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A CARNAPIAN APPROACH TO COUNTEREXAMPLES TO MODUS PONENS

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Abstract. This paper proposes a Carnapian approach to known counterexamples to Modus Ponens (henceforth, MP). More specifically, it argues that instead of rejecting MP as invalid in certain interpretations, one should regard the interpretations themselves as *non-normal*, in Carnap's sense.

Keywords: counterexamples to modus ponens; Carnap's formalization of logic; non-normal interpretations.

I. KNOWN COUNTEREXAMPLES TO MP

It is widely known that there are some situations in which MP seems to fail to preserve truth. One such situation has been described by Vann McGee in relation to the 1980 elections in the US (McGee 1985). Opinion polls showed the Republican Ronald Regan decisively ahead of the Democrat Jimmy Carter, and the other Republican in the race, John Anderson, a third distant. McGee points out that those aware of the poll believed, with good reason, the premises of the following argument, but they did not have any reason to believe its conclusion:

McG_P1. If a Republican wins the election, then if it is not Regan who wins, it will be Anderson.
McG_P2. A republican wins the election.
McG_C. Therefore, if it is not Regan who wins, it will be Anderson.

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This alleged counterexample to MP has received many criticisms. Some authors, for instance, rejected it because MP, as usually understood, is taken to preserve truth rather than grounds for believing (Sinnott-Armstrong *et al*., 1986). Some others argued that the context of the argument should be considered as a part of it, and since McGee fails to do this, the inference from McG_P1 and McG_P2 to McG_C is a mere enthymeme, rather than an instance of MP (Fulda 2010).

More recently, Niko Kolodny and John MacFarlane have presented another counterexample to MP (Kolodny and Macfarlane 2010). Consider a situation in which several miners are trapped in a mine, either in shaft A or in shaft B. We do not know which shaft they are in, but we do know that water threatens to flood the shafts. We have enough sandbags to block one shaft, but not both. If we block one shaft, all the water will go into the other shaft, killing all miners inside. If we block neither, each shaft will fill halfway with water, and just one miner, the lowest in the shaft, will drown. When deliberating about what to do, it appears natural to reason in the following way:

KM_P1. If the miners are in shaft A, we ought to block shaft A.
KM_P2. If the miners are in shaft B, we ought to block shaft B.
KM_P3. Either the miners are in shaft A or they are in shaft B.
KM_C. Therefore, either we ought to block shaft A or we ought to block shaft B.

However, it also appears natural that in this situation w*e ought to block neither shaft*. The apparent paradox shows, according to Kolodny and MacFarlane, that our reasoning must be considered invalid, despite "its obvious logical form". This entails that at least one of the three rules involved (disjunction elimination, disjunction introduction, MP) must be taken as invalid. Since rejecting disjunction introduction or disjunction elimination would not solve the paradox (see Kolodny and John MacFarlane 2010, 127-28) the only way out is by faulting MP.

In order to explain "why modus ponens fails when it does, and also why it seems to work fine in most cases," Kolodny and MacFarlane propose a semantics for deontic modals and indicative conditionals. According to this semantics, the truth of a sentence is relative to a point of evaluation, i.e. a structure <w, i> consisting in a possible world state (w) and a set of possible world states (i). An argument is valid iff there is no structure <w, i> such that the premises are all true at <w, i> and the conclusion is false at <w, i>. This semantics allows for the invalidity of the above instance of MP: the consequent of KM_P1 is true relative to the point of evaluation determined by the information provided by its antecedent, i.e., it is true at <w, ia>, where ia includes only possible world states where the miners are in shaft A, but KM_C is false relative to the same point of evaluation, i.e., it is false at <w, ia>, although KM_C is true relative to another point of evaluation, i.e., it is true at <w, iab>, where iab includes both possible world states where the miners are in shaft A and possible world states where they are in shaft B (Kolodny and MacFarlane 2010,137-38).

Some authors criticized this approach by arguing that the miners paradox could be solved without rejecting MP's validity, by assuming a dynamic notion of logical consequence (Willer 2012). In agrement with such criticisms, we believe that the paradox should not be taken to fault MP's validity, but this is because there is actually no paradox to start with, since, as we want to argue, the very applicability of MP in situations like the one considered by Kolodny and MacFarlane should be resisted.

We sketch an approach to the known counterexamples to MP that does not require giving up the classical logical point of view. Such counterexamples describe an interpretation in which a rule of inference, typically considered to be valid, fails to be valid, thereby exhibiting a mismatch between the syntax and semantics of classical logic. We want to suggest that instead of faulting MP, one should rather regard the described interpretation as *non-normal* – in Carnap's sense, which will be briefly presented below. Our point of view is, roughly, that the failure of MP's validity does not need to be explained, because the situations in which MP has been taken to fail are not situations in which it should be taken to fail.

II. CARNAP'S FORMALIZATION OF LOGIC

In his wonderful 1943 book, *Formalization of Logic,* Rudolf Carnap pointed out that there exist non-normal interpretations of classical logical operators. Non-normal interpretations are true interpretations of a logical calculus, i.e., interpretations that do not affect its soundness and completeness, which provide logical operators with a different meaning from the one given by normal truth-tables (NTT). Consequently, as Carnap emphasized, not all logical properties of the operators defined by NTT are represented in the propositional calculus (Carnap 1943, 94).

Non-normal interpretations show that the standard rules of inference are not categorical, i.e., that logical operators may have non-isomorphic interpretations, which is why it raises a challenge for contemporary logical inferentialism (Raatikainen 2008, Murzi and Hjortland 2009, Koslow 2010). The existence of non-normal interpretations motivates Carnap's project of a "full" formalization of logic, i.e. a logical calculus in which all properties of the operators are formalized by inferential rules.

According to Carnap, there are non-normal interpretations in which every sentence is true, and non-normal interpretations in which at least one sentence is false. A formula's property of being true when its negation is false, and conversely, is not represented by the rules for negation. The disjunction operator meets the same difficulty because a disjunctive formula's property of being false when its both disjuncts are false is not represented by the rules for disjunction. In this case, we can have non-normal interpretations in which a formula and its negation are both true, but also non-normal interpretations in which a formula and its negation are false and a disjunction is true even if its disjuncts are false.

We obtain non-normal interpretations of the former kind by letting every sentence express a true proposition. A nice example of non-normal interpretation of the latter kind was given by Alonzo Church in his review of Carnap's book. Church presents a calculus containing only two elementary sentences: A1 and A2, where A1 is interpreted as "There are 14 days in a week" and A2 is interpreted as "There are 21 days in a week". Every molecular sentence will be taken to express a proposition of the form "There are n days in a week" according to the following rules:

a) If P expresses a proposition "There are x days in a week", then ~P shall express "There are z days in a week", where z is obtained as the quotient 294/x.
b) If P and Q express "There are x days in a week" and "There are y days in a week", respectively, then P v Q shall express "There are z days in a week" where z is obtained as the greatest common divisor of x and y.

We will then have the following tables:

~	
14	21
21	14

v	14	21
14	14	7
21	7	21

An interpretation of this calculus is non-normal because both P and ~P express false propositions, and P v Q expresses the true proposition "There are 7 days in a week" although P and Q both express false propositions. (Church 1944, 494. See also Smiley 1996, 7).

We should immediately note that the existence of non-normal interpretations for negation and disjunction entails that also implication allows for non-normal interpretations, due to its being expressible as a disjunction. Consequently, in a non-normal interpretation of implication, one could validly infer a false sentence from true ones. For the purposes of this paper, we can define a MP-non-normal interpretation as one that allows inferences from true to false. Then, of course, the meaning of implication in a MP-non-normal interpretation is different than the meaning of implication as provided by a MP-normal interpretation, e.g., by NTT.

In the next section, we sketch a proposal to treat those interpretations that seem to undermine the validity of MP as non-normal interpretations, in Carnap's sense. We also briefly address two possible objections to this proposal.

III. ONE RULE, TWO MEANINGS

The known counterexamples to MP indicate situations in which we can apparently infer from true or accepted sentences to false sentences or ones that cannot be accepted. Their proponents seem to assume that in those situations MP is actually applicable, i.e., that in those situations we can, and do actually, reason by MP. Then, since reasoning in this way takes us from accepted or true sentences to false sentences or ones that cannot be accepted, they claim that we are forced to reject the validity of MP.

But why should one believe that, in situations like the ones described in the first section, we can and do actually reason by MP? Do we, and can we, in such situations, reason by the rule of inference typically called "MP" that has the typical meaning associated with it?

We have seen, in the previous section, that the meaning of implication in a MP-non-normal interpretation is different than the meaning of implication in a MP-normal interpretation, such as given by NTT. This entails that MP has a different meaning in those situations in which it is taken to fail, situations that we regard as MP-non-normal interpretations, than in those situations in which it is considered valid, which we regard as MP-normal interpretations. This immediately suggests that, in the face of a paradox like the one described in the first section, there is a way of preserving MP's validity after all.

Consider, first, an analogy between reasoning that involves MP and reasoning according to the laws of classical mechanics. Just as one could consider MP as invalid in some situations or one could regard these situations as MP-non-normal interpretations, one could similarly consider the laws of classical mechanics as invalid in special relativistic settings or one could regard such settings as non-classical-mechanical, i.e., as interpretations in which the laws of classical mechanics cannot apply. The view that we favor, i.e., the one which preserves the validity of MP and regards MP-non-normal interpretations, is similar to the view according to which one preserves the laws of classical mechanics as valid, but regards the relativistic settings as non-classical-mechanical interpretations.

Secondly, it should be clear that in situations like the ones described in the first section, in which MP allegedly fails – situations that, as suggested, we regard as MP-non-normal interpretations – we *cannot* reason by the rule of inference typically called "MP" that has the typical meaning associated with it, i.e., as given by NTT. This is because, in a MP-non-normal interpretation, MP does *not* have the typical meaning. Rather, its meaning is such that the inference from truth to falsehood is allowed. If one fails to distinguish these two meanings of MP, as Kolodny and MacFarlane appear to do, then one is guilty of making an equivocation. Considering the laws of classical mechanics might help us again to see the point. For these laws *cannot* be applied in special relativistic settings precisely because their meaning is provided by classical-mechanical settings. Changing the settings changes the meaning of the laws.

However, one could raise the objection that rules of inference are purely syntactic instruments, with no meaning attached to them. From this point of view, MP is the same rule in all interpretations, and then its applicability should not be restricted only to some subclass of interpretations. Although in certain interpretations MP blocks the inference from truth to false, in other interpretations MP allows it. One typically considers the former as a valid application, and the latter as invalid. So the paradox presented by Kolodny and MacFarlane is real.

But this objection misses the target. For in situations like those described in the first section, MP is *not* considered a purely syntactic instrument. Rather, it is considered as having the meaning provided by NTT. But this, we believe, is a mistake. For in such situations, as already mentioned, MP is such that the inference from truth to falsehood is allowed. Thus, MP has here, in a MP-non-normal interpretation, a different meaning than the typical one provided by NTT. This, however, does not entail, by itself, any breach of validity.

Another objection that could be raised against the approach proposed in this paper is that while Kolodny and MacFarlane's paradox is taken to show the invalidity of MP for indicative conditionals (Kolodny and MacFarlane, 2010, 138), what we called above a MP-non-normal interpretation is a non-normal interpretation of material implication. The material implication is defined by the normal truth-tables (NTT) but, as is well known, it is not adequate for all uses of implication in natural language, since it permits for an implication to be true even when its antecedent is false. In contrast, an indicative conditional is taken to be true only if its antecedent is true.

But this objection too can be dismissed, if we note that a non-normal interpretation of material implication, again in Carnap's sense, is also a non-normal interpretation of indicative conditionals. This is so because a non-normal interpretation of material implication allows inferences from truth to falsehood, rather than blocking inference from falsehood. Only if it blocked inference from falsehood, would a non-normal interpretation of material implication fail to be also a non-normal interpretation of indicative conditionals. But this is not the case, as we showed above in the second section.

IV. CONCLUSION

Our aim in this paper was to sketch a different approach to known counterexamples to MP, one that does not require giving up classical logic. We have argued that instead of rejecting MP as invalid in some situations in which it has been taken to be invalid, we should preserve its validity and regard the situations as describing MP-non-normal interpretations, in Carnap's sense. Just like the laws of classical mechanics are applicable only in classical mechanical settings, MP is a rule of inference with a restricted area of applicability, since it cannot be applied to MP-non-normal interpretations, if associated with its typical meaning provided by NTT.

This approach to known counterexamples to MP does not assume that the existence of non-normal interpretations for classical logical operators is not a problem for contemporary logical inferentialism. Indeed, as mentioned at the outset, this problem has been recently addressed in a number of papers (e.g., Smiley 1996, Rumfitt 1997, 2000). What we want to emphasize, however, is that the existence of non-normal interpretations for classical logical operators allows us to deal with the challenge raised by the known counterexamples to MP. Failure of categoricity is not always a theoretical disadvantage. There is a further question, of course, whether a categorical formalization of classical logic would actually prevent a successful solution to this challenge.

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