What is Reasoning?

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Abstract The usage of language and cognition have perhaps been the oldest specific features of a human mental activity. However, is there anything really exceptional in the fact *that* we use language and *that* we cognise? Is there anything specific in *how* we do it? It seems that reasoning is especially important among various linguistic and cognitive human activities. But what is reasoning? What is human reasoning? Is there anything *specific* about it? Which cases of reasoning are the *correct* ones and *why*? I take as my starting point the views on reasoning presented by the logicians and philosophers belonging to the analytic philosophy of language and epistemology, especially to the Polish analytic philosophy (The Lvov-Warsaw School: Tadeusz Czeżowski, Kazimierz Ajdukiewicz, Janina Kotarbińska and Alfred Tarski). In addressing the above questions I develop an improved view according to which the formal conditions of correctness are based on formal relationships (a consequence etc.). Such conditions depend on informal (material) conditions of correctness which are based on informal (material) relationships (reference, causality, spatial relationships etc.).

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1 Introduction

Each of us belongs to the biological species called *Homo Sapiens* in terms of our physical features, especially, in terms of the human nervous system and its main element – the brain. We are, in this respect, a part of nature understood as the material world. But we transcend this material dimension with our minds. In other words, the human mind is something more than a complex of material (physical, chemical or biological) elements and rules according to which such a complex of elements works. Our human mind enables us: to feel emotions (feelings), to decide (the will) and to think (the practical and the theoretical reason, the intellect). The intellect is featured by intelligence and an intellectual intuition. An activation

of our mental, rational, intellectual, intelligent, intuitional abilities (dispositions) enables us to use language and to cognise.

Cognition may be understood as a process and its result – knowledge. Knowledge is a true and justified belief. A belief is an asserted sentence with its meaning (sense) which is a logical judgment (a proposition). Such a judgment can be justified in a *direct* way – by perception or *indirectly* – by reasoning. However, strictly speaking, three types of a cognitive process (and of knowledge) can be distinguished: the perceptual, the intuitive and the discursive ones. I prefer to qualify these cognitive processes using the term "types" rather than "kinds" as this distinction is not a product of classification but of typology. The boundaries between these cognitive activities (and respectively, their concepts) are vague. So, let us repeat, the following types can be distinguished:

- Perception is a cognitive process obtained by using senses: sight, hearing etc.
- Intuition is a momentous, quick, "without any steps" act of an intellectual seeing (apprehending, grasping, understanding) that something has such and such a feature or something is related to something else.
- A discursive process is "realised in steps": e.g. an analysis, a classification, reasoning, a discussion etc.

These cognitive activities are mutually and closely interrelated. Intuition is engaged in a perceptual act during the process of getting a concept of something which is perceived (conceptualisation). But intuition is also useful or perhaps necessary in the *discursive* process of reasoning:

- to see the *relationship* between a premise and a conclusion (a premise is a sentence which is a starting point and a conclusion – an ending point, a goal of reasoning),
- to grasp that a sentence is true or
- to acknowledge (accept) a sentence as a true premise or a true conclusion of reasoning. Such a pragmatic activity is called assertion.

"A transition from some beliefs to a conclusion counts as inference only if the thinker *takes* his conclusion to be *supported* by the presumed truth of those other beliefs. [...] It's enough that we take our premises to be true, that is, judge them to be true." [7, p. 4]. However, the question arises: "What is it to believe something *because* one *takes* it to be supported by other things one judges to be true? What kind of taking are we talking about?" [7, p. 6]. The notion of "taking" can be explicated in the following way: "(Taking Condition): Inferring necessarily involves the thinker *taking* his premises to support his conclusion and drawing his conclusion *because* of that fact. The intuition behind the Taking Condition is that no causal process

counts as inference, unless it consists in an attempt to arrive at a belief by figuring out what, in some suitably broad sense, is supported by other things one believes. In the relevant sense, reasoning is something we *do*, not just something that happens to us. And it is something *we* do, not just something that is done by sub-personal bits of us. And it is something that we do with an *aim* – that of figuring out what follows or is supported by other things one believes." [7, p. 5], [22, 27, 10, 11]. However, what is reasoning? What makes something reasoning?

2 The Definition of Reasoning

Reasoning is a process or an activity concerning sentences or judgments. The process leads to a result: new sentences or judgments. Such a result is a logical structure consisting of judgments which are linked as premises and a conclusion, reasons and a consequence, a starting point and an ending point (a goal) of reasoning [13, p. 119].

Reasoning can be understood in various ways:

- as complex reasoning (something more complicated than inference) or
- as simple reasoning (inference).

Complex reasoning consists of inference and of another procedure (a method), for instance, of questioning. A proof is a kind of complex reasoning.

A proof in a logical sense is a complex composed of a logical judgement to be proved which is linked by a relationship of a consequence with other logical judgements (premises). The conclusion can be deductively derived from the premises [12, pp. 91, 93]. At the starting point we know a conclusion which is the last element of the structure of proof. We ask the guiding question: How do we get to know (prove) that the conclusion is true? After that we try to find the correct premises among judgments we have already accepted. However, the following question arises: "what is it to draw a conclusion from a premise *because* you take the premise to provide support for the conclusion?" [22, p. 389].

If we want to build a proof, we match a true premise with a judgment to be proved. In a case when a proof is deductive reasoning, a premise is a reason and a judgment to be proved (a conclusion) is a consequence. A premise must be connected with a conclusion by a relationship of a *logical consequence*. In other words, a conclusion must follow logically from a premise on the *basis* of a logical law. Such a proof is justifying reasoning because we match a correct premise to support a conclusion. Such a proof is also regressive reasoning because we "*move*" *from* a conclusion *to* a correct premise. So the direction of finding a correct

premise is opposite to the direction of the relationship of a logical consequence [12, p. 93]. Yet, what is simple reasoning, that is, inference?

”Inferring is a movement of thought between propositions which may, in special circumstances, result in the thinker coming to judge the proposition inferred to be true.” [27, p. 28]. Inference is a way of thinking. But “thinking” is a broader concept than “inference”. It means that every inference is a way of thinking, but not every way of thinking is inference.

Inference “involves judging a conclusion to be true because one takes the (presumed) truth of the premise to provide support for that conclusion.” [22, p. 389]. The word “be*cause*” or “‘therefore’ is used to express or report an inference, it does so by virtue of the contextually salient explanatory relation being precisely the relation that Frege spoke of in describing inferring as believing a conclusion because one takes it to be *justified* by something. It is, in other words, a relation that obtains between some conclusion that is justified, and something else – a reason – that makes it justified. This is not the kind of relation that some epistemologists call ‘propositional justification’, which is a relation between a person and a proposition that the person is justified in believing, but rather a generalization of the relation that epistemologists call ‘doxastic justification’, which is a relation between a person’s belief and whatever makes that person’s belief justified.” [22, p. 400]. Thus, some relations can be distinguished:

(a) a relation between something and thinker (a person, a cognitive subject) *S* who believes (judges, accepts, takes etc.) that conclusion (a logical judgment, a proposition etc.) *q* is true.

This something is supposed to justify (support, warrant, entitle etc.) *S* believing that *q* is true. But what is this something? Let us reformulate (a) to see it:

(b) a relation between premise *p* presumed to be true (a reason justifying *q* as true) and *S* who believes that *q* is true because of *p*.

This is a pragmatic relation, that is, a relation between linguistic expressions and language user *S*.

(c) This something can be understood not just as *p*, but as something which justifies *p* as true, something which *p refers to*, something making *p* true (a *truth-maker*).

Such a relation is a semantic relation. But what are the conditions which justify *S* believing that *p* is true? Or when is *p* true? Let us analyse this situation. At the starting point of reasoning (a proof) *S* knows *q* and *S* searches *p* to justify *q* in a logically and materially correct way. In other words, *S* is justified to judge *q* as true if *q* is justified by *p*. And, thinking in a regressive way, that is, “going back”, *S* is justified to judge *p* as a true belief and a right

reason justifying *q* if *S* is *justified* to judge *p* as a true belief and a right reason justifying *q*. And so on. There appears the infinite regress (or a circularity) in reasoning. However, it is not identical with the infinite regress (or a circularity) in justification. And perhaps a non-inferential justification is accessible. One way of non-inferential justification is to claim that some beliefs – basic beliefs – are justified by intuition (a reflection). Such beliefs must clearly, obviously, surely be true etc. However, the problem with intuition is that a particular *p* is clear etc. – and thus fundamental – for some people, but it is not for others. And it makes the notion of intuition complicated. (I will analyse this problem in the following sections and I will also propose a solution to this problem).

Inference, or to be more specific inferring, is a mental, *complex* process consisted of judgments. However, inference is not just an accidental collection of judgments. The conclusion is accepted as true on the basis of the acceptance of premises. The crucial issue is the relationship between the acceptance of premises and of a conclusion. Moreover, weaker or stronger acceptance of premises leads to the acceptance of a conclusion which has not been accepted yet or has been accepted with a lower degree of certainty. The degree of acceptance of a conclusion is not higher than the degree of the acceptance of premises [1, p. 107]. Inference is not just ”a few sentences”. So, what is it that makes inference? Inference consists of sentences. It seems that they are elements of an inferential structure. And yet, what makes them a complex (a structure)? What unites such sentences? What is the basis of the structure? Is it a chain (a sequence) of sentences? What is this chain (this sequence)?

Premises accepted (acknowledged) as true, in other words, asserted premises are the basis of asserting a conclusion. A sentence – a conclusion – is asserted on the basis of a relationship which connects asserted sentences playing the role of premises or a conclusion. But what is this relationship? What relationship justifies the fact that a premise “sends” (“transmits”) its meaning – a logical judgment – to a conclusion? [21, p. 260]. The candidates for these relationships are formal and informal relationships [16].

Another question is what makes something a correct, good reasoning? Is incorrect, bad reasoning still reasoning?

3 The Conditions of Correctness of Reasoning

The conditions (rules) allow to judge (evaluate) reasoning in terms of correctness (rightness) or incorrectness (non-rightness). What makes reasoning right? Which premise or conclusion is right? “The premise judgments need to have caused the conclusion judgment ‘in the right

way.'" [7, p. 3]. It is important to emphasise that an act "might seem right without being right: there is a distinction to be made between seeming right and being right." [10, p. 23]. What is the evidence that such a distinction is useful? "An essential part of the attitude of seeming right is recognizing the possibility of correction. You recognize that a certain sort of challenge to your act is appropriate and may succeed. We may call the challenge 'checking'. When an act seems right to you, relative to a particular rule, you recognize that it might no longer seem right to you if you were later to check what you did. This recognition appears as a disposition. Having the attitude of seeming right involves a disposition to stop having this attitude in particular circumstances, specifically if you were to check the act and it were no longer to seem right. This is a counterfactual disposition, since you might never check. You may not be disposed to check – perhaps because you are confident – but you still have this counterfactual disposition. Checking may consist simply in trying again in the same way to follow the rule, or it may involve something more." [10, p. 22].

Then let us consider that act of checking. Checking involves conditions (rules) of evaluating, in our case, evaluating the correctness of reasoning. Some general conditions of correctness have been distinguished: the *formal* (logical) and *informal* (material) ones: see e.g. [1, pp. 97-181], [12, p. 93].

3.1. The Formal Conditions of Correctness

Formal logic concerns – as the term "formal" suggests – a *form* of used expressions. It does not concern rather a *content* of such expressions. But the opinion that formal logic totally passes over whatever contents would be slightly exaggerated for even shapes *p*, *q*, *r* – representing simple sentences – express the content that *p* is identical with *p*, *p* is not *q*, *p* differs from $\rightarrow$ (the symbol of implication) etc.

Sentences which play the roles of premises or a conclusion are linked by *formal* relationships: in such cases a shape, a composition (an order) of expressions and their logical value (truth, falsity) is taken under consideration. Such formal and *inter*-sentential relationships are worked out by a propositional logic and a first-order logic. Sentences consist of names connected by *intra*-sentential relationships which are worked out by a syllogistic logic and a first-order logic [21, p. 261].

It is worthy of distinguishing *implicit* and *explicit* formal conditions of correctness of reasoning [20, p. 234]. Implicit conditions concern the correctness of procedures linked with inference (questions guiding reasoning, definitions of terms used in premises and a conclusion etc.). Explicit conditions fix the correctness of inference itself (e.g. a consequence, truth).

Let us present and analyse some formal implicit conditions:

(1) A question which guides inference has to be correct, that is:
   - meaningful (linguistically well constructed),
   - adequate (the question's assumption has to be true),
   - justified (there is a reason to pose such a question),
   - decidable (it is possible to obtain an answer in a finite number of steps),
   - creative (an answer for such a question delivers a new knowledge).

(2) Terms used in premises and a conclusion have to be correctly defined:
   - the word defined (*definiendum*) must not be used in the *definiens* in an explicit definition,
   - in the case of a lexical definition the connotation (intension) and the denotation (extension) of the *definiendum* and the *definiens* must be identical, i.e. mutually interchangeable (the condition of adequacy). In other words:
   - the extensions of the *definiendum* and *definiens* must not be mutually exclusive,
   - the extension of the *definiens* must not overlap with the extension of the *definiendum*,
   - the extension of the *definiens* must not be superior to the extension of the *definiendum* (i.e. the definition must not be too broad),
   - the extension of the *definiens* must not be inferior to the extension of the *definiendum* (i.e. the definition must not be too narrow): see e.g. [1, pp. 68–70], [20, pp. 233-234].

There are also some formal explicit conditions of correctness:

(3) It is against the logical law of non-contradiction: $\sim(p \wedge \sim p)$ to accept contradictory premises.

Therefore, there are a number of formal conditions of correctness of inference. They are based on many different formal relationships. And a logical consequence is not the only formal relationship. However, it is the main one.

(4) A logical consequence links the premises and a conclusion in the case of an infallible reasoning: a deduction and a mathematical induction.

The literature concerning a logical consequence is very extensive: see e.g. [23, 14, 2, 15]. Nevertheless, it is not our major topic.

3.2. The Informal (material) Conditions of Correctness

Not every consequence is a logical one. It is worthy of distinguishing a formal (logical) and an informal (material) consequence. It seems that formal and informal consequences are related to informal conditions of correctness of reasoning.

"We need not treat all correct inferences as correct in virtue of their form, supplying implicit or suppressed premises involving logical vocabulary as needed. Instead, we can treat inferences such as that from «Pittsburgh is to the west of Philadelphia» to « Philadelphia is to the east of Pittsburgh,» or from «It is raining» to «The streets will be wet,» as *materially* good inferences – that is, inferences that are good because of the content of their *non*logical vocabulary." [8, p. 85], [9, pp. 94-116].

Expressions are connected not only by formal relationships, but also by *informal* ones. Such relationships come out when sentences and names are analysed in terms not only of a logical form, but also of their *contents* [21, p. 262].

There are some informal conditions of correctness:

(1) Sentences playing the roles of premises or a conclusion are presumed to be true.

(2) Sentences consist of names: individual or general ones. Individual names (e.g. "Christopher Columbus") refer to unique objects. General names refer to classes of objects: names of artefacts (e.g. "a building") and natural kind terms ("gold", "a lemon", "a tiger" etc.).

Such terms refer to natural kinds, i.e. kinds in nature: see e.g. [17]. An ostensive definition is useful for introducing new terms into a language: see e.g. [19].

(3) Sentences refer to states of affairs which are linked by many different informal (material) relationships like causality, spatial relationships etc.

So far the following problems (questions) of the paper have been presented: What is reasoning? What is human reasoning? Is there anything specific about it? Which cases of reasoning are the correct ones and why? The definitions of reasoning have been given and some formal and informal conditions of correctness have been shown. However, the main questions have still not been answered in a satisfactory way. So, let us reformulate the questions and consider how logicians can, for instance, know that $((p \to q) \wedge p) \to q$. In addition to that, let us express this logical rule (principle) called *modus ponens* (MP or *modus ponendo ponens* – MPP) less symbolically as follows: (if *p*, then *q*) & *p*, so *q*. And let us analyse the clear physical example of reasoning which fulfils the scheme: *if* water is heated up to the temperature of approximately 100 degrees Celsius at a standard atmospheric pressure, *then* it boils. In fact, if water is heated up to such a temperature, then it boils. How can logicians know that this scheme is correct?

It is worthy of noticing that "when you reason by modus ponens, you may do some reasoning in identifying what is the antecedent and what is the consequent of the conditional proposition you are reasoning with." [10, p. 20-21]. Moreover, if "you infer q from p and $p \rightarrow q$, this will seem right relative to the modus ponens rule, but not relative to the rule of inferring a tautology. This means you must have a way of identifying different rules to yourself, which means identifying different dispositions. You must be able to identify some disposition as the modus ponens one, for instance. You can even choose which rule to follow. If you choose the modus ponens rule, this explains why you infer q, rather than something else, from p and $p \rightarrow q$. Choosing a rules mean choosing a disposition. This is not as mysterious as it may sound, and it does not imply you can map out in advance where the disposition will lead in all cases." [10, p. 22].

Perhaps the *machine-like* (syntactic) model of inference is an adequate answer to the question: What is reasoning? It may seem that formal conditions of correctness (a consequence etc.) are more important than informal (semantic) conditions such as truth, reference etc. According to such a model:

- if you apply true premises to a correct scheme of a deductive inference or of a mathematical induction, you will get a true conclusion with an absolute degree of certainty,
- if you apply true premises to a correct scheme of an enumerative induction, you will get a true conclusion with a lower or higher degree of certainty which depends on a quality and a quantity of evidence. Then you will be justified (entitled) to acknowledge a conclusion as true with a lower or higher degree of certainty.

"It is tempting to think that there are two kinds of inference – deductive and inductive. But in what could the difference between these two kinds of inference consist? Of course, in some inferences the premises logically entail the conclusion and in others they merely make the conclusion more probable than it might otherwise be. That means that there are two sets of standards that we can apply to any given inference. But that only gives us two standards that we can apply to an inference, not two different kinds of inference." [7, p. 5].

Does the machine-like model of inference give adequate answers to the questions: What is reasoning? What is human reasoning? Is there anything specific about it? Which cases of reasoning are the correct ones and why? Not quite so.

Thus, let us now notice that "if rule-following is to explain what reasoning is, eventually you must do some rule-following that does not involve reasoning. Moreover, as Boghossian shows clearly, it must not depend on a belief (or any intentional attitude) whose content is that

you should act this way. As Boghossian earlier put it, following Wittgenstein, this sort of rule-following must be done 'blindly'" [10, p. 21]. The point is that the *deepest* basis of inference must be non-inferential. It is a *blind* rule-following. How can such a sort of rule-following be blind? In what sense? Is the deepest basis of reasoning blind, that is, accidental? It seems that it is not. Thus how can we explain that an inference, for instance, according to *modus ponens* principle, is not just a matter of good luck? What is the answer to the question: "how could MPP premises warrant MPP conclusions while being blind? Answer: they do, because they are written into the possession conditions for the conditional, and the conditional is a non-defective concept. […] If we are to make sense of the justified employment of our basic logical methods of inference, we must make sense of [...] *blind but blameless* reasoning – a way of moving between thoughts that is justified even in the absence of any reflectively appreciable support for it." [3, p. 248], [4, 26, 25, 5, 24, 18, 6].

To overcome an infinite regress (or a circularity) in reasoning, some conditions in logic have been fixed to be met:

It is important to accept – as a formal foundation of the method of reasoning – a set of rules (*modus ponens*, *modus tollens* etc.) and a set of axioms which are just assumed as clearly, obviously, surely true etc. Such a set of axioms should be:

- independent (the axioms – sentences should not be mutually provable),
- non-contradictory (the axioms and their consequences should not be contradictory),
- complete (every correct sentence or its negation can be proved on the basis of the axioms),
- decidable (there is a method of proving in a finite number of steps whether or not a given sentence belongs to the system) etc.

If you do not assume anything, then you will not prove anything.

It is important also to accept – as an informal (material, empirical) foundation of reasoning – the usefulness of an ostensive definition. If you do not assume it, then you will not get empirical terms, including natural kind terms and empirical sentences which are supposed to deliver an empirical content about some reality.

Perhaps the main claim of this article is also a good candidate for an explanation of why or how we can reason. Namely, it seems that the formal (logical) conditions of correctness of reasoning are based on formal (logical) relationships and these conditions depend on informal (material) conditions of correctness based on informal (material) relationships. The formal relationships are not sufficient for a correct inference and they need to be supported by informal relationships. In other words, "the notion of *formally valid* inferences is definable in

a natural way from the notion of *materially correct* ones. […] the notion of *logically* good inferences is explained in terms of a prior notion of *materially* good ones." [8, pp. 85-86], [9, pp. 104-105].

The formal relationship of the consequence between a sentence which is an antecedent (reason) *p* and a sentence (the consequent) *q* in inference seems to depend on the truthfulness of *p* and *q*. And the truthfulness of *p* and *q* is determined by the relationships of references of *p* and *q* to the relevant states of affairs.

Let us analyse the above claims using the example of freezing water. An enumerative induction is used in the context of discovery of regularities concerning such water. Namely, if there is any water at a temperature of about 0 degree Celsius at a standard atmospheric pressure, then the water freezes. It is a complex sentence consisting of two sentences *p* and *q* linked by a logical connective of an implication expressing the relationship of a consequence. The implication is true if *p* and *q* are true and they are true if *p* and *q* – on the one hand – express the given logical judgments and – on the other hand – *p* refers to the given temperature and atmosphere and *q* refers to the water which freezes. Water in fact freezes at such temperature and such atmospheric pressure. So, the basis of the whole case is the informal (material) relationship of causality between the states of affairs: the temperature, atmosphere and freezing water. The implication of sentences *p* and *q* depends on the (causal) laws of nature.

In the context of justification – however – the empirical claims (conclusions) are supported by deductive inference (precisely speaking, hypothetico – deductive inference). The problem is that deductive inference is infallible if the conditions of its correctness are fulfilled, especially, if premises are true. But in difficult cognitive cases, that is, if one cannot recognise (know) in a satisfactory, certain way whether empirical premises are true, then one just believes the premises to be true with a lower or higher degree of certainty depending on the quality and quantity of evidence. Difficult cognitive situations "disrupt" infallibility of such a deductive "machinery". This is why our minds are able to cognise and express the laws of nature just in a revisable, fallible (tentative) and changeable way.

4 Conclusions

Reasoning is a mental, intellectual activity or its result. At the starting point there are sentences and their meanings (logical judgments) or sentences accepted as true (beliefs). Such

sentences play the role of premises or a conclusion. Reasoning is a transition from premises to a conclusion on the basis of formal and informal relationships.

It seems that a good candidate (hypothesis) for an adequate explanation of the human capacity to cognise (to reason) is the *compatibility* of rational (intelligible) nature and of us – humans. Namely, our mental "processes dovetail with the causal structure of the world [...] our processes of belief acquisition are indeed well adapted to providing us with an accurate picture of the world" [17, p. 3]. Our human knowledge of the world is possible on the basis of the assumed hypothetical *fit* between our mental cognitive abilities and the reality, especially the assumed causal structure of the reality which, among others, consists of natural kinds of objects.

This compatibility makes it possible to activate our mental, rational, intellectual, intelligent, intuitive abilities to use language and to cognise (to reason). We are able to reason in a rational way about the material world because – to a certain extent – we are a part of the material world. It suggests the existence of a subtle mental, linguistic and cognitive tuning, by analogy with a discovered subtle cosmological and biological tuning. The explanation of why or how we can reason is a matter of a natural regularity and – to a certain extent – naturally based ability to reason.

However, we humans transcend the material world with our minds as we have such features and functions which do not exist in nature. Such a fundamental feature of the human language and cognition is *normativity*. The conditions and evaluation of the correctness of reasoning: correct (right, valid, sound, good, proper) or incorrect (non-right, invalid, unsound, bad, improper) belong to normative vocabulary and are the evidence of a specifically human normative aspect of reasoning.

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