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THE FORMAL PRINCIPLE OF INCONSISTENCY
IN LOGIC AND NATURAL LANGUAGE

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The formal principle of inconsistency in logic, in the form in which it comes from Aristotle, asserts that two contradictory judgments are not both true. Since the 20th century logic has progressed towards ever higher formality, it might be more suitable to say that inconsistent sentences, rather than judgments, cannot be both true.¹ The universally accepted and lectured classical calculus of sentences² adopts this principle without reservations. Some of the more recent logical systems are limiting the scope of its applicability, and also the natural language in which we daily express our judgments and inferences accepts in some cases a simultaneous occurrence of contradictory sentences. This text sets out to present a brief and simplified outline of this state of affairs. The systems of logic that accept inconsistencies and the related issues concerning natural language will be presented against the (vaguely sketched) background of classical logic.

LOGIC
SENTENTIAL CALCULUS

¹See Jaśkowski 1948: 60. Jaśkowski stresses, however, that the principle of contradiction that refers to sentences must be appended with a constraint rule that what is meant is the truthfulness "on account of the same language" or "given the meaning of the words appearing in these sentences is the same." These remarks obviously cross the boundaries of purely formal syntagmatics and bring us closer to the original Aristotelian version (Marciszewski 1988: 157).

²The term, even though broadly accepted, is inappropriate in the sense that it pertains to systems formed in relatively recent times (late 19th century). Ancient and medieval European logic is distinguished from "classical" and is called traditional.

Let us start with the contradictions in logic. Within its limits, the "natural environment" for the occurrence of the principle of inconsistency (traditionally formulated as a negated conjunction of inconsistent sentences) is the sentential calculus. Classical logic accepts the principle as binding, so any contradictions within the logic must be rejected as false. If the authors of alternative logical concepts want to change that, they must meet rather complex difficulties as the rejection of the principle violates a network of interdependencies it is caught up with. The main technical problem that makes it hard for inconsistency to be introduced into the system of making inferences is the danger of causing the so-called overflow. A logical system is affected by overflow if we are forced to recognize all the sentences that occur in it as true. (It resembles a situation where somebody answers all yes/no questions³ with "yes"). Such a situation is the case along with classical logical laws, when there occurs within a system a contradiction or any (other) falsity that has been accepted (considered true). This is related to an interpretation of the implication functor, accepted in classical logic: in connecting two clauses, the first (antecedent) being false, the functor results in a true sentence, irrespective of the value of the other component clause (postcedent); in particular, any implication is true, whose antecedent is a conjunction of contradictory sentences. Any logical system admitting one contradiction within its propositions must then modify its laws in such a way as to prevent overflow.

The method of the modification applied allows the classification of these kinds of logics (the so-called paraconsistent logics). One of these is presented by Graham Priest and Richard Routley (1984, 1989)⁴. The three types of paraconsistent logics identified might be tagged: non-adjunctive, positive plus and relevant. The differences between them concern the interpretation and possibilities of using conjunctions, and thus the mechanisms of inference, too. The following notes are brief characteristics of the three types of logic. The so-called dynamic dialectical logic situates itself beyond the classification, and will be briefly discussed later on.

The distinctive feature of the non-adjunctive logic is that a recognition of any two sentences does not entail the recognition of their conjunction. The pioneering discursive logic by Stanisław Jaśkowski (1948) does not undergo overflow if two interlocutors express inconsistent opinions separately. Overflow occurs only when one interlocutor speaks for the conjunction of inconsistent sentences, introducing the so-called conjunctive inconsistency (as opposed to the non-adjunctive one)⁵ to the discourse. Thus a possibility of the system overflowing upon the conjunctive law of overflow (which Jaśkowski calls the conjunctive form

³That is, settlement/decision questions (see e.g. Szymanek 2001: 260).

⁴See: somewhat different classifications in Priest (1988); *cf.* Marconi (1981).

⁵The occurrence of inconsistent sentences in conjunction is a matter of strong inconsistency, also called collective and conjunctive; if the inconsistent sentences are not in conjunction, we speak of weak inconsistency, also called adjunctive and distributive

of Scotian Law) becomes limited.⁶

All utterances by the participants are appended by discursive assertion, that is, a modal functor of possibility or a note "in the view of one of the participants..." Also, Jaśkowski introduces a non-standard implication appending the antecedent with a discursive assertion and the postcedent with ordinary assertion. This understanding of implication (discursive assertion) allows for the blocking of the implicative form of the law of overflow, and at the same time it allows for the application of the rule of detachment [based on *modus ponens*] to interlocutors' propositions. The downside of Jaśkowski's logic includes its inability to freely create the conjunction of premises, expressed by the interlocutors separately, which considerably limits inference within the logic.

Positive plus logic is a positive fragment of intuitionistic logic that is enriched (contrary to its name) in the functor of specific "negation" (Priest, Routley 1989: 176-177). The theses formulated by Newton da Costa, that define a new functor with an old name, do not allow for an identification of extensional interdependencies between the logical value of a sentence, its negation and the negation of its negation. It is known from the given conditions, however, that a sentence and its negation can both be true, and at least one of those is always true. Therefore, a modified negation does not form an inconsistency with a relevant assertion — it forms subcontraries, and the principle of inconsistency is not a proposition of positive plus logic. These properties make some authors fail to recognize the functor da Costa introduced as negation (Priest, Routley 1989: 163-165). Da Costa's logic is also different from classical logic in that in connection with the changes concerning negation, a number of inference laws, such as *tollendo tollens*, fail within it (Priest, Routley 1989: 165).

The paraconsistent relevant logic retains classical conjunction and negation. Relevant implication, in its approximation of common inferential intuitions, requires that there be a substantive connection between the antecedent and postcedent — the possibility of overflow is largely limited in relevant logic. This logic is also different from the ones mentioned before in its introduction of a novel logical value. A sentence may not be true only, not false only and not only true and false at the same time: it may have the value "paradoxically inconsistent," that is, "true and false at the same time."

Dideric Batens's dynamic dialectical logic is different from the previously discussed static calculi in that it adjusts to the actual discourse situation. Acting upon a consistent set of premises, Batens's logic behaves like classical logic (Batens 1989: 190). Its application to inconsistent data results in no overflow, although

(Poczobut 2000: 335).

⁶The law of Duns Scott (the law of overflow) enables us to infer any sentence from a pair of inconsistent sentences. Its conjunctive form is this: *if [P and Not(P)], then Q*. The alternative implicational form: *if P then [if simultaneously also Not(P), then Q]*.

in a situation like this some inference rules used within it are blocked. Batens divides the sentences appearing in a proof into those that behave consistently at a given stage of proof (either only those with a negation mark or those without it only appeared in it as proposition), as well as those that behave inconsistently (both proposition and its negation is a proposition in a proof). If there appears an inconsistency in proof (even in the sense of non-adjunctive inconsistency), that is, if it will turn out that sentence p behaves inconsistently, it causes the elimination from the proof of those lines which were only formed because so far sentence p was treated as one that behaves in a consistent manner (the rule of dynamic logic is the "presumption of consistency" — the behavior of a sentence is treated as consistent until the moment it might turn out not to be so). This is facilitated by the modified manner of writing the stages of the proof: the standard four columns of annotation (ordinal number, newly included formula, preceding formulas, used in a given step, respective inference rule) are supplemented by Batens with a fifth column : it lists the sentences whose consistent behavior conditions the validity of the step.

PREDICATE CALCULUS

There is at least one more place in the coursebooks of logic, where there is a talk of contradiction (although no principle of inconsistency is formulated there). This point is the logic square, where sentences in the pairs SaP-SoP and SeP-SiP are determined to be mutually inconsistent. There is no formal interpretation of negation in those, but they are considered contradictory as they describe irreconcilable (as is usually admitted) states of affairs.

In these contradictions, two issues converge, connected with another two or three of the traditional interpretations of logical inconsistency (the first, logical one, was discussed before). On the one hand, the inconsistencies can be explained by making a reference to the ontological principle of inconsistency: the same cannot simultaneously be and not be; on the other hand, one can refer to the psychological version of the same principle which has it that the same thing cannot at the same time have a property and not have it. In the psychological variant I suggest skipping what is psychological and instead to focus on the impossibility of a co-occurrence of a quality and its deficiency. This procedure seems legitimate on several counts. First, it is not known why it is in relation to qualities that the psychological impossibility is supposed to obtain and why, as we can imagine, our imagination has broader skills when it comes to truthfulness and existence (even if special treatment were to pertain to the two as transcendentals, the list of the marked ones needs supplementing). Second, the justification of the psychological proposition arouses doubts.⁷ Third, having a conviction can be treated as a mare

⁷A criticism of this proposition can be found as early as Husserl (Husserl 1973).

feature of the cognizing subject (Poczobut 2000: 99). Fourth, one can have justified doubts whether the Polish translation appropriately renders the thinking of the Stagirite (Stuchliński 1994).

If we decide to make a similar change, the interpretations will enable a recognition, in the inconsistencies of the logic square, of the inconsistency of being vs. non-being and it having vs. non-having a given property. Each of the inconsistent pairs, written in the language of quantifiers, will clearly pertain to existence and property and also, using De Morgan's laws, it may be in many ways portrayed as a pair made up of a sentence and its negation.

NATURAL LANGUAGE

One can spitefully say that in the case of natural language the issue of inconsistency is much easier and much more complex than in classical logic. It is simpler because in natural language the issue of overflow does not exist on account of the lack of such rules of inference that might cause it. Discursive inconsistency is ubiquitous in natural language and although we are able to link facts, we know that not all opinions need to be treated seriously. Therefore, we use a selective non-adjunctive logic. The speakers and the scientific theories that get affected by inconsistency do happen and we tend to lend them a ready ear by omission or because better solution, but we do not recognize, and neither does relevant logic, an absolute law of everything being inferred from inconsistencies. Deceived, we attempt to reverse the decisions previously made upon a conviction of somebody being honest, which happens in dynamic dialectical logic. Paradoxes of the sort of the paradox of a liar simply exist and tend to be treated as a kind of harmless joke.⁸ Therefore we apply an additional category of judgment: paradoxically inconsistent. Natural language probably betrays all the features thanks to which particular paraconsistent logics avoid overflow. The issue is much more complex because both conjunction and negation, which occur in it, as well as the mechanisms of inference — other than "the same" elements in classical logic — elude a detailed description.

The following part of the sketch will skip a number of issues worth considering within our topic and will focus on some aspects of the conjuncts of negation and conjunction (that build the conjunctive inconsistency) as well as the mechanisms of inference in natural language. It would be more convenient to retain in this part of the paper a division between issues of connecting sentences into compound ones, and smaller syntactic elements into concatenations. However, the boundary that divides a compound sentence from a single clause is far from clear.⁹ Also, it is not exactly obvious how to make a distinction between sentential and

⁸K. Ajdukiewicz (1985a) wrote of these paradoxes as jokes in 1931.

⁹Discussion on that issue is beside the topic of this paper; see Saloni, Swidziński (1985), Nagórko (1996).

non-sentential negation (Pietrzak 1999: 9-10, 23-24, 33-34). Further remarks will concern (just as the above on logic) the connectors of conjunction and negation understood as functors, having sentential arguments, and attempts to describe the mechanisms of inference.

Starting from the inter-sentential conjunct "and:" it is apparently identical with the corresponding logical functor, it creates a compound sentence from two component clauses, but the sentence thus formed is true only when both clauses are true (to ignore the issue of difficulty judging the veracity of such figurative sentences as "he is on cloud nine"). However, there are serious differences between these.

A logical conjunctive connector is an extensional connective and therefore can connect any sentences irrespective of the situational context. It is very different regarding natural language¹⁰ — contrary to what is suggested by some misleading terminology¹¹. The *Encyclopedia of General Linguistics* says that it is incorrect to connect with a co-ordinating conjunct, such as "and," sentences that are not related to each other in content (Polański 1995: 502-503). One can agree that such a relation need not to be implied by the literal meanings of sentences, but it may originate from the structured situation of discourse, and even the sentence "Robin is a mammal that hunts at night and $2 + 2 = 4$ " can imaginably be accepted in some sort of context. Still, the very fact that for any sentence such a peculiar context would be necessary indicates that we are not dealing with an extensional conjunction in the logical sense of the term. The same sentence needs no special context to be accepted in the language of extensional logic.

In the case of logical extensional connectives, one can freely (in any sentence and at any time) replace in the existing complex sentence its particular component sentences with others provided that one replaces a true sentence with another true

¹⁰The examples will concern Polish, which to my knowledge does not affect the conclusions.

¹¹Linguists use the terms "extensional" and "intensional" more readily in relation to sentences than to conjunctions (logicians used those in relation to both these groups and also to whole languages); cf. Urbańczyk (1991: 397) (*ibidem* a note stating the existence of a difference between the meaning of the terms as used in linguistics and logic); Nagórko (1996: 205-206); Grzegorzczkowska (1998: 98). In the latter, the added difficulty is the fact that the terms "extensional" and "intensional" are only used to denote two in three types of hypotactically connected sentences rather than — which is the case in logic — two complementary wholes. Cf. usage of these terms in relation to negation (Antas 1991: 26 and next).

The terminological confusion dates back to 1962, when Tadeusz Kotarbiński used both terms of conjunctions, making a poor distinction between conjunction of the Polish language and logical functors. Still, the terms "extensional" and "intensional" are treated as complementary in his text (Kotarbiński 1962: 9-10). The article by Kotarbiński is the oldest source that the encyclopaedia by Urbańczyk mentions when discussing intensional sentences (Urbańczyk 1991: 397).

one and/or a false sentence with another false one, and this has no bearing on the veracity or falsity of the whole formula (the so-called *salva veritate* substitutability). From the point of view of extensional logic, singular sentences do not exist in any other way than as carriers of logical values, so there is no difference between the above sentence about the ~~pussy-bird~~ and addition and the sentence "Picasso was a king and painted pictures." This property, too, distinguishes the "and" of classical logic and the "natural 'and'."

It is also worth noting that in the case of the "natural 'and'," in many cases the sequence of the elements connected is not insignificant. It suggests a temporal or logical sequence.¹² If the connector "and" were extensional, there would be no difference between the sentences "he thought and did," and "he did and thought," as well as between "You are a doctor and you should know," and "You should know and you are a doctor." Both this fact and the many functions of the conjunction "and" in Polish, makes it distinct from the respective logical connective.

The conjunction "and" surely is not an extensional conjunction in this term's logical sense. This is why a natural conjunction clearly demonstrates the features of relevance. This also pertains to other conjunctive connectors, such as "neither," "not only... but also..." The complications list is supplemented by the occurrence of a communicative element in the semantic of some connectors of a complex meaning, such as "but" and "since" (Wojtasiewicz 1972) as well as the existence of compound connector-less sentences.

Negation, as a one-argument functor, is not subject to syntactic limitations of relevance. We can negate any sentence. However, some pragmatists argue, it is not always so. Givon notices that negation only happens in some contexts in natural language, especially when it can be thought that it is not negation but the corresponding affirmative statement that is true or when the speaker assumes that the interlocutor wrongly thinks so.¹³ (Interesting examples are provided by sentences with the expressions such as "there is no doubt"¹⁴ or "I am positive" used exactly when doubt and hesitation arise). This condition considerably reduces the possibility of using negation, and also sentences in the form of strong inconsistency.

When discussing the issue of negation in natural language, it is worth noting that it has no formal mark that would clearly signal its presence and

¹²Among the cases of non-altering "and," Wojtasiewicz (1972) identifies the sequential "and" (A shot was fired and a boar fell down on the ground), explicative (Smith fell off a horse and broke his leg) and accessory "and" (Smith sings and does accompaniment to himself on the guitar).

¹³After Gazdar (1979: 67) and Antas (1991: 38). In a similarly pragmatic manner, the right usage of the conjunction "if" was described by Kazimierz Ajdukiewicz, noting that it is not used when it is obvious that the antecedent is false or the postcedent — true (Ajdukiewicz 1985b).

¹⁴For a remark on the English phrase "no doubt" see Jespersen (1935:322).

would be absent in other situations. The word "nie," which in Polish is a clear and sole candidate for this kind of mark,¹⁵ in colloquial and careless speech appears in the function of asking for confirmation, like a question tag in English (You were in the cinema yesterday, nie[Polish]/weren't you[Eng.]?)¹⁶ or as an insertion (We were driving for a long time, nie[Pol.]/well[Eng.], and we were tired). Also, in natural language, a "negation"¹⁷ can be seen as creating an opposition rather than inconsistency, when the negated element along with its negation falls short of making up all thinkable logical possibilities, and it can be that neither corresponds to reality (Jespersen 1935: 322f). In Jespersen's opinion, in the case of predicate denial, the justification for such an approach is the fact that without formulating a decisive assertion or negation, we can qualify a declarative sentence as corresponding to a possible state of affairs (in the argumentation provided, it is hard to separate what concerns an act of assertion and that which concerns the content of the judgment under consideration).

On the other hand, negation can be expressed in a way that does not require the appearance of a negative particle (implied negation) (Jespersen 1935: 336-337). We are dealing with this phenomenon in sentences such as "If this is Mark's handwriting, I am a priest" or "A cactus will grow here on my palm if this is his handwriting." Interestingly, in such cases we are dealing with truly extensional substitutability of false for false, as long as the falsity is obvious enough to be identified (Antas calls such falsity rhetorical) (Antas 1991: 44-45). Providing similar examples from English, Jespersen supplies sentences that include contents which a speaker would naturally disagree with, such as "I am a rogue if . . .," "I'm dashed if..." (Jespersen 1935: 337).¹⁸

As can be seen from the above, conjunction and negation in natural language are complicated phenomena and are hard to describe. The fact that despite all these complexities we can still effectively communicate must result from the existence of decoding mechanisms. They allow for the proper interpretation of even those sentences which at the literal level do not have any sense as uttered in that particular moment of the dialogue. As noted by Marek Tokarz, the speaker may "try to provide us with information that has little or nothing to do with the

¹⁵Another complex issue is the relationship between the Polish "nie" (meaning negation, like English "no[t]") and the logical functor of negation (Dąmbska 1964: 237; Antas 1991: 14 and next; Bogusławski 1975: 27 (see note)).

¹⁶The German non-negational "oder" placed at the end of a sentence seems more open than the Polish "no" and the English and French question tags. It corresponds to the cases of opposition discussed below.

¹⁷If one may call thus a functor that creates an opposition, and not a contradiction; a functor that creates an opposition; the situation of the particle "nie" resembles in these terms the situation of the functor of "negation" in the extended positive logic.

¹⁸Also, Jespersen makes a note of other kinds of implied negation, such as those expressed by a verb form or a question.

meaning of the expression used" (Tokarz 1993: 216).¹⁹ A possibility of decoding such signals, beside the cases of agreed codewords, has long been a marked challenge for linguists and logicians. Tokarz remembers the 1946 proposition by Yoshua Bar-Hillel concerning taking "well corroborated laws of pragmatics" into consideration in drawing conclusions from interlocutor's statements: "if S says sentence x, S believes that x is true" or "if S uses primitive language, S is unnerved" (Tokarz 1993: 217f).

H. P. Grice did some sort of taxonomy of this type of relationship. His popular conversational maxims demand that the statements uttered be true and relevant (!), contain the right amount of communicated content and convey it clearly. All these recommendations are subordinated to the chief principle of collaboration with the interlocutor.

The authors see the issue of transmission differently. It is not always the point to tell the truth; sometimes it is to entertain someone with a story (Wilson, Sperber 2000: 230). Relevance is not a sufficient value to justify discourse for all, either. What constitutes one, to Wilson and Sperber, is such relevance which surpasses the relevance of all alternative discourses that are potentially possible at the same time. Two indexes are relative measures of discourse relevance for a given person at a given time: cognitive results (should be as big as possible) and cognitive effort that is needed for the addressee to achieve these results (ought to be minimal). (It is not known how to compare two utterances, with one having a higher informative power but a lower simplicity.) The following example illustrates the proposition.

Peter is a bit off color and goes to the doctor. The doctor — once he has established what is wrong with the patient — may diagnose the patient in any of the following ways (Wilson, Sperber 2000: 231).

- a. You are sick.
- b. You have the flu.
- c. You have the flu or 29 is a square root of 843.

As argued by the authors of the example, literal meanings of all three versions are relevant for the sick patient. B. is more relevant than version a. as the patient can learn more from it. B and c. are in that respect equivalent, but version c. requires much more effort on the part of the listener.

The proposal by Wilson and Sperber brings to mind the solution put forward in 1910 by Jan Łukasiewicz. In a hypothetical world, where all judgments are considered true "a doctor is summoned to the patient [...] diagnoses high

¹⁹Tokarz illustrates this thesis with an example of rhetorical falsity being applied instead of explicit negation for attracting attention to a mistake that has been committed by the interlocutor.

temperature [...] and all other symptoms of [...] diphtheria. At the same time he knows that there is no high temperature and nor is there a sore throat [...] etc., but pays no attention to the negations that are always true. He only states what there is and not what there is not.” (Łukasiewicz 1987: 97). The selectivity of reception and its reverse, the relevance of the communication, is thus the common denominator of the researchers dealing with information being processed in natural discourse, be it from linguistic or logical positions.

Another example is about the functionality (which I tested) of a strongly inconsistent sentence, (which additionally brings us closer to the essential subject matter of this paper) in the context of a phone call. The answer ”yes and no” when asked whether x can come to the phone is definitely recognizable as one that informs us about the difficulties of doing so.²⁰ Even if we do not have a satisfactory definition of a context or a guarantee that such statements will always be understood, individual cases of successful communication of this kind are an argument against excluding those sentences as incorrect.

What conclusions follow up regarding the principle of inconsistency in natural language? Surely, such a language need not block using strongly inconsistent sentences, as illustrated by Polish. Certainly, in sentences of this shape, a keen listener may understand the intended communication considering the context that is not necessarily internally inconsistent.

To sum up, it ought to be said that neither in logical systems nor in natural language is there a need to exclude strongly inconsistent sentences as unacceptable (i.e. false in logic, incorrect in natural language). The existence of such sentences need neither cause overflow in the system, in the first case, nor a communication paralysis in the other.

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²⁰A similar example is given by Antas: ”This is and is not red” is interpreted by her as an ascertainment of similarity rather than identity of colors (Antas 1991: 27). Obviously, in both cases one can speak of a change in the boundaries of the applicability of a given predicate, which does not change the fact of there being inconsistency at the surface structure level.

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