judgment (proposition) that refers to knowledge which at the moment is not yet there (as opposed to indicative judgment produced whenever the problem has a straightforward solution). For example, a problem expressed by "is there P?" may have a less straightforward solution, such as "there is Z" or "there is not Z". However, the answer may be conditional: "There is P if there is Q." This solution creates a new problem "is there Q?," a sort of sub-problem of the original problem. Its solution is required before one can proceed with the search for the original *explorandum*.

The above-discussed problems can be classified as follows:

A) Problems concerning specific objects or classes of objects:
- 1. general-to-general problems,
- 2. general-to-specific problems,
- 3. specific-to-general problems,
- 4. specific-to-specific problems.

B) Solving method:
- 1. purely argumentative problems
- 2. observational-argumentative problems

C) A problem's *explorandum* describes the state of affairs or indicates the action of the subject:
- 1. cognitive problems:
  - 1.1 cognitive problems (semiotic type):
    - 1.1.1 identification problems,
    - 1.1.1 interpretive problems.
  - 1.2 cognitive problems (theoretical type).
- 2. pragmatic problems:
  - 2.1 pragmatic problems (cognitive type) (research problems),
  - 2.2 pragmatic problems (executory type).

D) *Explorandum* expands, specifies or modifies knowledge:
- 1. exploratory problems:
  - 1.1 modifying knowledge content:
    - 1.1.1. introducing new elements to knowledge,
    - 1.1.2. introducing greater detail to knowledge.
- 2. problems modifying the degree of certainty of knowledge (cognitive problems only).

E) *Explorandum* is more or less specific:
- 1. open problems:
  - 1.1 unconstrained,
  - 1.2 oriented.
- 2. closed problems:

2.1. broad,
2.2 narrow.

F) *Explorandum* consists of a single judgment or a set of judgments with a varying degree of certainty:
1. sharp problems,
2. fuzzy problems.

G) *Explorandum* consists of a judgment with a broad or narrow scope:
1. problems with sharp semantics,
2. problems with fuzzy semantics.

H) Other problem criteria: easy or difficult, standard and non-standard, clearly-structured or vaguely-structured, simple and complex, related to certain manners of reasoning, with broad or limited applicability of "problem-solving strategies," etc.

PROBLEM-SOLVING

Problem-solving refers to a set of argumentative processes and observational-argumentative processes that lead to a goal defined as transforming the initial (input) knowledge into the desired (output) knowledge. Throughout the process one identifies the contents of the knowledge at hand as well as the sought-for knowledge, eventually transforming the judgments appearing in *explorandum* into a judgment or a set of judgments that are close enough to what is specified in the *exploratum*.

Problem-solving usually effectuates via reasoning (purpose-oriented thought processes): it has a point of departure, i.e. a premise or a set of premises, and proceeds to create and/or confirm (with a specific degree of certainty) judgments (propositions) contained in *explorandum*. Created and/or confirmed judgments, the *exploratum*, is the conclusion or conclusions drawn from the reasoning. If the problem can be solved directly, the whole process can be completed in a single stage (although it may itself consist of multiple and/or complex steps), without formulating intermediate problems (sub-problems). If it is not possible to reach the solution directly, one goes on to formulate an additional problem (sub-problem), its *explorandum* conceived as a departure point for further reasoning that ultimately leads to a solution for the original problem. In other cases, where the solution based exclusively on reasoning is not possible, one needs to resort to observation. Much like in argumentative problems, here one may also formulate intermediate problems. First off, one determines what there is to observe in order to solve the original problem, thus formulating a sub-problem of a purely cognitive (theoretical) nature. Second, there emerges a pragmatic problem of a cognitive

type, *explorandum* of which consists an action that enables capturing of the phenomenon in question. This is followed by the action itself, which assists the process, but does not belong to the problem-solving procedure (problem is used here in the sense adopted in this paper). Nevertheless, because of its inherent thought component, observation cannot be entirely thought of as separate from the problem-solving process.

Observation of a phenomenon or a state of affairs (object, property, relation) happens via conscious perception and understanding of the sense data. In the process, mental representation of the impression is linked with the existing knowledge. Eventually, the mind generates a judgment that reflects (describes) the phenomenon in question, construed as a source of the signal triggering the impression. In other words, judgment constitutes a perception of the phenomenon, or a reception of phenomenal data. The forming of a judgment with regard to specific phenomenon is known as mental identification, or recognition and interpretation of perception. In our daily or professional life identification of phenomena is, so to speak, automated, proceeding and without conscious reflection it would also be difficult to break down the process into its component parts. However, in less clear cases or when the observed phenomenon is a highly complex one (especially when it resembles other phenomena, against which it is meant to be differentiated), interpretation of the impression is similar to problem-solving: aware of the impression's characteristics, one seeks to understand the phenomenon at hand. Usually, one is aware that it belongs to such and such class, can be one thing or another, etc. Therefore, the problem is solved by answering the question "what is it?," "what are its properties?," "which particular object (from among similar objects) is it?," "is it such and such?" Interpretation of the impression, i.e. the process of transforming the impression into a judgment, is the first stage — or type — of semiotic reasoning. By identifying the impression, the boundaries of knowledge are pushed further, thus creating a new point of departure to solve the original problem. Speculation that something occurs is now traded for certainty. Put shortly, reasoning can go as follows. Original problem: "is there P?" Preliminary solution: P occurs if there is Q. Result of observation: there is Q. Solution of the original problem: there is P.

Ways of reasoning used in problem-solving can be roughly divided according to the following criteria: direction of reasoning, and horizontal and vertical complexity. Under the first criterion, there are progressive and regressive types of reasoning; under the second criterion, there are single-link/multi-link and single-tier/multi-tier types of reasoning (Doroszewski

1990; Doroszewski 1991).

In logical implication, for example, the reasoning is progressive if the conclusion is contained in the consequent, it is regressive if the conclusion is present in the antecedent.

The reasoning is PROGRESSIVE if by accepting the judgment "if P then Q," and stating that P, one concludes that Q. In Ajdukiewicz (Ajdukiewicz 1974), this operation is described as inference in the narrow sense. In problem-solving, this is a type of reasoning where *explorandum* is contained in the consequent of the logical implication of a general judgment. In the simplest cases it can be found via *modus ponens*. Problems solvable by progressive reasoning can vary in terms of the degree of certainty pursued by the *explorandum*. They can be either open (unconstrained and oriented) or closed (broad and narrow). By accepting an indicative "there is P," one can ask the following questions: "what follows from P?" (unconstrained problem); "which Q can follow from P?" (oriented problem); "which Q_1, $Q_2 \ldots$ follows from P?" (oriented broad problem); "knowing that P, I want to know if Q" (oriented narrow problem).

Progressive reasoning includes the verification of hypotheses, which is a lead-up to observation that pursues the solution to a cognitive sub-problem (see above). Here, input knowledge is used to formulate conclusions on whether certain phenomenon occurs or not. Its *explorandum* can have a varying degree of precision. Also, its content is limited to phenomena observable under given conditions.

The reasoning is REGRESSIVE when one accepts that "if P then Q" and uses "there is Q" to investigate whether there is P. Contrary to progressive reasoning described above, this kind of reasoning is not infallible, which means that its product is not entirely certain. "There is Q" can only increase the level of certainty that "there is P". One common type of regressive reasoning is explanation: one seeks such P that from P follows Q (proven by observation, for example). In other words, the most common formulation of explanatory problem includes *explorandum* (or, to be more precise, *explanandum*) which consists of P, an occurrence of which is explained by the fact that there is Q (P being a cause for Q, for example). Similarly to progressive reasoning, *explorandum* in explanatory problems can have a varying degree of precision. It can thus answer various questions, such as "what causes Q?" (open unconstrained problem); "which P causes Q?"(open oriented problem);"which P_1, $P_2 \ldots$ causes Q?" (closed broad problem); "does P cause Q?" (closed narrow problem). Since "there is P" is often secured by observation, explanatory problems are fairly common

among semiotic problems.

Another major type of reasoning is demonstration, used primarily in formal sciences. It is similar to explain (Ajdukiewicz 1965) in that both seek proposition(s) which would imply that the proposition to be demonstrated (*demonstrandum*) is true. However, contrary to explanation, demonstration deals with propositions that are not recognized in advance. In short, demonstration seeks to establish whether the proposition is true. To find the answer, one tries to find another proposition, its truth-value already known, from which it would follow that the *demonstrandum* is true. Such a problem can be classified as a closed problem of a narrow type. Seen from a different perspective however, it is also an open problem of unconstrained type because its *explorandum* (understood as a proposition that implies proposition be demonstrated) is not encumbered with specific conditions. Precisely this unconstrained nature of demonstration causes familiar difficulties with formalization and automation of problem-solving processes.

Reasoning techniques used in problem-solving can have a varying number of essential steps, or thought-links. There are SINGLE-LINK problems, where inference effectuates via a single general proposition (proposition), and MULTI-LINK problems, which are solvable only by going through a number of interrelated general propositions. One common example of multi-link reasoning is a string of general propositions expressed in the form of logical implication, where the consequent of the preceding proposition is also an antecedent in the following proposition. Since logical implication is transitive, even far-apart elements can be linked into an inferential sequence. In practice, such reasoning techniques do not really create inferential sequences but resemble rather more or less complex networks or systems. If there are alternative paths of reasoning, which is not uncommon, the problem-solving strategy evolves into more or less complex structures.

In some cases, problem-solving involves theorems (laws) already at hand or other theorems that may require adjusting to a particular problem by rearranging a specific chain or system of theorems. In any case, however, they do not have to be derived from other theorems. Reasoning which applies this sort of law or set of laws can be called SINGLE-TIER reasoning. It is primarily applied to more or less standard, frequent and simple problems. However, more complex problems, including those confronted only occasionally, can be solved only through laws (theorems) of a more general nature. This feature makes them applicable to various specific cases. General-to-specific reasoning is a MULTI-TIER reasoning. The most complex and unconventional problems, particularly those requiring creative

thinking (such as original scientific problems), combine single- and multi-link as well as single- and multi-tier reasonings.

Depending on the nature of input knowledge, *explorandum* as well as one's general knowledgemeans problem-solving can include application of qualitative laws, quantitative laws (theorems) or a combination of both. QUALITATIVE reasoning uses concepts phrased in regular language to apply inference techniques similar to those developed in classical logic. QUANTITATIVE reasoning employs concepts expressed by numerical symbols and formal schemata (mathematical formulas), as well as operations performed on numbers and corresponding variables. In other words, mathematical and quantitative problem-solving methods are applied when input knowledge and *explorandum* are expressed formally and quantitatively. In empirical sciences, such problems often include measurement, a procedure where properties of objects are ascribed numerical values.

To recapitulate, broadly conceived problem-solving can be broken down into the following phases and sections:

A) Problem formulation (against the ultimate goal):

1. a precise account (clear understanding) of the current (initial, input) knowledge in the given area,

2. defining the *explorandum* (of the immediate goal).

B) Problem-solving:

B1) purely argumentative problems:

1. picking (deducing) a general theorem (or sets of general theorems) for reasoning,

2. reasoning;

B2) observational problems:

1. determining the manner of observation (solving a pragmatic-cognitive problem),

2. executingand interpreting the observation.

C) Formulation of *exploratum*.

D) Assessment of *exploratum* (with regard to immediate and ultimate goals).

PRACTICAL AND SCIENTIFIC PROBLEMS

I shall now illustrate the above remarks by showing how various types of problems and problem-solving strategies are using inactivity informed by scientific background (by doing so, I shall be referring to vocabulary and classifications proposed in the previous paragraphs of the paper). First,

my approach will be applied to a typical case of practical activity such as medical treatment. This shall be followed by a brief discussion of the problems encountered in scientific (experimental) practice.

I. MEDICAL PROBLEMS

By virtue of dealing with a specific patient representing a specific case, medical practice, in this paper limited to treatment, is concerned with SPECIFIC PROBLEMS. Its departure point (INPUT KNOWLEDGE) and *explorandum* are also of specific character. Medical problems are designed to reach the ultimate goal of medical practice, that being nursing the patient back to health by pursuing methods prescribed by medical science. For this reason, in that type of activity COGNITIVE problems and PRAGMATIC executory problems coincide and are intertwined. Problem-solving in medicine requires both general medical knowledge and expertise in other areas. It is driven by the desire to fulfill the physician's primary task defined as delivery of proper medical treatment.

Generally, a medical procedure consists of: I. preliminary examination (subject-oriented and object-oriented); II. in-depth examination; III. treatment planning and execution; IV. assessment.

I. Preliminary health information provided by the patient during the initial contact serves as a point of departure, or the input knowledge, for primary and secondary problems. Depending on the content and scope of accessible knowledge, the problem may be phrased in various ways, such as a) is the patient sick?; b) does he need further treatment?; c) what is he suffering from?; d) what is there to be discovered about the patient's health?; e) what examination should one administer?; f) what kind of treatment would be fitting?

Problems related to those questions vary in nature, some belong to COGNITIVE problems (a, c, d), others are PRAGMATIC problems of COGNITIVE TYPE (e) and EXECUTORY TYPE (b, f). There are also CLOSED problems of NARROW TYPE (a, b) and OPEN problems of UNCONSTRAINED TYPE (c, d). Finally, there are OPEN problems of ORIENTED TYPE (e, f). One characteristic thing about the first stage of medical procedure is that, regardless under which category it falls, *explorandum* is rather VAGUE (with one exception indicated below). A physician seeks only general information about the patient's condition (problems a, c or d), the same can be said of potential diagnostics (e) and treatment (f). This is because at this stage one needs only a general directive for further action, not a basis for minute decisions. One exception here would be a

type of an a)-problem, namely "is the patient's life in immediate danger?," followed by an f)-problem. The answer to the a)-problem must be specific enough to secure informed solution of the pragmatic-executory problem of the f)-category.

Cognitive problems emerging in the first stage of medical procedure are primarily of SEMIOTIC nature, which means that their point of departure draws from the results of observation. Much like any other semiotic problem, they consist of an IDENTIFICATIONAL sub-problem (what is it that I observe?) and a SEMIOTIC PROBLEM PROPER (what does this observation mean?). In the process, one interprets linguistic signs (the interview) and natural signs (examination). As far as identification in observation goes, it is particularly natural signs (patient's symptoms) that show specific properties. In the semiotic problem proper, *explorandum* is established through semiotic deduction, used to find correlates of the observed signs. Cognitive medical problems are interrelated with pragmatic problems (which are therapeutic in nature, as shown below), but this relationship is much more direct in subsequent stages of medical procedure. In its first phase, cognitive problems are formulated based on general medical knowledge rather than specific therapeutic needs. In other words, at this stage, the physician seeks to examine phenomena already conceptualized in medical knowledge. And since it is designed to have practical application, its governing concepts and laws have structure and content designed to correspond with therapeutic needs. In this somewhat indirect manner cognitive problems faced in the early stages of medical procedure help reach the ultimate goal of the whole process. General medical knowledge delineates also boundaries for *exploranda* of unconstrained problems; this is because both identification of specific phenomena and their semiotic interpretation focuses on pathologies that include symptoms, pathological conditions or illnesses. *Explorata* of semiotic problems are, in the early stages of medical procedure, rather VAGUE, which means that they are usually broad in scope. This relates particularly to patient's condition, which is assessed based on symptoms (signs), although sometimes this vagueness relates also to signs themselves.

II. Information on a patient's condition collected during initial contact serves as a point of departure (input knowledge) for problems formulated and solved during the in-depth examination. The knowledge in question includes *explorata* of the already solved problems, that of being conclusions regarding observable symptoms and semiotic conclusions describing unobservable ("internal") pathologies and other phenomena. At that stage, this knowledge suffices for initial formulation of PRAGMATIC EXECUTORY

problems (THERAPEUTICAL problems) where one asks what to do to achieve the desired effect of the treatment. At this stage, a typical therapeutical problem will be solved by concluding what is the right treatment in the particular case. This approach is usual in OPEN ORIENTED problems — a patient's condition is not yet fully explored, meaning that *exploranda* of such problems are VAGUE, describing certain kinds or groups of treatment rather than specific actions. To narrow down the available alternatives and find the best option, the physician must formulate and solve new cognitive problems. In doing so, their *exploranda* must provide sufficient substance for proper articulation and solution of therapeutical problems informing the decision-making process. Such problems can be formed in the following way. Therapeutic actions under consideration are narrowed down to those actually available. Each of these actions brings about the desired result with regard to the specific condition of the patient. Hence, the physician is considering a set of possible (probable) conditions of the patient where each corresponds with specific action. However, at this stage it is not yet known which of the "internal" conditions actually occurred. This uncertainty can be reduced by formulation and solution of new COGNITIVE THEORETHICAL problems. *Explorandum* of such a problem describes the condition-related and observable phenomenon. The theoretical component of the problem resides in the fact that, contrary to semiotic problems, its point of departure (premise) consists of a phenomenon that emerged in the wake of semiotic conclusion rather than observation. These are OPEN ORIENTED problems, where one tries to determine which as yet unknown but observable phenomenon accompanies the presumed (probable) condition of the patient. Informed by the results, the physician creates further problems, preparing ground for observation that will ultimately confirm or refute whether the phenomenon in question occurs. Those problems can be classified as PRAGMATIC COGNITIVE problems and seek to determine which cognitive action (examination) should be taken to establish whether such and such phenomenon occurs. However, since there is a limited number of examination methods that under given circumstances are both available and useful, those problems are in fact CLOSED and BROAD, which means that the examination method is chosen from a closed set of available options. That being said, some examinations can be completed via different technical means, therefore it is quite important to decide how the examination should be performed. These problems concern mostly instrumental examinations in modern clinical medicine. These procedures are often associated with verification of hypotheses made with regard to the patient's condition. Solutions

to pragmatic-cognitive problems provide substance for a detailed diagnostic plan, with its subsequent elements executed conditionally or unconditionally, depending on the results.

Specific activities performed during the examination draw the conclusion of whether the assumed phenomenon occurs, and if so what are its properties. This further leads to a semiotic problem, its point of departure at this stage is already guided by a large body of information. Since the goal is to verify hypotheses, both observed phenomena (here used as signs) and "internal" phenomena being their potential correlates, i.e. *exploranda* of identificational and proper sub-problems are specified down to considerable detail. Therefore, while being either BROAD or NARROW, the semiotic problem is at that moment usually already CLOSED. One tries to understand which of the considered phenomena was perceived in the examination (or whether such and such phenomenon occurred) and which "internal" phenomenon could be a correlate of the observed sign (or whether one can assume that such phenomenon occurs). Apart from that, in some examinations, especially in those delivering abundant information, the interpretive problem is often OPEN and ORIENTED, or even UNCONSTRAINED.

Symptom interpretation is at the stage closely linked with the planning of therapy. In other words, *exploranda* of semiotic problems are now used as basic elements of the input knowledge on which therapeutic problems are based. At this advanced stage of treatment, semiotic and therapeutic problems are inseparable, which can be both troublesome and beneficial: on the one hand one must be simultaneously considering a number of judgments, but this close interrelation helps or even enables finding correlates of the sign. Since the medical knowledge of today is already well advanced, almost every sign (symptom) can be linked to various correlates ("internal" phenomena, pathologies, etc.). That said, only some of them are relevant treatment-wise and for this reason they are considered to be of primary importance.

III. Input knowledge in therapeutic problems consists of judgments describing, with varying degrees of probability, pathological phenomena that occur or are likely to occur in the particular case. *Explorandum* of the therapeutic problem (or the PRAGMATIC-EXECUTORY problem) consists of a judgment (usually a set of judgments) that describes one of the available actions. At the last stage of the medical procedure the judgment in question must be specific enough as to make a decision regarding the treatment. Judging by the patient's condition, one needs to determine which action (as compared to other options) will bring or is likely to bring the desired outcome. Similarly to pragmatic cognitive problems (see above), the

number and diversity of the available treatment options is limited, therefore problem-solving is by design a predefined process in terms of possible choices, which means that it is a CLOSED problem of a BROAD OR NARROW type. When it comes to determining all details and aspects of actions, therapeutic problems emerge as OPEN ORIENTED problems. Reasoning leading up to the solution of therapeutic problems is fairly complicated and includes creating and solving sub-problems, with their *explorandum* defined as a desired condition of the patient or a desired change in such condition. The recommended therapy includes action that leads (or may lead) to the desired change in the patient's condition.

IV. Due to its high complexity and uncertainty associated with the majority of medical procedures, therapy results cannot be predicted with absolute certainty and down to the smallest detail. This means that the post-treatment stage focuses on result–related problems which are highly diversified in terms of substance and structural qualities. The case is now knowledge-intensive as the physician is not only familiar with their patient's condition, but is also aware how it was supposed to change in the wake of the treatment. This knowledge may constitute, therefore, a point of departure for a variety of problems. In some cases the physician may seek to verify certain highly specific judgment, e.g. whether the treatment has had the desired effect on the patient, what are the exact changes that came into effect after the treatment or what is the general condition of the patient. These questions constitute both OPEN (UNCONSTRAINED AND ORIENTED) problems and CLOSED (BROAD AND NARROW) problems. COGNITIVE problems aside, at this stage one also encounters PRAGMATIC problems devoted to future diagnostics and therapy.

While assessing the results of the treatment, a physician must decide whether to continue or terminate the treatment. The problem is similar to one encountered at the very beginning of the medical care and boils down to the question: does the patient need help? This time, however, the decision whether to terminate the treatment must be taken on much more complicated premises.

II. SCIENTIFIC (EXPERIMENTAL) PROCEDURES

Scientific examination starts by concluding that knowledge in a given area is insufficiently certain, specific, complete, etc. At that point the scholar also has an idea how to deal with the identified shortcomings and goes on to formulate a basic research problem. It is a GENERAL problem as it concerns classes of objects rather than single objects. *Explorata* of

these problems consist of general prospositions considered to be true, being scientific theorems or laws.

Scientific problems can either EXPLORE new content or MODIFY existing knowledge. The former introduces new elements or greater specificity, the latter increases the level of certainty.

Depending on the degree of specificity set in the *explorandum*, the problem can be either an OPEN ORIENTED problem, or a CLOSED (BROAD OR NARROW) problem. The scientist seeks to establish which kind of properties (or their values) characterize the object of his interest. He may also hypothesize about the previously unknown or insufficiently examined phenomenon belonging to a larger group of phenomena. If the aim is to verify the truth-value of various claims, the problem is of broad character, if one examines only one hypothesis, the problem is of narrow character.

Experimental scientific problems consist of both purely argumentative components and observation, which means that they fall into the category of OBSERVATIONAL-ARGUMENTATIVE problems. If the basic problem is of an open (oriented) nature, the first thing one needs to do is to identify actions that enable observation of the properties one is looking for or methods for establishing their values. That is to say, one has to solve a PRAGMATIC-COGNITIVE sub-problem, thus laying out a research plan. If the basic problem aims to verify a hypothesis, the scholar must first determine which phenomena would occur if the hypothesis under inquiry was true. Those phenomena must be observable and relevant to the choice of the hypothesis or its successful verification. This step solves a COGNITIVE problem of THEORETICAL TYPE (as opposed to observation-driven problems) because it is based on premises that are not derived from observation. It is of a GENERAL-TO-SPECIFIC nature, as premises (scientific hypotheses) are general, while conclusions (problem's *explorandum*) are specific. In that case, only after solving this prior problem can one formulate and solve a PRAGMATIC-SCIENTIFIC problem, that is, determine which cognitive (scientific) action can help observe whether the assumed phenomena do, in fact, occur.

Planned research, when carried out, provides the scholar with new data about the phenomena he seeks to explore. He interprets the results of observation via SEMIOTIC reasoning (problem). While conducting an experiment or some other type of examination of natural phenomena, the scientist deals predominantly with equipment-generated results such as pictures, charts, symbols (particularly digits), etc. Mostly, those that can be treated

as instrumental signs (Doroszewski 1993) which can be further interpreted in measurement procedures. Since at that stage of the research one deals with a fixed state of affairs, the problem one is dealing with is SPECIFIC. Its *exploratum* describes properties (or values) of the examined objects, asserts whether something occurred or not, etc. The point of departure for such reasoning consists of judgments describing "indications" produced by the equipment, which also includes specific states of affairs.

The last stage of scientific inquiry leads to the solution of the primary problem, which consists of generalized judgments derived from interpreted results of observation (scientific theorems, laws, or hypotheses which, it must said, fall short of absolute certainty). These judgments reflect the desired knowledge and are usually expressed in the form of linguistic description, as general judgments that are either true or probable. They emerge as a solution to the GENERAL-TO-SPECIFIC, or inductive, problem. The premises consist of specific judgments, while conclusions are of a general nature. Today, contemporary experimental sciences, as we know, attach great importance to mathematical reasoning and description of conclusions.

CLOSING REMARKS

In the final part of the paper I shall briefly discuss theoretical and practical implications of the matter discussed in the article.

Both in scientific and practical activity, it is crucial that intellectual capabilities allow for effective a) formulation and solution of open oriented problems; b) breaking down of problems into sub-problems and synthesis of higher-order problems, as well as creation and solution of problems by embedding them in a broader context; c) choice of the level specificity for the input knowledge and *explorandum*, in line with the circumstances and specific needs.

a) It seems that for scientific research and practice open oriented problems are especially typical. They occupy a middle ground between unconstrained and closed problems, and may, to a certain extent, substitute either.

Unconstrained problems, where the *explorandum* is not preconditioned, arise when one makes an unexpected observation or the unconventional problem calls for an open-minded approach. Unconstrained problems play a major role in creative thinking. However, the sole ability to come up with original judgments cannot be at the crux of experimental or practical activity. On the other hand, closed (broad or narrow) problems, where one chooses from a limited number of rigidly defined solutions, are typical of , for

example, advanced stages of medical treatment, because their formulation requires input knowledge which is relatively extensive. Solving processes in both of these types of problems carries specific risks. One may arrive at flawed or unproductive *exploratum* (unconstrained problems) or formulate the problem incorrectly, thus precluding the finding of the appropriate *exploratum* (closed problems).

While being more or less structured and schematized in terms of possible solutions, open oriented problems nevertheless allow for some free (or even creative) thinking. The primary reason why they are so widely applicable is that the nature of their *explorandum* is not rigidly determined. It may be a value of a certain property which is not measureable against a predefined scale, for example the weight of a certain object. Solutions to such problems, via reasoning or observation, can conform with the *explorandum* regardless of the fact that the value of the given property (such as weight) is expressed through a numerical scale, interval or comparative, with only approximate precision. If the interpretation of the sign is treated as a solution to the oriented problem, then, from the pool of non-predefined phenomena that are potential correlates of this sign, one chooses only those that satisfy a specific condition. Consider, for example, a physician trying to come up with the appropriate treatment or a researcher wanting to determine what kind of experiment to conduct. They both seek to identify properties of their actions that would best suit their needs.

b) At the beginning of scientific or practical activity, one is confronted with a primary problem of finding the best path of action for reaching one's ultimate goal. Since it is closely related to the main purpose of the medical or scientific activity, one can refer to it as a medical or scientific task. In most cases, direct completion of this task, i.e. a simple solution to the problem, is not possible. It must be broken down into the main sub-problems, such as cognitive (diagnostic) problems, and executory (therapeutic) problems. Those are often divided into further sub-problems, thus creating a pattern of hierarchies and relationships. On the other hand, while creating and solving concrete problems that render immediate results, one has to bear in mind higher-order problems, since the former are sub-problems of the latter. In other words, all problems (not only in medicine) are created and solved in a broader context that also shapes more detailed problems.

Creation and solution of problems — from the basic down to the most detailed — is a thought process aimed at reaching both one's ultimate and intermediate goals. Problems must be, therefore, formulated and solved adequately to the goals one seeks to achieve. For this and other reasons, both

creation and solution processes are equally important and closely related. In practical problems, it is especially important to match content of cognitive and executory problems: *exploranda* of the former must contain knowledge that will properly serve as a point of departure for the latter. In scientific problems, one fundamental thing is to secure content that is verifiable.

c) Problems are created and solved basing on both case-related and general knowledge. Ways and means followed and used in problem-solving are, therefore, shaped not only by goals one desires to reach, but also by limitations associated with the character and scope of general and case-specific knowledge. Pragmatic problems, in turn, greatly depend on the available research and means. This can be illustrated by medical procedures. Knowledge available at the point of departure, e.g. information regarding the patient's condition used by the physician to formulate the problem, is more or less specific. Similarly, different levels of required specificity correspond with what one seeks to establish by formulating *explorandum*. This may include exploration of pathology (illness), manner of examination, route of administration, dose, etc. General knowledge possessed by physicians may vary, which means that a specialist and a general practitioner each can work under a different set of premises. Medical problems are formulated with a degree of precision required in the given case, which, in turn, is bolstered by the general knowledge of the physician. This is linked with a degree of certainty that a physician wants and can achieve in the *explorandum*. The bar should be set high enough, but it shouldn't be ambitious beyond reach. In scientific research, this is of secondary importance. Input knowledge of the researcher is very specific, usually the *explorandum* has very ambitious goals reflecting the scientist's desire to achieve the highest degree of certainty there could possibly be.

Analytical approaches to scientific and practical problems can be utilized to explore their structure, systematize and introduce greater precision to concepts, or highlight the relevant ways of reasoning. In other words, it encourages better understanding of the broad and complex issue that problem-solving is. One cannot expect, however, that analysis will provide us with exact and universal ways for the creation and solution to scientific and practical problems. Each process always has an individual touch, especially in science. Most of the problems created and solved by, and applied in, science might as well be formulated and solved by individual members of these communities in slightly different ways, while still resulting in a similar degree of success and manner pursued to reach the primary goal.

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METAPHORS IN *THE RIGVEDA*[1]

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The Rigveda was composed by Aryans, an Indo-European people migrating in waves through the mountain passes of the Hindu Kush into the area of present-day Punjab (Erdosy 1996). The process of its creation stretches to encompass the entire second half of the 2^{nd} millennium B.C.[2] *The Rigveda* is a collection of poetic hymns praising the gods, most prominently Agni, the deity of fire and poetry, Indra, the god of rain and war, and Soma, the god of the plant used in the production of a narcotic, intoxicating beverage.[3] The currently known, complete form of *The Rigveda* most probably took shape around the 7^{th} century B.C. Similarly to other ancient Indian texts, *The Rigveda* was preserved by oral tradition for more than a millennium, and was not written down until the 2^{nd} century B.C. (Gonda 1975: 18).

The Rigveda is divided into ten books — the *mandalas* (literally: "wheels" or "cycles"). The so-called "family books" (II–VII) are the oldest; the opening and final sections were composed last. The final book constitutes a commentary, directly stating what was only alluded to in the previous parts. It must be noted that despite the chronological differences, *The Rigveda* is relatively uniform, both linguistically and thematically.

[1]The present article is based on two chapters of my book *Kosmogonia Rygwedy. Myśl i metafora*, Wydawnictwo Naukowe Semper, Warszawa 2001.

[2]The composition of the oldest parts of *The Rigveda* is usually dated to around the 13^{th} century B.C. (Gonda 1975: 22–23). Witzel (1999), however, claims they were created as early as between 1700–1500 B.C.

[3]Other deities include Mitra, the god of concord, usually mentioned in tandem with Varuna, the god of royal authority, law and moral order; Brihaspati, the god of the holy word; Aśvins, the gods of dawn, Ushas, the aurora; Surya, the sun; Savitr, matutinal vivacity; the Maruts and Parjanya, the gods of storm..

The authors of the hymns made use of metaphors, and it is the metaphor that constitutes the key to *The Rigveda* – for its creators and compilers as well as for the modern-day man trying to understand its message. Analysis of the metaphors leads to conclusions consistent with those presented by cognitive linguists dealing with the metaphor, most notably Lakoff (Lakoff, Johnson 1980; Lakoff, Turner 1989). Firstly, the metaphor in *The Rigveda* is more than just a literary figure of speech: it is a way of thinking and expressing thoughts about the world. Secondly, the metaphors in *The Rigveda* are based on descriptions of everyday experience intentionally chosen by the poets.[4] The metaphors are structured according to these descriptions, so that each actual phenomenon may be precisely depicted. It is impossible to understand such metaphors, or the meaning behind them, without the framework of what Lakoff calls "experiential basis" or "the source domain" (Lakoff 1980; 1987). In the case of the metaphors in *The Rigveda*, the experiential basis is constituted by descriptions of everyday occurrences.

The present analysis attempts to trace the changes on the linguistic level of *The Rigveda*, disregarding its metaphysical stipulations that also influenced the emergence and meaning of metaphors.[5] It shall focus on two issues: the construction of metaphors describing the creation of the world (the so-called philosophical metaphors) and of metaphors arranged around one general experiential basis.

In this paper I will use the term "the source domain" to denote the concept in terms of which another concept is conceived, and the term "the target domain" to denote the concept which is conceived with use of the source domain. In cognitive linguistics such thinking which involves mapping of one concept onto another one is called the conceptual metaphor and I will treat the target domain as the meaning of a metaphor thus understood. "Experiential basis" is a more general term which refers to the experience, broadly understood, which motivates thinking about something.

I. CREATION OF THE PHILOSOPHICAL METAPHOR

The experiential basis for metaphors describing the creation of the world in *The Rigveda* is composed of three basic processes, namely the expansion

[4]The metaphors in *The Rigveda* are also constructed in the process of transforming the prevailing linguistic image of the world, expressed chiefly in myths. Indeed, the deepest contents of myths contain references to everyday experience.

[5]Information on the metaphysics of *The Rigveda* is found in my book (Jurewicz 2010).

of the Aryans, the birth of the morning light and the extraction of soma. Depictions of these processes, which shall be called "defining events", impart structure on the entire world-view in *The Rigveda*. They also form a collection of definitions on the basis of which metaphors are constructed.

All defining events involve the creation of a phenomenon crucial in life, in the broad sense of the word.[6] The resulting product is achieved through the destruction of another phenomenon, which personifies the forces that confine it.[7] In the majority of descriptions of defining events, the destruction of the confining phenomenon is accomplished by the life-giving phenomenon, making it both the cause and the result of the event.

All life-giving phenomena produce light (the aurora, the sun), or are described as either bright and luminous (desirable goods gained from expansion, soma juice) or allowing men to experience brightness (the ecstatic state resulting from drinking soma) (Jurewicz 2010). The confining phenomena are depicted in dark colours (enemies and mountains) or *are* dark (the night).[8] The general structure of defining events as described in *The Rigveda* may therefore be presented as the emergence of light from darkness. I shall apply the term "symbols of light" for the life-giving phenomena and states, while the label "symbols of darkness" is used to describe the confining phenomena and states.

A philosophical metaphor is a description of a defining phenomenon that has a metaphysical or, strictly speaking, cosmogonic meaning. The process of creation presented by means of philosophical metaphor has exactly the same structure as defining phenomena: the emergence of creation is due to the destruction of the previous state. The symbols of light and darkness are also applicable; in this case darkness and light become the symbols of the pre-creation state and the beginning of existence.

I shall demonstrate the construction of philosophical metaphors in *The Rigveda* with the example of the metaphor of seizing the treasury, which

[6]Expansion results in the acquisition of land, providing people with additional space and resources. The morning light and the sunrise result in light, warmth and the possibility to see and travel. The preparation of soma has, according to *The Rigveda*, a twofold influence: to human beings it grants health, longevity, extraordinary cognitive abilities and immortality; it is also the warrant of sunrise and rainfall in the entire universe.

[7]Territorial expansion is hindered by enemies and mountain peaks; the aurora and the sun hide in the darkness of the night, and the soma juice – within the plant.

[8]Although *The Rigveda* does not contain any specific descriptions of the stem of the soma plant, the pressing of soma juice is presented as a process of extracting light from its hiding (Jurewicz 2010: 144ff).

originates from the descriptions of territorial expansion and obtaining the goods of the enemy. In Mandala 10, Hymn 108[9] the enemy's treasury is a desirable commodity:

[Sarama says:] I come appointed messenger of Indra, seeking your ample stores of wealth, O Panis (10.108.2ab).

Paved with the rock is this our treasure-chamber; filled full of precious things, of kine, and horses. These Panis who are watchful keepers guard it. In vain hast thou approached this lonely station (10.108.7).

This scene has already been mitologised: the enemies of the Aryans, the Panis, are spoken to by the she-dog leading the army, but the underlying realities of conquest are evident. The "treasure-chamber" means a real treasury filled with all kinds of sought-for goods — "precious things, kine and horses". Describing the treasure chamber as rock-paved may also echo actual experience: precious objects and herds of cattle were probably kept in caves and niches in stone. The symbol of darkness here is the rock, while the treasure chamber is the symbol of light. It should be noted, however, that from the perspective of the cattle and the hoard, it is the treasury that represents darkness (it encloses the goods; its destruction or unlocking releases the treasure within), and the hidden goods symbolise the light. Thus, the treasure chamber may be perceived in two different ways: either as the symbol of light or of darkness.

In the following passage the treasury has a metaphorical meaning:

He [Indra] found the treasure brought from heaven that lay concealed, close-hidden, like the nestling of a bird, in rock, enclosed in never-ending rock. Best Angiras, bolt-armed, he strove to win, as 'twere, the stall of kine; So Indra hath disclosed the food concealed, disclosed the doors, the food that lay concealed (1.130.3).

The experiential basis for this description may also be traced to territorial expansion. The image of a treasury in stone is a variation of the stone-paved treasure chamber of the Panis from Mandala 10, Hymn 108. The basis is emphasised by the authors themselves, who compare Indra's discovery of the hidden treasury to a different fact of war — the seizure of pastures full of cattle. Notably, the two images correspond: the rock and the stall are symbols of darkness, whereas the treasure and the cows symbolise the light.

The treasure in this case does not, however, consist of cattle and goods, but of the sky. Finding the sky is tantamount to the emergence of

[9] All quotations from *The Rigveda* are based on the translation by Ralph T.H. Griffith (1896). Alterations are due to differences in interpretation and are marked with square brackets (translator's note).

dawn, in whose luminescence the sky starts to manifest, differentiating itself from the dark earth. The image of discovering the treasure hidden within the rock proves to be multidimensional: on the surface it refers to territorial expansion, while the deeper levels allude to a different defining event, namely the morning.

The role of the morning becomes even more evident from the fact that throughout *The Rigveda* the contents of the treasury (in this case explicitly called "the heaven") may also be used as a source domain for the sun, often called "golden" or "refulgent" (literally: "a gay-hued stone") (*The Rigveda* 7.63.4; 10.45.8; 5.47.3). The stanza describes not only the discovery of the sky illuminated by the light of dawn, but also of the rising sun, which becomes apparent when the treasure is compared to the nestling of a bird or, as the Polish translation suggests, an embryo hidden within the rock. In *The Rigveda*, in terms of birds the sun is conceived (e.g. *The Rigveda* 9.71.9; 9.85.11).

It should be noted that the comparison to the nestling bird (i.e. the sun) pertains to the entire treasury, and not — as one might expect — only to its contents. It is an example of the same tendency that was noticed in the description of a treasury full of cattle and goods hidden within a rock: a tendency to make the symbols of darkness ambiguous, allowing them, in certain circumstances, to assume the role of symbols of light. This ambiguity is particularly clear in case of the nestling bird: a hatchling does not *contain* its own mature form (in the way that a treasury contains treasure), but *constitutes* it.

The treasury compared to a nestling, or an embryo, of a bird is a source domain for a nascent form of the sun — not yet born, but already potentially present in the darkness of the night. This potential manifests itself in the brightening of the night sky, so beautifully described by the Polish phrase "już świta" ("the day is dawning"). According to the imagery of *The Rigveda*, at night the sky and the earth become one. This state is sometimes described by the metaphor of sexual union (e.g. *The Rigveda* 10.5.1). The earth and the sky beget the sun. The rock enclosing the treasury is the source domain for both an egg and the night union of the earth and the sky, the fruit of which is the sun. The concept of growing, hatching and flying into the sky implicit in the metaphor of the embryo of a bird evokes the image of the rising sun that ascends from the earth to heaven.[10] Indra's

[10]What we see here is a characteristic feature of the metaphors of *The Rigveda*. They may have many meanings; applying a given meaning reveals the hidden logic, and with it a new sense of the entire description. The understanding of this logic and

discovery of the treasure is tantamount to the destruction of the rock and the hatching of the bird. This in turn symbolises the end of darkness and the emergence of sunlight.

The description of the morning does not constitute the ultimate meaning of the metaphor of finding a treasury within a rock, but serves to express its deepest level — the description of creation. The movement of the rising sun divides its parents, the sky and the earth, thus creating the world as we know it. The life-giving nature of creation so portrayed is also made evident in the final verse of this passage (1.130.3). It contains the metaphor of opening the door to concealed food, which is also based on two defining events: territorial expansion and the dawn. In case of expansion, seizing the enemy's cattle is described as opening the enclosures (barns, corrals, pasture grounds etc.) in a more or less brutal manner. The arrival of the dawn is, in turn, portrayed as the opening of the door to cows, which symbolise the morning light (Jurewicz 2010: 99ff). It should be noted that the food mentioned in the passage may actually be milk. In this case, the metaphor of disclosing the food acquires the same threefold structure as the metaphors of discovering a hidden treasury and the nestling of a bird hidden within a rock: the door is (implicitly) concealing the cows, just as the rock ensconces the treasure chamber, while the cows are hiding milk in their udders, just as the treasury encloses the herds and the riches, or as the embryo of the bird contains its future form.

Thus the philosophical metaphor of opening a treasure chamber contains the following layers: territorial expansion, the morning and the creation of the world. Nowadays, the meaning pertaining to expansion is almost obsolete, but in order to comprehend the structure of the metaphor as a whole and to grasp all semantic subtleties of its contents, it is crucial to understand it.

Another point that becomes apparent is the way the meaning of the metaphor is being constructed throughout the stanza. The second verse reveals the basis of the metaphor — it evokes the image of pastures full of cattle, known from descriptions of territorial expansion. The hidden meaning of morning manifests itself in the fact that the treasure is "brought from heaven" and in comparing the treasury to a nestling bird (in terms of which the sun is conceived), which also uncovers the hidden meaning of the never-ending rock (verse a) — the night. The meaning of creation is visible in another metaphor with the same structure, namely the disclosing of the

discovering the other meaning is usually easier if the reader knows other myths.

door to food (verse c).

II. THE ARRANGEMENT OF METAPHORS AROUND AN EXPERIENTIAL BASIS

The descriptions of defining events constitute the framework of all metaphors in *The Rigveda*. There are, however, specific experiential bases whose influence is limited to only one or several metaphors, and does not structuralise the entire world-view, as is the case with defining events.

Specific experiential bases are objects, processes and states that one may encounter every day. They possess certain common features which, taken out of their specific context, form the general idea of an object, a state and a process. It is this general idea that comprises the experiential basis for the metaphor. It refers to what Lakoff calls the "basic level" — the level of description closest to our minds, which constitutes the central level of taxonomy (e.g. dog), below the superior level (e.g. animal) but above the subordinate level (e.g. poodle) (Lakoff 1987: 46, *passim*). Metaphors organised around a general experiential basis are also grounded in specific bases. The processes, phenomena and states conceived metaphorically have things in common with their experiential bases, both in general and specific. In Lakoff's terms, there is an ontological correspondence between the source domain and the target domain of the metaphor, i.e. between the concept which lends its categories and the concept which is conceived in terms of them (Lakoff 1987: 386–387).

I shall now focus on a group of metaphors grounded in the general experiential basis of purification through heating. As I decided to disregard the metaphysical layer of *The Rigveda*, the Sanskrit word *agní*, meaning both fire and the god thereof (Agni) shall only be translated as "fire" and the word *sóma*, denoting both the god and the intoxicating beverage, shall be translated as "soma". This way, the linguistic processes constituting the main subject of the present analysis may become more visible. I hope to be able to demonstrate how experience, on which the metaphor is based, structuralises the phenomenon described, emphasising some features and concealing others.

1. THE METAPHOR OF CLEANSING

The Sanskrit root *måj-* — literally: "to clean, to cleanse, to polish" — has the following figurative meanings. Firstly, it is used to denote the pressing of the soma plant in handmills or filtering the extracted juice through fleece:

Men beautify [polish: *måjanti*] him [soma] in the vats, him worthy to be beautified, Him who brings forth abundant food (9.15.7).[11]

Secondly, it has the meaning of starting a fire:

I make his back to shine [I polish: *sám mÁrjmi*], with chips provide him; to offer food and with my songs exalt him (2.35.12cd).

Both these seemingly unconnected actions have a common result: the substance and the phenomenon that emerge have certain qualities in common. The filtering made the soma juice clear and translucent and gave it a hue described in *The Rigveda* as yellow, golden, red or brown. Kindling the fire brings forth a bright flame, which has the very same colour as the soma juice (yellow, golden, red and brown) and — according to *The Rigveda* — is both clean and purifying.

The Rigveda reveals the experiential basis for the metaphor of cleansing. Both fire and soma juice are frequently called "a steed" or compared to one. Those descriptions of kindling and extracting juice, which contain the metaphor of smoothing, also include references to horses.

This Singer excellent at sacrifices, [fire] the Priest, they glorify with homage. Him who spread out both worlds by Law Eternal they balm with oil [they polish: *måjanti*], strong Steed who never faileth (5.1.7).

[Soma] Whom, having passed the filter, ten dames cleanse [polish: *måjánti*], as 'twere a vigorous steed; While he disports him in the wood (9.6.5).[12]

It may be assumed that the experiential basis for this metaphor comes from grooming a horse. This activity, though significantly different from kindling the fire or extracting soma juice, is similar to the latter two processes in the fact that it results in a clean, shiny product.

The root *måj-* has one more figurative meaning, namely that of understanding. Creative, poetic thinking is described in terms of polishing inspired thoughts.

For Indra, who is Lord of old, the singers have decked [polished *marjayanta*)] their lauds with heart and mind and spirit (1.61.2cd).[13]

[11] *måj-* , denoting starting a fire: *The Rigveda* 1.60.5; 3.18.4; 7.3.5; 10.122.5. *måj-* meaning the pressing of straw: *The Rigveda* 1.135.5; 9.6.5; 9.15.7; 9.17.7; 9.68.7.

[12] *måj-* used in a description of kindling the fire compared to a steed: *The Rigveda* 4.15.6; 7.3.5. *måj-* used in a description of extracting soma juice compared to a steed: *The Rigveda* 9.6.5; 9.17.7; 9.29.2; 9.63.17; 9.85.7.

[13] See: *The Rigveda* 1.95.8; 9.47.4. Fragments 10.39.14 and 10.167.4 talk of decking (i.e. adorning, cleansing) a song of praise. *måj-* meaning intellectual activity appears in the description of the Angiras — the mythical ancestors of humankind, who create the world by getting to know themselves. The accounts of the deeds of the Angiras

According to *The Rigveda*, poetic cognition was achieved under the influence of the intoxicating soma juice. Therefore, soma is sometimes considered to be the causative factor of mental polishing:

Seer and Sustainer, he himself desireth riches for the sage; When he embelisheth [polishes: *marmåjyáte*] his songs (9.47.4).

The nature of intoxication resulting from drinking soma juice may explain why it is described by metaphors based on the experience of making an object shiny and bright. The descriptions included in *The Rigveda* suggest that visions of light were a characteristic part of inebriation with soma (e.g. fragments 8.48.3; 9.106.4; 9.109.11). As it turns out, *The Rigveda* describes cognition as an activity similar to kindling fire and extracting soma juice.

This similarity becomes even more apparent when we take into account that fire is also mentioned as a causative factor of mental polishing:

[The fire] makes him a most noble form of splendour, [polishing] him in his home with milk and waters. The Sage adorns [polish: *marmåjyate*] the depths of air with wisdom [...] (1.95.8ac).

According to *The Rigveda*, drinking soma juice results in a feeling of warmth, which was probably considered the starting point of gaining knowledge and expressed with the metaphor of a fire burning within a person (e.g. *The Rigveda* 8.48.6). It should be noted that kindling the fire may be seen as heating the flame hidden within the drill or the flint-stone. Moreover, although we lack empirical confirmation, *The Rigveda* presents the extraction of soma juice as a process of heating.[14] It may be concluded that the three processes that form the meaning of the metaphor of cleansing are similar to each other and to the activity that constitutes the experiential basis for this metaphor. The structuralising influence of experience on the description of the occurrence becomes clear: similarities between the experiential basis and the phenomena described by the metaphor (the target domains) are emphasised, while their differences are disregarded. Noticing the differences (especially those between the target domains, e.g. kindling the fire and

often contain the metaphor of releasing cows from their stone enclosures, which derives from descriptions of territorial expansion. Here the rock represents both ignorance and the state of the world before creation began. In terms of cows thought and speech are conceived, the speech to describe it and the emerging world. *The Rigveda* 4.1.4a mentions the Aógiras: "polishing themselves by breaking the rock."

[14]The container for filtering soma was placed in the hearth (e.g. *The Rigveda* 1.160.3; 9.67.23-24), mixing soma juice with milk is sometimes referred to as cooking (e.g. *The Rigveda* 9.11.6; 9.46.4; 9.1.9). In later tradition, offerings of soma are included into cooked offerings, though it is not *de facto* heated up (see: Malamoud 1996: 39).

extracting soma juice) is the next step in understanding the metaphor, which leads to metaphysical conclusions.

2. THE METAPHOR OF CLARIFYING BUTTER

The causative influence of fire on human cognition is accurately depicted in another metaphor — that of clarifying butter (to obtain ghee). *The Rigveda* uses it frequently to describe the visions that come as a result of drinking soma juice: the stream of melting butter symbolises a thought that begins to clarify, allowing a clearer and more detailed image of reality:

From inmost reservoir in countless channels flow down these rivers which the foe beholds not. I look upon the streams of oil [melted butter: *ghRitásya*] descending, and lo! the Golden Reed is there among them (4.58.5).

The process of clarifying butter involves heating it — treating it with fire.

Subsequent stanzas of this hymn suggest that the metaphor of clarifying butter may also mean the preparation of soma and the kindling of fire (Jurewicz 2010: 238ff). As opposed to the metaphor of cleansing, which derives its meaning from the comparison of soma and fire to a horse, the metaphor of clarifying butter has a clearly visible experiential basis: most probably soma juice was mixed with butter; oil was also poured on the fire to feed it.[15] As it has already been mentioned, the authors of *The Rigveda* had a tendency to grant an ambiguous nature to symbols of darkness, which enclose or give birth to symbols of light. This may be the reason why soma and fire were identified with the melted butter that was poured into them.

An interesting example comes from fragment 10.122.7, which may be considered proof that the authors of *The Rigveda* strived to unify the meanings of the metaphor of cleansing and the metaphor of clarifying butter:

They who at flushing of this dawn appointed thee their messenger, these men have paid thee reverence. Gods strengthened thee for work that must be glorified, while they made butter, [oh fire], pure for sacrifice (10.122.7).

Making butter pure means melting the butter used as fuel for the fire. What should be noted here is the fact that the vocative "oh fire" is placed directly after the word describing the butter, as if the author wanted to identify both the kindled fire and the ghee. In this case the semantics of the root *måj-* would include both clarifying butter and kindling the fire.

[15]The mentioned fragment 5.1.7 talks of polishing the newly kindled fire with melted butter. The custom of mixing soma with melted butter may be inferred from fragments 9.82.2; 9.96.13 and 10.29.6.

3. THE METAPHOR OF SOAKING WITH MELTED BUTTER (GHEE)

The semantic similitude of the metaphors of cleansing and clarifying butter may be justified with the correspondence of their experiential bases: clarifying butter has a similar effect to grooming a horse — the resulting ghee is bright and luminous, just as a clean horse's back. The validity of seeing such a correspondence is confirmed by *The Rigveda* itself. It uses the image of soaking with melted butter to express sweating. Fire is often portrayed as a horse gleaming with ghee:

Never decaying, seizing his appropriate food, rapidly, eagerly through the dry wood he spreads. His back, as he is sprinkled [with butter], glistens like a horse: loud hath he roared and shouted like the heights of heaven (1.58.2).[16]

The sweaty back of a horse is shiny and smooth, just like the back of a freshly groomed steed. It may therefore be assumed that grooming and sweating have the same effect. Thus the metaphor of soaking with ghee carries the same concept of glistening and smoothness as the metaphor of cleansing and the metaphor of clarifying butter. The activities that form the experiential basis for all three metaphors are also similar in the fact that all these processes whose result is due to heating: grooming a horse involves brushing, which makes the animal feel warm; clarifying butter involves melting it on the fire; animals and people sweat when they are hot. It should also be noted that sweating is a purifying process.

The target domains s of the metaphor of soaking with ghee also correspond with those of the metaphors of cleansing and of clarifying butter. The similarities are very clear when it comes to the meaning of kindling the fire and extracting soma juice. One may even wonder whether the descriptions are meant to evoke any metaphor at all: a flame sprinkled with oil does indeed shine with it, and so does soma mixed with butter. Soaking with ghee can also be used to conceptualise gaining knowledge, as it is sometimes applied in describing people:

O Lords of splendour, aid us through the Three-times-Seven, as we pour holy oil [soak with melted butter: *ghRitaścútas*], O Indra-Varuna (8.59.5cd).[17]

[16] Agni whose back is soaking with melted butter: *The Rigveda* 5.4.3; 5.14.5; 5.26.2; 7.2.4; 10.122.4. Agni's horses glistening with melted butter: *The Rigveda* 1.14.6; 3.6.6.

[17] The newer parts of *The Rigveda* contain another variant of this metaphor, namely the image of people dripping with hot milk (fragment 10.67.6-7). The process that constitutes the experiential basis for this metaphor corresponds to the experiential bases of the metaphors discussed above, as it also involves heating a substance in order to obtain its desired form.

The phrase: ”pouring holy oil” refers to sweating that results from the hard work of kindling the fire or from drinking the warming soma juice — i.e. from feeling the heat. Drinking soma brings not only warmth, but also cognition. Knowledge is the most important aim of intoxication, therefore sweating becomes a symptom of gaining cognition. Thus the image of people who soak with melted butter conveys the meaning of extending one's knowledge.

It seems justified to assume that the use of the metaphor of soaking with melted butter to conceive cognition is a variant of the metaphor of clarifying butter. Given the warming influence of soma juice, sweat may be considered an external symptom of gaining knowledge. And since in terms of ghee both thought and sweat are conceived, the meaning of the metaphor of clarifying butter may include all aspects of the cognitive process — internal and external – by presenting the image of heating up inner thoughts and their overflowing in the form of perspiration.

4. THE METAPHOR OF SHARPENING

Another metaphor which belongs to the same group as those already discussed is the metaphor of sharpening. In the following fragment in terms of sharpening, blowing into the fire, i.e. kindling, is conceived:

Whose flames, when thou art sending forth the smoke, completely reach the mark, When Trta in the height of heaven, like as a smelter fanneth thee, e'en as a smelter sharpeneth thee (5.9.5).

Archer-like, fain to shoot, he sets his arrow, and whets his splendour like the edge of [bronze] (6.3.5ab).

In one fragment fanning the fire, metaphorically conceived as sharpening, is called decking (i.e. cleansing, polishing). It may be interpreted as a tendency to unify the meanings of the two metaphors:

The men have decked him both at eve and morning, Most Youthful [fire], as they tend a courser. They kindle him [they sharpen him: *niśíśānā*], a guest within his dwelling: bright shines the splendour of the worshipped Hero (7.3.5).

The experiential basis for the metaphor of sharpening is an activity that also involves heat and rendering an object more shiny, bright and smooth — just as in the case of grooming a horse, clarifying butter and sweating. It may even be argued that these activities are also similar in the fact that they result in a translucent object/substance: well-sharpened metal is almost transparent.

The following fragment proves that associating the metaphor of sharpening with the metaphor of clarifying butter is justified. Here the process of preparing an offering is referred to as "sharpening":

Oblations meant for you had been made rady [sharpened: *niśitāni*]; these have we set aside: for this forgive us (1.171.4cd).

If the offering consists of soma, then the metaphor of sharpening means extracting the juice. If what is being offered is milk, the metaphor means cooking it, and if it is ghee, what is meant by "sharpening" is in fact the process of clarifying. Thus the metaphor of sharpening gains the general meaning of heating and — in most cases — purifying. It should also be noted that all these activities are conceived with the metaphor of clarifying butter. I have already demonstrated that it can mean extracting soma juice. The meaning of cooking reveals itself in two ways. Firstly, the idea of melting butter involves the concept of cooking. Secondly, there is the second variant of the metaphor of soaking with melted butter, namely the metaphor of perspiring hot milk (*The Rigveda* 10.67.6–7; see: footnote 32). This is another method of conceiving the process of cognition — as inner heating and producing sweat. It points to the fact that *The Rigveda* postulates a correlation between melting butter and cooking milk.

Fragment 10.76.7 describing the extraction of soma juice, includes the metaphor of cleansing the offering with one's lips:

The Stones press out the Soma, swift as car-borne men, and, eager for the spoil, drain forth the sap thereof; To fill the beaker, they exhaust the udder's store, as the men purify [polish: *marjayanta*] oblations with their lips.

This stanza offers a good example of how the authors of *The Rigveda* created new metaphors and broadened the meaning of old ones. The first three verses of the passage quoted above describe the process of extracting soma juice. The meaning of the first verse is very literal (except for the comparison to car-borne men, which evokes the image of carts and their drivers). The next two verses contain the metaphor of milking a cow (a cow being milked is an androgynous symbol, as it also denotes a bull seeking out a cow). The final verse depicts people who purify the offering using their lips, which is in fact a combination of several metaphors whose experiential basis comes from the process of cleansing. The basis allows us to understand the meaning of the image of men purifying the offering with their lips in the following manner: the way the metaphor is introduced (with the use of a comparative particle) suggests that its meaning is the same as in the case of the metaphor of milking — in these terms extracting soma juice is

conceived.[18] This view is further corroborated by the fact that the offering mentioned in this fragment consists of soma, and that the metaphor of purifying has the meaning of extracting soma juice (see above). Purifying oblations with lips must therefore mean pressing soma. It may simultaneously denote the kindling of fire, as it is one of the meanings of the metaphor of cleansing (see above), as well as of the image of lips, associated with the meaning of the metaphor of sharpening — namely blowing into the fire. Thus, it may be surmised that in terms of purifying oblations with lips both the kindling of fire and the extraction of soma juice are conceived.

Consequently, the metaphor of milking a cow and the metaphor of purifying offerings with lips may have a common scope of meaning, as the target domain of both is the pressing of soma. This conclusion, together with the metaphysical assumptions of *The Rigveda* (according to which fire and soma are basically the same thing; Jurewicz 2010: 195ff, 321ff *passim*) signalises that the metaphor of milking may also mean kindling fire. This meaning finds its confirmation in the fact that in *The Rigveda* milk hidden in the udders of a cow is sometimes identified with fire (Jurewicz 2010: 216ff).[19]

The metaphor of sharpening is never used to conceive the extraction of soma juice. *The Rigveda* does, however, contain a metaphor of sharpening horns, which presents the kindled fire and the extracted soma juice through the image of a bull sharpening its horns. This depiction evokes the idea of becoming cleaner, brighter and more translucent by means of kindling or pressing (*The Rigveda* 5.2.9; 8.60.13; 9.87.7). It is also possible that the meaning of pressing soma may be conveyed by the metaphor of sharpening a thunderbolt (*vájra*), identified with soma juice (*The Rigveda* 55.1; 8.15.7; 8.76.9; 10.153.4).[20]

The metaphor of sharpening is, however, clearly understood as meaning cognition. Mental powers are often depicted as "being sharpened:"

Sharpen this song of him who strives his utmost, sharpen, God Varuna, his strength and insight [. . .] (8.42.3ab).

A song being created is a song being sharpened, as one sharpens a battle axe. Again, this scene brings to mind the image of blowing air onto the fire

[18]The metaphors that allow us to understand the meaning of the metaphor of seizing a treasury are introduced in the same way.

[19]The mentioned passage 10.67-7 that contains the metaphor of sweating with hot milk depicts the Angiras as seeking milk which is fire.

[20]Indra's thunder is very clearly identified with soma in fragment 9.72.7. See also: *The Rig Veda* 3.44.5; 9.47.3; 9.111.3.

in the process of smelting:

Aśvins, these hymns that struggle to approach you, sharpen ye like an axe upon a whetstone! (2.39.7cd).

The cognitive meaning of this metaphor becomes even more apparent in the fact that soma is considered a "sharpening" factor: *The Rigveda* 10.108.8 describes the Angiras as "[sharpened] with soma" (see also: *The Rigveda* 7.104.19). Knowledge may also be depicted as resulting from fire – it is the element that sharpens a man:

Give riches to the sacrificer, O Most Wise [fire], for thou art he who granteth wealth. Inspire with zeal [sharpen: *śiśīhi*] each priest at this our solemn rite; all who are skilled in singing praise. (7.16.6).[21]

The metaphor of sharpening also appears in descriptions of gaining cognition, where fire is not so much the cause, as the result — the phenomenon revealed by the process.[22]

I balm with oil the mighty Raksas-slayer; to the most famous Friend I come for shelter. Enkindled, sharpened by our [intentions], may [fire] protect us in the day and night from evil (10.87.1).

The metaphor of sharpening something with one's intention may have a more literal meaning, expressing the efficacy of the intention to kindle the fire: it is so effective that it may be considered the incendiary factor. At the same time, the metaphor describes the process of gaining knowledge, simultaneous with the external activity of kindling the fire (indeed, these two processes may constitute but two aspects of the same phenomenon — the manifestation of fire in a hearth and in a human being).

5. THE METAPHORS OF PURIFYING GOLD AND BALMING, ANOINTING WITH BALM AND LICKING

The last metaphor from the group described in the present article is the metaphor of purifying gold. Although in *The Rigveda* it appears but seldom, the metaphor has been elaborated upon in later texts, where it is usually used to conceive cognition. The experiential basis for the metaphor comes from an activity similar to those forming the bases for previously discussed metaphors – one that involves heating an object in order to make it brighter,

[21]See also: *The Rigveda* 3.16.3; 3.24.5; 6.15.19. In fragment 4.5.4 the concept of sharpness is associated with heat.

[22]Other metaphors from this group also denote the act of discovering fire and soma. Cleansing as a source domain for mental activity revealing fire and soma appears in fragments 2.35.4 and 9.2.7, whereas the metaphor of clarifying butter is included in fragment 4.58.

cleaner and shinier. The stanza quoted below contains the metaphor used to evoke all three of its target domains: primarily the process of extracting soma juice and cognition, but also kindling the fire. This last meaning becomes apparent due to the reference to the metaphor of the descendant of the waters (Jurewicz 2001: 342-344):

They balm him, balm him over balm him thoroughly, [lick the intention] and balm it with the meath. They seize the flying Steer at the stream's breathing-place: cleansing with gold they grasp the Animal [in these waters] (9.86.43).

Ghee and gold are similar in colour (in fragment 4.58.5 one of the forms of melting butter is called "golden"). *The Rigveda* describes soma, fire and the horse in terms of which the kindled fire is conceived as golden or of golden hue.[23] It also suggests a correspondence between the experiential bases of the metaphors of purifying gold, cleansing, clarifying butter and soaking with ghee: all of these actions are performed on golden substances/creatures. Verses a and b introduce the metaphor of balming and licking an intention, which stems from the experiential bases of men anointed with balm and calves or colts being licked clean by their mothers. The metaphor of anointing with balm and licking enables us to conceptualise cognition, depicting it as a laborious process of shaping thoughts, which results in a clear, lucid understanding of the situation. (I assume that a similar image is brought to mind by the English metaphor of "polishing a text"). As the word "intention" is often figuratively used to mean soma and fire, the metaphor of anointing with balm and licking may also refer to extracting soma juice and kindling the fire.[24] Thus, its scope of meaning corresponds with all of the previously discussed metaphors. The process of licking an animal is similar to that of grooming a horse, which constitutes the experiential basis for the metaphor of cleansing. The correspondence of the experiential bases for the metaphors of purifying gold and sharpening an object is even more apparent, as in both cases the process has to do with metal.

This group of metaphors (cleansing, clarifying butter, soaking with melted butter, sharpening, purifying gold and anointing with balm and

[23]The term *hári* used to describe fire and soma (e.g. *The Rigveda* 1.95.1; 9.103.4; 9.80.3) means "golden/yellow" and constitutes a periphrastic designation of a horse.

[24]Fire and soma are called "intention" e.g. in fragments 1.77.3; 3.11.6; 9.107.3. Their creation is symbolically depicted as the birth of a calf or a colt, licked clean by their mothers, e.g. in fragments 2.35.6,13; 9.95.57; 9.100.1,7. Mental capacities also appear as the subject in the metaphor of licking, which evokes the image of a calf/colt and has the meaning of extracting soma juice and gaining cognition, e.g. in fragments 9.85.11 and 9.86.31,46.

licking) bases on similar experiential bases and shares the meaning of kindling the fire, extracting soma juice and gaining cognition. The source domains of these metaphors include: grooming a horse, melting butter, sweating, sharpening metal tools, anointing a man and licking a newly-born colt or calf. All of these processes include cleansing and heating. Their recipients are both inanimate objects (butter, metal, gold) and living creatures (horses/colts, calves, humans). All of them symbolise fire, soma juice and thoughts. Kindling the fire, extracting soma juice and gaining cognition are the target domains of all the mentioned metaphors.

It should be emphasised that although these metaphors share the same scope of meaning, each of them has more and less typical denotations. What is more, some of these metaphors communicate unique meanings.

1. The metaphor of cleansing has three equivalent target domains: kindling the fire, extracting soma juice and gaining cognition.

2. The metaphor of clarifying butter is used primarily to conceive gaining cognition. The meanings of kindling the fire and extracting soma juice are secondary.

3. The metaphor of soaking with melted butter has the following target domains: kindling the fire, extracting soma juice and sweating. This last target domain, unique to this metaphor, becomes the source domain for its fourth target domain, that of gaining cognition.

4. The metaphor of sharpening is primarily used to conceive kindling the fire and gaining cognition. The meaning of extracting soma juice is weakest and may only be noticed through associations with other metaphors (made either by the author or by the readers themselves).

5. The metaphor of purifying gold primarily means extracting soma juice and gaining cognition. The meaning of kindling the fire becomes apparent only through associations with other metaphors (made either by the author or by the readers themselves).

6. The metaphor of anointing with balm and licking has the meaning of gaining cognition, kindling the fire and extracting soma juice.

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