

## INFERENCE AND COMPULSION

CESARE COZZO

Sapienza University of Rome

Department of Philosophy

### §1 Seven factors that characterize a conception of inference

How can an inference be compelling? The question presupposes a sufficiently clear, non-empty notion of inference. A first approximation is to say that an inference is a unit of reasoning. By dividing an instance of reasoning into parts that are themselves instances of reasoning we eventually come to an end: the result are minimal, elementary instances of reasoning. The word “inference” is used to refer to these units of reasoning. The first approximation, however, leaves room for many different notions of inference, according to which conception of reasoning one adopts. What is reasoning? A very general and abstract answer is: reasoning is data processing. If we accept this answer, an inference is a single simple transition from given data to processed data. The given data are the *premises* of the inference and the processed data are the *conclusion* (or *conclusions*) of the inference. This is a very broad notion of inference. Many authors prefer a more specific notion according to which, though an inference is always a particular kind of transition from given data to processed data, not every such transition is a genuine inference in the proper sense. Be that as it may, starting from the very broad notion of inference, one can distinguish at least seven factors with respect to which a conception of inference can differ from other conceptions.

The **first** factor are premises and conclusions. What are they? The very general answer is that they are simply *data*. Carlo Cellucci (2002, p. 223, 2008, p. 337) argues for this view. Most contemporary authors, however, say that premises and conclusions can only be items capable of being true or false, *truth-bearers*. This second, more specific, answer to the question as to the nature of premises and conclusions admits of many different developments: truth-bearers can be linguistic entities (sentences), non-linguistic abstract entities (propositions) or mental states, like beliefs. A third answer consists in saying that premises and conclusions are not objects or states in which we happen to find ourselves, but responsible *acts* or *actions*, which we *do*. Following Immanuel Kant (KrV B94/A69, Kant 1985, p. 138) one can say that they are «acts of the understanding [*Handlungen des Verstandes*]» or mental acts of judgement (cf. Martin Löf 1985, Sundholm 1994, 1998, 2002). If we prefer to focus on public linguistic practice, we can conceive of premises and conclusions as *linguistic acts*, such as assertions (but perhaps other linguistic acts as well, like questions or commands). The **second** factor is the subject processing the data. The subject, too, can be understood broadly or narrowly. If you think that only a person can make an inference, you have a narrow conception of the subject of inference. If you believe that not only a person, but also a machine, or a non-

personal biological entity can infer, then you have a broad conception of the subject. The **third** factor is the relation between the subject  $S$  and the premises (or conclusions)  $X$ . This obviously depends on our choices concerning the first and the second factors. The relation can take different shapes: the data  $X$  are stored in  $S$ ;  $S$  is in the representational state  $X$ ;  $S$  is in the neural state  $X$ ;  $S$  performs the act  $X$ , *etc.*

The **fourth** factor is the relation between the premises and the conclusion. In *Symbolic Logic* Richmond Thomason (1970, p. 92) defines an inference as «an ordered pair  $\langle \Gamma, A \rangle$  where  $\Gamma$  is a set of formulas [the premises] and  $A$  is a formula [the conclusion]». This may suffice in an introduction to formal logic, but if we try to answer the question “what is an inference?”, we realize that even the very broad notion of inference contains the idea of a more specific relation between premises and conclusion: not every pair  $\langle \Gamma, A \rangle$  is an inference. The views of philosophers and logicians on this specific relation are diverse. Kosta Došen (2012, p. 8) maintains that it is an *abstract* relation, which does not directly concern human, psychological or linguistic events. The related entities are propositions and «as a proposition is not something mental that comes into being when one asserts a sentence, so an inference should not be taken as a mental activity of passing from sentences to sentences or from propositions to propositions [... or as] the accompanying verbal and graphical activities». This view deprives inferences of the temporal nature implied by the idea of a *transition* from premises to conclusion. Most philosophers, however, insist on precisely this temporal character of inferences. A transition is a *change*. Change is an essential feature of the relation between premises and conclusion: an inference is a change that starts with (a relation of the subject to) the premises and ends with (a relation of the subject to) the conclusion (or perhaps in the plural: conclusions). This change is very often understood as a *psychological change*. In the famous essay *Some consequences of four incapacities* Charles Peirce (1868) proposes a notion of inference according to which every «operation of the mind» is an inference, including emotions and sensations. If we adopt this broad notion of inference, we shall conclude that many inferences are unconscious and involuntary. One can easily reach this conclusion if one thinks that an inference is a change, because a change can be something that happens independently of our consciousness and will. The change starting with the premises and ending with the conclusion will be considered a causal process and the relation between premises and conclusion a *causal* relation. If it is a psychological change, an inference will be a causal process in which a mental event is the cause of another mental event. This causal process can be something that happens to us beyond our control. For Gilbert Harman (1986, p. 2) a reasoning is a process of «change in view», that is a process of revising one’s beliefs or intentions and «it may well be that reasoning is a relatively automatic process whose outcome is not under one’s control». A different standpoint is taken by those who follow in the footsteps of Kant and consider the relation between premises and conclusions to be constituted by a *conscious and deliberate act* on the part of the subject. In a manuscript probably composed around April 20, 1901, about thirty years after the aforementioned essay, Peirce defines a narrower notion of inference: «inference is any act of deliberate assent, in any degree, however slight, which a man accords to a proposition because he thinks that assent warranted by his already accorded assent to another proposition or propositions, called the premisses» (Peirce 1985). A philosopher who has recently insisted on the central role of the notion of

inference in the history of logic, Göran Sundholm, characterizes inferences as: «acts of passage in which a certain judgement, the conclusion of the inference, is drawn on the basis of certain already made judgements, the premisses of the inference» (Sundholm 1994, p. 373). Sundholm (1998, p. 27) stresses that this is essentially Gottlob Frege's view. Frege (1906, p. 387) wrote: «an inference ... is an act of judgement that is drawn according to logical laws from judgements previously made. Each premiss is a certain proposition which has been recognised as true, and also in the conclusion-judgement a certain proposition is recognised as true» (Sundholm's translation).

The **fifth** factor that contributes to distinguishing a conception of inference is the attitude adopted towards the stability of the connection between premises and conclusion. It is universally acknowledged that in many cases a new piece of information can undermine the connection: the connection can cease to be valid, or good, or acceptable. The inference from "Tweety is a bird" to "Tweety can fly" is acceptable only until new information emerges to the effect that Tweety is a penguin. Most philosophers, however, have maintained that some inferences, deductive inferences, are such that the connection between premises and conclusion is stable and can never be subverted by a new piece of information. This tenet can be questioned. The **sixth** factor is the private or public character of inferences. For Harman, as we have seen, reasoning is a psychological process which can be automatic and unconscious. A unit of reasoning in this sense is mostly private and not publicly accessible. On the other hand, Michael Dummett (1991, p. 184) writes: «we are concerned with principles or rules of inference as they are actually observed in the course of informal, or at least unformalised, reasoning, in everyday life, in the law courts, in political argumentation, in scientific literature, in mathematical proofs and elsewhere». Reasoning and inference in Dummett's sense are publicly accessible practices. The **seventh** factor is the context in which premises and conclusions are placed. Dag Prawitz (1973) shows that for an adequate characterization of an inference it is necessary to take into account not only premises and conclusions, but also the arguments for the premises, the assumptions that are discharged and the variables that are bound by making the inference. One may suggest that further contextual factors should also be considered.

## §2 The problem of inferential compulsion

Different attitudes to the seven factors that we have listed will lead to different conceptions of inference. Different conceptions of inference are not necessarily mutually incompatible: they can serve different purposes. Let us consider a notion of inference as a tool for dealing with a problem. One may legitimately adopt two different notions of inference, let's say inference-1 and inference-2, in order to tackle two different, equally important problems. The question "what conception of inference ought we to adopt?" thus leads to the question "what is the problem?". The problem addressed in this paper is the compulsion of inferences. We are all familiar with the experience of being compelled by an inference that forces us to accept a conclusion. We accept the conclusion, perhaps an unwelcome one, by virtue of a special force, which is neither the threat of violence, nor the charm of a seductive persuader: it is simply the sober force of reasoning. A compelling inference is endowed with this force. What is it for an inference to be compelling?

What notion of inference is apt, if we want to make this experience of compulsion intelligible? This is the problem of inferential compulsion. It is a problem because the compelling force is a very special force. In his *Remarks on the Foundations of Mathematics* Ludwig Wittgenstein (1956, I §113) writes: « “But am I not compelled, then, to go the way I do in a chain of inferences?” – Compelled? After all I can presumably go as I choose! –». Wittgenstein draws our attention to a crucial feature of inferential compulsion: the fact that when we are compelled in this inferential sense, in another sense we are not compelled at all. This is also an experience encountered in ordinary life. We meet people who obstinately refuse to accept the obvious consequences of given premises. For example, an interlocutor can refuse to conclude *B*, even though he (or she) accepts *A* and “if *A*, then *B*”. What happens? Nothing. Zeus does not strike him (or her) dead for sins against logic. Our interlocutor is free.

The problem of inferential compulsion is connected with another problem, that of justification-transmission: how is it possible for an inference to transmit justification from the premises to the conclusion? In other words: under what conditions is an inference such that if a subject is justified in accepting the premises, then he, or she, is justified in accepting the conclusion? The connection between compulsion and justification-transmission depends on a plausible assumption concerning the relation between the notion of justification and the notion of an argumentative context with rational disputants, the idea that justification is something publicly acknowledgeable by rational subjects: if a person is justified in asserting a sentence, or an inference has the power to transmit justification, then both facts must be acknowledged by the disputants involved, if they are rational. Consider the statements i) *S* is justified in accepting *A*; ii) any interlocutor of *S* must accept *A* on pain of irrationality; iii) any interlocutor of *S* is compelled to accept *A*. On the basis of the assumption that justification is rationally acknowledgeable (i), (ii) and (iii) are interdeducible. If this is so, an inference is endowed with the power of justification-transmission if, and only if, it is endowed with the power of compulsion. To see why, let us make the following two hypotheses: 1) an inference *I* performed by Lisa has the power of transmitting justification: if Lisa is justified in accepting the premises in  $\Gamma$ , she is also justified in accepting the conclusion *C*. 2) Lisa’s interlocutor, Gino, accepts the premises of *I*, and is thus willing to grant that one is justified in asserting the premises. From hypotheses (1) and (2), since Gino acknowledges the power of *I* to transmit justification, it follows that 3) Gino agrees that Lisa is justified in asserting the conclusion *C*. Therefore Gino is compelled to accept *C* on pain of irrationality: *I* has compelling force. We have shown that if *I* transmits justification, *I* is compelling. On the other hand, let us suppose a) inference *J* is compelling, b) Lisa is justified in asserting the premises of *J*, and c) Lisa performs inference *J*. From hypotheses (a), (b) and (c), and from the acknowledgeability of justification we can conclude that any rational interlocutor of Lisa must accept the premises of *J* and is hence compelled to accept the conclusion of *J*. Thus Lisa is justified in asserting the conclusion of *J* and *J* has the power of transmitting justification. We have shown that if *J* is compelling, *J* transmits justification. In what follows I shall examine three conceptions of inference which are aimed at solving the problems of compulsion and justification-transmission.

### §3 Paul Boghossian on inference

In *What is Inference?* Paul Boghossian (2012, p. 1) remarks that the nature of inference is a topic «of great interest in its own right and surprisingly understudied by philosophers». He tries to develop an account of the nature of inference capable of answering «the question what conditions an inference must satisfy if it is to transmit the justification that a thinker has for its premises to its conclusion» (p. 8). So, it seems that Boghossian is trying to solve the same problems we have in mind. According to Boghossian, the premises and conclusions of an inference are *beliefs*. Let  $I$  be an inference from  $\Gamma$  to  $C$ :  $\Gamma$  is a set of beliefs-premises and  $C$  is a belief-conclusion. The subject of the inference, Boghossian says, is a *person*. The relation between premises and conclusion is not a mere succession: an inference cannot simply consist in having a belief  $C$  *after* having the beliefs in  $\Gamma$ . Nor can the relation between premises and conclusion consist simply in the fact that the beliefs in  $\Gamma$  *cause* the belief  $C$ . What constitutes the transition from  $\Gamma$  to  $C$ , according to Boghossian, is «a person-level, conscious, voluntary mental action» (p. 2). It is an action: «something we do, not just something that happens to us. [...] something that we do with an aim». The aim is «to arrive at a belief by figuring out what, in some suitably broad sense, is supported by other things one believes». To the subject the action appears suitable for reaching the aim *because* the subject is guided by a special attitude towards the relation between  $\Gamma$  and  $C$ : « $S$  takes the (presumed) truth of [the premises in  $\Gamma$ ] to provide support for [the conclusion  $C$ ]» (p. 4). So, Boghossian proposes a requirement for a satisfactory account of the nature of inference, the *taking condition*: «inferring necessarily involves the thinker taking his premises to support his conclusion and drawing his conclusion because of that fact» (p. 5).

*What is Inference?* is mainly an attempt to provide a correct analysis of the rough notion of “taking the premises to support the conclusion”. The question is “what does this taking consist in?” and Boghossian considers two possible ways of answering. The first family of answers is «in terms of some occurrent intentional state» (p. 9). To this group belong various specific answers. An occurrent intentional state can be the *belief* that judging that  $P^1$  and  $P^2$  ... and  $P^n$  supports judging  $C$  (where  $P^1$  and  $P^2$  ... and  $P^n$  are the premises in  $\Gamma$ ). Alternatively it can be a belief of a different kind, or perhaps an *intuition*, understood as an «intellectual seeming» or a «temptation to believe» which is «not subject to epistemic assessment» and does not require justification. This line of thought, however, seems to be unsatisfactory. Boghossian examines numerous difficulties besetting the various versions of an analysis of the notion of “taking the premises to support the conclusion” based on occurrent intentional states. But a general problem is that, if the crucial “taking” consists in an occurrent intentional state  $T$ , then  $T$  takes on the role of an additional premise: this way of attempting to explain the nature of an inference  $I$  from the premises  $P^1, P^2, \dots, P^n$  to the conclusion  $C$  amounts to crediting the subject with another inference  $J$  whose conclusion is still  $C$ , but with the new premise  $T$  being added to  $P^1, P^2, \dots, P^n$ . To explain the nature of an inference in this way is only to shift the problem: one explains what it is for a subject  $S$  to make an inference  $I$  by saying that  $S$  makes another inference  $J$ . Moreover the problems of compulsion and justification-transmission remain unsolved.

The second kind of answer to the question “what does this taking consist in?” is in terms of rule-following. In another recent paper Boghossian (2008a, rep. in 2008b, p. 109) imagines that in performing an

inference the subject follows a rule like: “if you are rationally permitted to believe  $P^1$  and  $P^2 \dots$  and  $P^n$ , then you are *prima facie* rationally permitted to believe that  $C$ ”. Boghossian is well aware that rule-following is a problematic notion, which requires careful explanation. However, he comes to an embarrassing conclusion. There seem to be two possible ways of analysing the notion of rule-following. One is the *dispositional* view: «for  $S$  to follow rule  $R$  is for  $S$  to be disposed to conform to  $R$  under appropriate ideal conditions». But «if all we mean by a thinker’s applying the rule of [*modus ponens*...] to the contents [ $A$ ] and [if  $A$ , then  $B$ ] is that the thinker is disposed, when considering such contents, to form the conclusion [ $B$ ], we have clearly lost any prospect of respecting the Taking Condition», because from this characterization nothing follows about the subject’s awareness that can explain the rule-following behaviour. The other possible way of analysing rule-following is the *intentional* view: the rule-following behaviour is explained by an intentional state that represents the rule: «on this Intentional construal of rule-following, then, my actively applying a rule can only be understood as a matter of my grasping what the rule requires, forming a view to the effect that its trigger-conditions are satisfied, and drawing the conclusion that I must now perform the act required by its consequent. In other words, on the Intentional view of rule-following, rule-following requires inference» (Boghossian, 2012, p. 15). So if we want to use the notion of rule-following to explain the nature of inference, the intentional view makes our attempted explanation circular. The embarrassing conclusion is this: we must acknowledge the failure of all attempts to provide an analysis of the notion of following a rule useful for a non-circular explanation of the nature of inference. Boghossian thus writes:

we face a stark choice between attempting to account for our mental lives without something that looks like the traditional notion of person-level reasoning, on the one hand, and being willing to take the notion of following a rule as an unanalyzable primitive, on the other. Since I have no idea how to dispense with the notion of reasoning, and since there are independent considerations that favor thinking that rule-following cannot be analyzed, I incline firmly towards the latter option. If this is correct, then inference is essentially a matter of following a rule of inference in one’s thought; and we can have no expectation that we will be able to give a non-circular analysis of what following a rule of inference amounts to (Boghossian, 2012, p. 17).

Assuming that rule-following is an unanalysable primitive, here is Boghossian’s account of the nature of inference: the inference of a subject  $S$  from the premises  $P^1, P^2 \dots, P^n$  to the conclusion  $C$  is the mental act of  $S$ ’s judging that  $C$  after having judged that  $P^1, P^2 \dots, P^n$  because  $S$  follows a rule according to which, if one is rationally permitted to believe that  $P^1$  and  $P^2 \dots$  and  $P^n$ , then one is permitted to believe that  $C$ . If we adopt this account of inference, how can we tackle the problem of compulsion?

A possible line of thought is to say that the compelling force of certain basic inferences depends on their being instances of meaning-constitutive rules. Consider the rule of *modus ponens*, according to which if one is permitted to believe  $A$  and ‘if  $A$ , then  $B$ ’, then one is permitted to believe  $B$ . According to the inferentialist conception of meaning that Boghossian has defended in some papers (cf. Boghossian 1997, 2003a, 2003b) the rule of *modus ponens* is constitutive of the meaning of the English word “if” and inferring according to *modus ponens* is part of what it is to possess the concept expressed by “if”. Let us term “justificatory inferentialism” the view according to which 1) some rules of inference are meaning-constitutive (or concept-constitutive) and 2) all meaning-constitutive (or concept-constitutive) rules are compelling. The justificatory inferentialist says that, since *modus ponens* is meaning-constitutive, if a subject

$S$  accepts the premises of an instance of *modus ponens*, then  $S$  is compelled to accept the conclusion. Suppose that Aldo accepts two premises  $A$  and ‘if  $A$ , then  $B$ ’. Aldo is forced to accept the conclusion  $B$  simply because Aldo understands the word ‘if’ and is thus implicitly aware that failing to accept the conclusion would render ‘if’ unintelligible. The compelling force of the inference consists in Aldo’s realizing that a refusal to accept the conclusion would clash with the meaning of the word ‘if’ in the major premise.

The main objection that can be leveled against justificatory inferentialism is that a rule of inference can be constitutive without being compelling. Consider the premise  $a$ ) “the behaviour of  $x$  manifests conflicting emotions and desires, lack of social contact, loss of will and bizarre or blunted emotional responses” and the conclusion  $b$ ) “ $x$  has schizophrenia”. Let  $\Sigma$  be the rule according to which, if one is entitled to believe premise  $(a)$ , then one is entitled to believe conclusion  $(b)$ . According to some psychiatrists (let us call them A-psychiatrists) rule  $\Sigma$  was constitutive of the concept “schizophrenia” (cf. Frith and Johnstone 2003, p. 30). But other psychiatrists (let us call them E-psychiatrists) criticized and rejected the concept of schizophrenia advocated by A-psychiatrists. For the E-psychiatrists an inference from  $(a)$  to  $(b)$  was not compelling, though they knew that it was constitutive of the concept “schizophrenia” used by A-psychiatrists. Thus rule  $\Sigma$  was constitutive of a concept but for E-psychiatrists it was devoid of compelling force, because they rationally rejected that very concept. A concept can be rationally rejected without jeopardizing its intelligibility. Another example is the rule *ex contradictione quodlibet*, according to which from the two contradictory premises  $A$  and not- $A$  one may infer any conclusion  $C$ . Supporters of paraconsistent logics are aware that in classical logic this rule is constitutive of the meaning of (classical) negation. But for the paraconsistent logician a recognizable instance of *ex contradictione quodlibet* is not compelling, because the paraconsistent logician rejects the classical concept of negation: classical negation is intelligible, but wrong. Both examples show that in an argumentative context a reasoner can rationally reject a concept and the corresponding language fragment. If one rejects the concept, one rejects (at least some) rules that are constitutive of that concept. The rejected rule that is constitutive of a rejected concept does not give rise to compelling inferences. Constitutivity is not sufficient for compulsion. Therefore constitutivity does not explain compulsion. Justificatory inferentialism fails to explain why an inference is compelling (cf. Cozzo 1994, 2008). The conclusion of our short inspection of Boghossian’s attempt at an account of inference seems to be that the attempt is unsuccessful. The analysis proposed by Boghossian is not a great improvement over our previous understanding of inference because it depends on a notion of rule-following that is both problematic and unanalysable. Moreover, the problem of compulsion remains unsolved.

#### §4 Dag Prawitz on inference

Dag Prawitz has proposed his new conception of inference in *Validity of inferences* (now Prawitz 2013), a paper presented at the Lauener symposium in 2006. The idea has been developed in many other subsequent papers (cf. Prawitz 2009, 2010, 2011, 2012, forthcoming). Prawitz distinguishes between intuitive and reflective inferences. An inference is intuitive if the subject is not aware of making it. We often

make intuitive inferences, but «when we deliberate over an issue or are epistemically vigilant in general, we are conscious about our assumptions and are careful about the inference steps that we take, anxious to get good reasons for the conclusion we draw». In this case we make reflective inferences: we are «aware of passing to a conclusion from a number of premises» (Prawitz forthcoming, p. 2). According to Prawitz, the premises and conclusions of reflective inferences are acts of judgement, the subject is a person and the relation between premises and conclusions is neither a mere succession, nor a mere causal connection: the transition from premises to conclusion is itself a mental act. Prawitz's aim is an adequate analysis of deductively valid reflective inferences. He thinks that an adequate characterization of deductive validity must imply that valid inferences are compelling. What does the act of performing a valid inference consist of? Clearly, it is not simply the act of passing from premises to conclusion. The act of passing is not enough: it is also necessary «to 'see' that the proposition occurring in the conclusion must be true given that the propositions occurring in the premisses are true» (Prawitz 2009, p. 179). To "see" that the conclusion must be true is to have an experience of the «necessity of thought» in the act of passage: «one is compelled to hold [the conclusion] true, given that one holds all [the premises] true» (Prawitz 2005, p. 677). But this use of the verb "to see" is metaphorical and «the problem is how to get a grip of this metaphoric use of 'see'» (Prawitz 2009, p. 179). Prawitz wants to give the metaphor a precise content by developing a *theory of grounds*.

The theory of grounds mathematically articulates a conception of our cognitive activity in which the main roles are played by certain acts and by certain states. The accomplishment of a cognitive *act* like the observation of a sunset brings about a new cognitive *state* of the subject: the subject *is justified* in making the judgement that the sun is setting. The *first basic idea* of the theory of grounds is to represent «the state of being justified in making a judgement» (2009, p. 179) as the possession of an abstract object: a ground. The act of observing the sunset is an act through which we come into possession of a ground for the judgement that the sun is setting. «Grounds on this conception [are] something that one gets in possession of by doing certain things» (Prawitz 2012, p. 893). Let us term an act of doing something through which we come into possession of a ground "a grounding act". When one performs a grounding act one comes into possession of a ground. Obviously, not only observations are grounding acts. The calculation through which we establish a numerical identity is also a grounding act. But the kind of grounding act that most directly concerns us is inference. This is the *second basic idea* of the theory of grounds:

the mental act that is performed in an inference may be represented [...] as an operation performed on the given grounds for the premisses that results in a ground for the conclusion, whereby seeing that the proposition affirmed is true. (Prawitz 2009, p. 188).

A *ground* is an abstract entity related to a particular judgement. A *grounding-operation* is a function with certain grounds as arguments and a determinate ground as value. Ground and grounding-operation are the two basic notions of the theory of grounds. The most detailed exposition of the theory of grounds can be found in the long essay *Explaining deductive inference* (Prawitz forthcoming). In terms of the two basic notions Prawitz defines the notions of *generic inference* and *valid generic inference*. A *generic inference* is determined by four kinds of elements: (1) a number of assertions or judgements  $A_1, A_2, \dots, A_n$ , called the premisses of the inference, (2) alleged grounds  $\alpha_1, \alpha_2, \dots, \alpha_n$  for  $A_1, A_2, \dots, A_n$ , (3) an operation  $\Phi$  and (4) a

judgement  $B$ , called the conclusion of the inference (cf. Prawitz forthcoming, p. 29). To make the inference is to apply operation  $\Phi$  to the alleged grounds  $\alpha_1, \alpha_2, \dots, \alpha_n$ . Prawitz adds that «no requirement is put on the alleged grounds and the operation; in other words  $\alpha_1, \alpha_2, \dots, \alpha_n$  may be any kind of entities, and  $\Phi$  may be any kind of operation» (*ibidem*). But a *valid* inference, as one should reasonably expect, must satisfy substantial requirements. In particular, the operation  $\Phi$  must be a genuine grounding-operation:

a generic inference [...] is (*deductively*) *valid*, if  $\alpha_1, \alpha_2, \dots$  and  $\alpha_n$  are grounds for  $A_1, A_2, \dots$ , and  $A_n$  and  $\Phi$  is an operation such that  $\Phi(\alpha_1, \alpha_2, \dots, \alpha_n)$  is a ground for the conclusion  $B$  (Prawitz forthcoming, p. 29).

The description offered here is only a rough outline, but I hope it reflects the essential ideas in Prawitz's view. If so, we can perhaps take provisional stock. Does Prawitz's analysis of inference solve the problem of compulsion? According to Prawitz's notion of deductive validity, every deductively valid inference has compelling force and transmits justification. The grounding-operation  $\Phi$  mathematically represents the «epistemic tie between premises and conclusion» (Prawitz 2009, pp. 181) established by the act of making the inference fused with the experience of being compelled. However, two objections can be raised, which I will summarize here (further details can be found in *Necessity of Thought* (Cozzo forthcoming) which refers to a less developed version of Prawitz's views).

The first objection is that Prawitz's mathematical representation of compelling inferences does not take into account compelling inferences with mistaken premises. Even if one of the premises of an instance of *modus ponens* is mistaken, a person who believes that both premises are true is no less compelled to accept the conclusion than a person who applies *modus ponens* to premises that are true and justified. To say this is to state the obvious. A satisfactory account of inferential compulsion should therefore be capable of representing the compelling force of the passage from premises to conclusion even when the premises are false or unjustified. The validity in Prawitz's sense of a valid generic inference is determined by the application of a grounding-operation  $\Phi$ , which mathematically represents the "necessity of thought", i. e. the experience of compulsion. The operation  $\Phi$ , however, can be applied only to grounds for the premises. If some of the premises are mistaken, and thus unjustified, there are no genuine grounds for those premises; there may be alleged grounds, to be sure, but for alleged grounds no grounding-operation  $\Phi$  is defined. Therefore Prawitz's analysis leaves out all the compelling inferences with mistaken premises. The second objection is that the social context in which the act of inference is performed seems to be irrelevant in Prawitz's treatment of the problem of compulsion. This is an objection, in my opinion, because there are reasons to think that the compelling force of an inference is relative to a particular kind of social context.

## §5 The contextual view

The initial idea is that inferences are acts in a public context. Part of the context are speakers who perform linguistic acts. Some linguistic acts involve commitments: the agent is a proponent who undertakes commitments to an interlocutor (and possibly to a larger group). Acts of this kind include assertions and inferences. A speaker performs an act of *assertion* if, and only if, she (or he) utters a sentence  $E$  and implicitly undertakes the commitment that  $E$  is true in the context of utterance. As Peirce wrote: «to assert a

proposition is to make oneself responsible for its truth» (1902b, *C.P.* 5.543, p. 384, cf. MacFarlane 2011). What is it for a proponent to undertake the commitment that the uttered sentence is true? This question can be answered by describing the interaction between proponent (speaker, asserter) and interlocutors (hearers). The practice of making assertions depends on two facts: the first is that assertions are often (not always) accepted by interlocutors and the second is that interlocutors act on the accepted assertions: the asserted sentences are treated as a basis for action because they are believed to be true in the context of utterance. It is obvious that this practice is very useful because a hearer often needs to come into possession of some information in order to decide how to act and the speaker who makes the assertion may be in a better position to get the information in question. By making the assertion, the speaker conveys the information and the hearer can take advantage of the assertion and act accordingly. The fact that people act on the basis of accepted assertions explains how an instrumental use of assertion is possible: speakers assert sentences in order to induce the hearer to do and believe what they want and often they deliberately make untrue assertions in order to influence the hearer's actions. But the practice of assertion continues to exist because interlocutors generally rely on the truth of assertions, until proved otherwise. Interlocutors have confidence because everyone agrees that an asserter will be held responsible if somebody acts on the basis of the asserted sentence, and this sentence turns out to have been untrue. By taking responsibility for the truth of the asserted sentence, the asserter implicitly acknowledges that he, or she, has certain duties and that the interlocutor has certain rights: the interlocutor has the right to ask for evidence supporting the truth of the asserted sentence and to criticize the assertion if satisfactory evidence is lacking; the asserter has the duty to respond to the interlocutor's objections, to provide a justification of the assertion and to retract the assertion if the evidence is against it. One might remark that many speakers do not let anybody challenge their assertions. But the remark that many rights and duties are not respected is no objection to the acknowledged existence of those rights and duties. The practice of making assertions, criticizing, justifying, accepting or withdrawing them is a public manifestation of a basic tacit agreement that an asserter is committed to the truth of the asserted sentence.

Like assertions, inferences are acts that involve commitments. A speaker *S* performs an act of *inference* if, and only if, 1) *S* asserts some *premises* (possibly under assumption or depending on assumptions), 2) *S* passes from the premises to another assertion, the *conclusion* (also possibly depending on assumptions), 3) in passing from the premises to the conclusion *S* (implicitly) undertakes the *commitment* that the premises support the conclusion. The latter commitment is sometimes expressed by “therefore”, “hence”, “because” and similar words or phrases. What is it for a proponent to undertake the commitment that the premises support the conclusion? This question can be answered by describing a certain way of interacting with interlocutors. The proponent of the inference acknowledges certain rights and certain duties: the interlocutor has the right to criticize the act of passage and to ask for reasons for the connection between premises and conclusion; the proponent has the duty to reply to the interlocutor's objections, or withdraw the inference.

The interlocutor can accept the inference or reject it. If the interlocutor accepts the inference and the premises, then the interlocutor will accept the conclusion. But how can the interlocutor be compelled to accept the inference? How is inferential compulsion possible? Let us consider the situation in which a reluctant interlocutor is forced to accept an inference because it is compelling. Is the reluctant interlocutor really constrained? Not really. The interlocutor can imitate Wittgenstein and say: “I am not compelled to go this way in the chain of inferences. After all I can go as I choose!”. So the key question is: in what sense is the interlocutor compelled?

The obvious answer is: one is compelled in so far as one *cares for truth* or *aims at truth*. Proponent and interlocutor sometimes care for truth and aim at truth, and sometimes not. They *can choose* whether to aim at truth. In this sense they are not compelled and they are free. But if they aim at truth, then they are compelled. Compulsion arises in a special context in which the participants aim at truth. So, in order to understand compulsion, we must understand what it is to care for truth or to aim at truth. I suggest that in order to explain the notion of “aiming at truth” we do not need to define truth. “Aiming at truth” is a general way of acting in conformity with certain epistemic virtues (cf. Cozzo 2012). Epistemic virtues are more specific ways of acting, which can be described by detailing what kind of actions belong to them. An incomplete list of epistemic virtues includes curiosity, reflectiveness, carefulness, sensitivity to detail, critical attitude, self-scrutiny, intellectual honesty, fairness, flexibility, open-mindedness, intellectual non-conformism, tenacity, intellectual courage, and a special wisdom enabling one to find the right dosage of virtues appropriate to the given context (cf. Zagzebski 1996, Fairweather and Zagzebski 2001, Roberts and Wood 2007, Baehr 2011). Let us say that a social context in which the participants aim at truth is an epistemic context. An epistemic context has four ingredients: *i*) a community of persons (proponent, interlocutor, audience) who aim at truth; *ii*) shared languages; *iii*) accepted knowledge-claims (arguments, statements, non-linguistic evidence); *iv*) problems (questions considered important and hypotheses for their solution). Epistemic contexts are essentially *unstable*. Persons aiming at truth exercise a critical attitude that leads them to challenge and sometimes to reject old problems, old arguments and old languages. One of the four components of an epistemic context are open problems, which stimulate the epistemic virtues of curiosity, open-mindedness, flexibility, intellectual courage: the results are new problems, new hypotheses, new languages, new arguments. In this way an old epistemic context  $C^1$  generates a new epistemic context  $C^2$ , which generates another epistemic context  $C^3$  and so on. Let us say that a series of epistemic contexts  $C^1, C^2, C^3 \dots, C^n \dots$ , where each  $C^{k+1}$  is generated by a preceding epistemic context  $C^k$  is a *research path*.

The basic idea of the contextual conception of inferences is that inferences belong to a social context. An inference  $I$ , conceived as an individual action performed at a certain time, is determined not only by the subject who makes it, by premises and conclusion, arguments for the premises, assumptions on which premises and conclusion depend, but also by the social context  $C$  in which the inference is made. Of an individual inference what Philip Davis and Reuben Hersh say of a whole mathematical argument holds true: «a mathematical argument is addressed to a human audience, which possesses a background knowledge». (Davis and Hersh 1987, p. 67). We can say that an individual inference  $I$  is *compelling in an epistemic*

*context C* if, and only if, *I* is made in *C* and *I* stands up to all the objections raised in *C*. The compelling force of an inference is relative to an epistemic context, because compulsion is a property of individual inferences and an inference is individuated by the context in which it is made.

Suppose that an individual inference *I* is compelling in an epistemic context *C* and another individual inference *J*, similar to *I* in all other respects, is made in a different epistemic context *G*. It is possible that the second inference *J* is not compelling because in its context *G* new effective objections are raised against it. If we abstract from the subject, the time and the social context, we can speak, following Prawitz, of a *generic* inference. Different individual inferences can exemplify or instantiate the same generic inference. But the property of being compelling does not apply to generic inferences: of two individual inferences that exemplify the same generic inference one can be compelling in its epistemic context and the other can fail to be compelling in the different context to which it belongs. Though the instances of a generic inference are compelling in many contexts, one can never rule out that a new epistemic context will be generated in the future in which an instance of that generic inference will be rationally rejected. For example, an individual inference from the two premises “all fishes are animals with a backbone” and “all fishes are aquatic animals” to the conclusion “some animals with a backbone are aquatic” was compelling in medieval epistemic contexts, but another individual inference with the same premises and the same conclusion is not compelling now, if we reformulate these sentences in the usual way in the language of first order logic.

Why is an inference compelling in an epistemic context? There are three different possible reasons. In the *first* case an inference *I* can be *meaning-constitutive*. In this case each participant in the epistemic context expects of other participants that whoever understands and uses certain expressions of an accepted language accepts the inference *I* and neither envisages the possibility of a justification of *I*, nor acknowledges the need to give such a justification. If someone criticizes a meaning-constitutive inference, the immediate reaction will often be: “but this is what the word ...*means!*”. For example whoever understands ‘if’ knows that if one uses (and thus accepts) the language-fragment involving the word ‘if’, one must accept a recognizable instance of modus ponens without further justification. In the *second* case an inference is not treated as meaning-constitutive, but nobody in the epistemic context considers it controversial. In the *third* case an inference was considered controversial and participants in the context raised some objections to it, but the inference has stood up to criticisms. So, there are three kinds of compelling inferences. The compelling force of meaning-constitutive inferences is stronger than the compelling force of the other two kinds of inferences, which can differ in degree.

To admit that some inferences are meaning-constitutive is to adopt some kind of inferentialism. But the variety of inferentialism which is part of the contextual view is different from Boghossian’s inferentialism. The contextual view, as it is formulated here, involves a *fallibilist inferentialism* (cf. Cozzo 1994, 2002): being meaning-constitutive is not sufficient for being compelling, as we have seen in section 3. We can give shape to meanings by adopting certain inferential practices, but the meanings so shaped can be rationally criticized, and rationally rejected. It can happen that an individual inference  $I^1$  is compelling in an epistemic context  $C^1$  because in  $C^1$  the participants accept a fragment of language containing certain words of

which inference  $I^1$  is meaning-constitutive, but in a new context  $C^2$  generated by  $C^1$  the language-fragment in question is rationally rejected and an individual inference  $I^2$  fails to be compelling though it exemplifies the same generic inference.

## BIBLIOGRAPHY

- Bab, S. and Robering, K. (2010 eds), *Judgements and Propositions*, Logos Verlag, Berlin.
- Baehr, J. (2011), *The Inquiring Mind*, Oxford University Press, Oxford.
- Bernardi C. and Pagli P. (1985 eds), *Atti degli incontri di logica matematica*, vol. II, Università di Siena, Siena.
- Boghossian, Paul (1997), *Analyticity*, in Hale B. and Wright C. (1997 eds), pp. 331–368.
- Boghossian, Paul (2003a), *Epistemic Analyticity: A Defense*, in «Grazer philosophische Studien», 66, pp. 15-35 (Rep. in Boghossian 2008b).
- Boghossian, Paul (2003b), *Blind Reasoning*, in «Proceedings of the Aristotelian Society Supplementary Volume», 77, pp. 225–248 (Rep. in Boghossian 2008b).
- Boghossian, P. (2008a), *Epistemic rules*, in «Journal of Philosophy», 105, pp. 472-500 (Rep. in Boghossian 2008b).
- Boghossian, P. (2008b), *Content and justification: Philosophical papers*, Oxford University Press, Oxford.
- Boghossian, P. (2012), *What is inference?*, in «Philosophical Studies», published on line.
- Brown J. and Cappelen H. (2011 eds), *Assertion*, Oxford University Press, Oxford.
- Cellucci, C. (2002), *Filosofia e matematica*, Laterza, Roma-Bari.
- Cellucci, C. (2008), *Perché ancora la filosofia*, Laterza, Roma-Bari.
- Cellucci, C., Grosholz, E. R., Ippoliti, E. (2011 eds), *Logic and Knowledge*, Cambridge Scholars Publishing, Newcastle upon Tyne.
- Childers, T. (1998 ed.), *The LOGICA Yearbook 1997*, Filosofia Publisher, Institute of Philosophy, Czech Academy of Sciences, Prague.
- Cozzo, C. (1994), *Meaning and Argument*, Almqvist & Wiksell, Stockholm.
- Cozzo, C. (2002), *Does Epistemological Holism Lead to Meaning Holism?*, in «Topoi» 21, pp. 25-45.
- Cozzo, C. (2008), *On the Copernican Turn in Semantics*, in «Theoria, a Swedish journal of philosophy», 74, pp. 295-317.
- Cozzo, C. (2012), *Gulliver, truth and virtue*, in «Topoi», 31, pp. 59-66.
- Cozzo, C. (forthcoming), *Necessity of Thought*, in Wansing H. (forthcoming, ed.).
- Davis P. J. e Hersh R. (1987), *Rhetoric and Mathematics*. In: Nelson J.S., Megill A., McCloskey D.N. (1987 eds), pp. 53-68.
- Došen, K. (forthcoming), *Inferential semantics*, in Wansing H. (forthcoming, ed.).
- Dummett, M. (1991), *The Logical Basis of Metaphysics*, Duckworth, London.
- Eisele, C. (1985 ed.), *Historical Perspectives on Peirce's Logic of Science: A History of Science*, vol. 2, Mouton De Gruyter, Berlin, New York, Amsterdam.
- Fairweather A. and Zagzebski L. (2001 eds.), *Virtue Epistemology: Essays in Epistemic Virtue and Responsibility*, Oxford University Press, Oxford.
- Frauchinger M. (2013 ed.), *Reference, Rationality and Phenomenology. Themes from Føllesdal*, Ontos Verlag, Heusenstamm.
- Frege, G. (1906), *Über die Grundlagen der Geometrie*, in «Jahresberichte der Deutschen Mathematiker-Vereinigung», 15, pp. 377–403.
- Frith, C. and Johnstone E. (2003), *Schizophrenia. A Very Short Introduction*, Oxford University Press, Oxford.
- Gärdenfors, P., Wolinski, J. and Kijania-Placek, K. (2002 eds), *The Scope of Logic, Methodology and Philosophy of Science*. Vol. II., Klüver Academic Publishers, Dordrecht.
- Hale B. and Wright C. (1997 eds), *A Companion to the Philosophy of Language*, Blackwell, Oxford.
- Harman, G. (1986), *Change in view*, MIT Press, Cambridge.
- Kant, I. (1985), *Kritik der reinen Vernunft*, Reclam, Stuttgart.
- MacFarlane J.(2011), *What is Assertion?*, in Brown J. and Cappelen H. (2011 eds), pp. 79-96.
- Martin Löf P. (1985), *On the Meaning of the Logical Constants and the Justification of the Logical Laws*, in Bernardi and Pagli (1985 eds), pp. 291-340.
- Nelson J.S., Megill A., McCloskey D.N. (1987 eds), *The Rhetoric of the Human Sciences*, University of Wisconsin Press, Madison.
- Peirce, C. S. (1868), *Some consequences of four incapacities*, in «Journal of Speculative Philosophy», 2, pp. 140-57.
- Peirce, C. S. (1902), *Belief and Judgment (from Reason's Rules)*, in Peirce (1960).
- Peirce C. S. (1960), *Collected Papers. Volume V*, ed. by Hartshorne C. and Weiss P, Harvard University Press, Cambridge, Mass.

- Peirce, C. S. (1985), *Hume's Argument against Miracles, and the Idea of Natural Law*, in Eisele (1985 ed.), pp. 904-912.
- Pelis, M. (2009), *The LOGICA Yearbook 2008*, College Publications, London.
- Prawitz, D. (1973), *Towards a Foundation of a General Proof Theory*, in P. Suppes et al. (1973 eds), pp. 225-50.
- Prawitz, D. (2005), *Logical Consequence from a Constructivist Point of View*, in Shapiro (2005 ed.), pp. 671-695.
- Prawitz, D. (2009), *Inference and Knowledge*, in Pelis (ed.), pp 175-192.
- Prawitz, D. (2010), *Assertions in the context of inferences*, in Bab and Robering (2010 eds), pp. 89-98.
- Prawitz, D. (2011), *Proofs and perfect syllogisms*”, in Cellucci C., Grosholz E., Ippoliti E. (2011 eds), pp. 385-402.
- Prawitz, D. (2012), *The epistemic significance of valid inference in «Synthese»*, 187, 3 (Special Issue: S. Lindström, E. Palmgren, D. Westerståhl eds., *The Philosophy of logical Consequence and Inference.*), pp. 887-898.
- Prawitz, D. (2013), *Validity of Inferences*, in Frauchinger M. (ed.) *Reference, Rationality and Phenomenology. Themes from Føllesdal*, pp. 179-204.
- Prawitz D. (forthcoming), *Explaining deductive inference*, in Wansing H. (forthcoming, ed.).
- Prawitz D. and Westerståhl D (1994 eds.), *Logic and Philosophy of Science in Uppsala*, Kluwer, Dordrecht.
- Roberts C. R. and Wood W. J. (2007), *Intellectual Virtues. An Essay in Regulative Epistemology*, Clarendon Press, Oxford.
- Shapiro, S. (2005 ed.), *The Oxford Handbook of Philosophy of Mathematics and Logic*, Oxford University Press, Oxford.
- Sundholm, G. (1994), *Ontologic versus Epistemologic: Some Strands in the Development of Logic, 1837-1957*, in Prawitz D. and Westerståhl D. (1994 eds.), pp. 373-384.
- Sundholm, G. (1998), *Inference versus consequence*, in Childers (1998 ed.), pp. 26-35.
- Sundholm, G. (2002), *A century of inference: 1837-1936*, in Gärdenfors, Wolinski and Kijania-Placek (2002 eds.), pp. 565-580.
- Suppes P. et al. (1973 eds), *Logic, Methodology and Philosophy of Science IV*, North Holland, Amsterdam.
- Thomason, R. H. (1970), *Symbolic Logic*, Macmillan, New York.
- Wansing, H. (forthcoming, ed.), *Dag Prawitz on Proofs and Meaning*, Springer, Dordrecht.
- Wittgenstein, L. (1956), *Remarks on the Foundations of Mathematics*, ed. by G. H. von Wright, R. Rhees, G. E. M. Anscombe Blackwell, Oxford.
- Zagzebski L. (1996), *Virtues of the mind*, Cambridge University Press, Cambridge UK.