CURSOS E CONGRESOS

La Filosofía Analítica en el Cambio de Milenio

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DUAL INTUITIONISTIC PARACONSISTENCY WITHOUT ONTOLOGICAL COMMITMENTS

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ABSTRACT: The issue of this paper is to offer two (dialogical) ways of defending a non-committal interpretation of paraconsistency: we will call one the *permissive* interpretation and the other the *non-ontological commitment* interpretation. Stating contradictions and negations is from a *permissive* point of view of paraconsistency a purely formal matter: If you do so, so can I.
The *non-ontological commitment* approach results from two rules. One restricts the use and introduction of singular terms to its formal use. The other establishes how to combine the permissive interpretation with this restriction in a second order free logic.
KEYWORDS: Logic, contradiction, inconsistency, paraconsistency, dialogical logic, free logic.

Introduction

More than fifty years ago an unusual challenge appeared in analytic philosophy: In a now famous meeting of the Mathematical and Natural Science Department of the University of Torun on Friday 19 March 1949 the Polish logician Stanisląw Jaskowski presented a paper entitled *A propositional Calculus for Inconsistent Deductive Systems*, which contested the Principle of Non-Contradiction. The Brazilian logician Newton C. A. da Costa introduced paraconsistent logic in his PhD in the 60s (da Costa [1974], in English) and since then developed many paraconsistent systems. Nowadays two main semantical approaches can be distinguished. One, which we call the *compelling interpretation*, based on a naive correspondence theory, stresses that paraconsistent theories are ontologically committed to inconsistent objects. The other, which we call the *non-committal interpretation,* does not assume this ontological commitment. The issue of this paper is to offer two (dialogical) ways of defending a non-committal interpretation of paraconsistency: we will call one the *permissive* interpretation and the other the *non-ontological commitment* interpretation. Stating contradictions and negations is from a permissive point of view of paraconsistency a purely formal matter: If you do so, so can I.

The non-ontological commitment approach results from two rules. One restricts the use and introduction of singular terms to its formal use yielding a type of free logic.. The other establishes how to combine the permissive interpretation with this restriction on singular terms.

1 The permissive interpretation of paraconsistency

1.1 Dialogical logic

Dialogical logic, suggested by Paul Lorenzen in 1958 and developed by Kuno Lorenz in several papers from 1961 onwards[1], was introduced as a pragmatical semantics for both classical and intuitionistic logic.

The dialogical approach studies logic as an inherently pragmatic notion using an overtly externalised argumentation formulated as a *dialogue* between two parties taking up the roles of an *Opponent* (**O** in the following) and a *Proponent* (**P**) of the issue at stake, called the principal *thesis* of the dialogue. **P** has to try to defend the thesis against all possible allowed criticism (*attacks*) by **O**, thereby being allowed to use statements that **O** may have made at the outset of the dialogue. The thesis A is logically valid if and only if **P** can succeed in defending A against all possible allowed criticism by **O**. In the jargon of game theory: **P** has a *winning strategy* for A. We will now describe an intuitionistic and a classical dialogical logic, starting with the intuitionistic version.

Suppose the elements of first-order language are given with small letters (a, b, c, ...) for elementary formulae, capital italic letters for formulae that might be complex (A, B, C, ...), capital italic bold letters ($\boldsymbol{A}$, $\boldsymbol{B}$, $\boldsymbol{C}$, ...) for predicators and τ_i for constants. A dialogue is a sequence of formulae of this first-order language that are stated by either **P** or **O**[2]. Every move - with the exception of the first move through which the Proponent states the thesis - is an aggressive or a defensive act. In dialogical logic the meaning in use of the logical particles is given by two types of rules which determine their *local* (*particle rules*) and their *global* meaning (*structural rules*).

The particle rules specify for each particle a pair of moves consisting of an attack and (if possible) the corresponding defence. Each such pair is called a

[1] Lorenzen/Lorenz [1978].
[2] Sometimes we use **X** and **Y** to denote **P** and **O** with **X**≠**Y**.

round. A round is *opened* by an attack and is *closed* by a defence if one is possible.

$\neg, \wedge, \vee, \rightarrow; \bigwedge, \bigvee$	*ATTACK*	*DEFENCE*
$\neg A$	A	$\otimes$ *(The symbol '$\otimes$' indicates that no defence, but only counterattack is allowed)*
$A \wedge B$	?L(eft) ------------------------- ?R(ight) *(The attacker chooses)*	A ------------------------- B
$A \vee B$	?	A ------------------------- $!_m B$ *(The defender chooses)*
$A \rightarrow B$	$?A$	$!_m B$
$\bigwedge_x A$	$?_\tau$ *(The attacker chooses)*	$A[\tau/x]$
$\bigvee_x A$	?	$A[\tau/x]$ *(The defender chooses)*

Fig. 1: Particle Rules

The first column in Fig. 1 contains the form of the formula in question, the second one possible attacks against this formula, and the last one possible defences against those attacks. (The symbol "⊗" indicates that no defence is possible.) Note that for example "?L" is a move - more precisely it is an attack - but not a formula. Thus if one partner in the dialogue states a conjunction, the other may initiate the attack by asking either for the left side of the conjunction ("show me that the left-hand side of the conjunction holds", or "?L" for short) or the right-hand side ("show me that the right side of the conjunction holds", or "?R"). If, on the other hand, one partner in the dialogue states a disjunction, the other may initiate the attack by asking to be shown *any* side of the disjunction ("?").

Next, we fix the way formulae are sequenced to form dialogues with a set of structural rules (orig. *Rahmenregeln*):

R0: Formulae are alternately uttered by **P** and **O**. The *initial formula* is uttered by **P**. It provides the topic of argument. Every formula below the initial formula is either an attack or a defence against an earlier formula stated by the other player.

R1: P may only repeat attacks if the situation has changed: a situation is *changed* (allowing the repetition of an attack) if and only if **O** has introduced a new atomic formula (which can now be used by **P**).[3] (No other repetitions are allowed.)
R2 ***(formal rule for atomic formulae)*: P** may not introduce atomic formulae: any atomic formula must be stated by **O** first.
R3 ***(winning rule)*: X** wins iff it is **Y**'s turn but he cannot move (whether attack or defence).
R_I4 ***(intuitionistic rule)*:** In any move, each player may attack a (complex) formula asserted by his partner or he may defend himself against *the last not already defended* attack. Only the latest open attack may be answered: If it is **X**'s turn at position n and there are two open attacks m, l such that m < l < n, then **X** may not defend against m[4].

Fig. 2: Structural rules

These rules define an intuitionistic logic. To obtain the classical version simply replace R_I4 by the following rule:

R_C4 ***(classical rule)*:** In any move, each player may attack a (complex) formula asserted by his partner or he may defend himself against *any attack* (including those which have already been defended).

Fig. 3: Classical structural rule

As already mentioned, validity is defined in dialogical logic via winning strategies of **P:**

Def. validity: In a certain dialogical system a formula is said to be valid iff **P** has a (formal) winning strategy for it, i.e. **P** can in accordance with the appropriate rules succeed in defending *A* against all possible allowed criticism by **O**[5].

1.2 The dialogical approach to permissive paraconsistency

An important distinction in dialogical logic which brings us to paraconsistency is the difference between a *provable* and a *refutable* thesis. Clearly if the Proponent has a (formal) winning strategy, the thesis is provable. But if the Opponent has a (formal) winning strategy after changing formal rights and duties, i.e. if the Opponent is the one who may use an atomic statement if and only if the Proponent has already stated the same statement before, we say that the thesis is *refutable*. Thus, clearly, contradictions are refutable. The question is whether some changes can be

[3] For a precise definition of *change of situation* cf. Rahman/Rückert [1999].
[4] Notice that this does not mean that the last open attack was the last move.
[5] Actually we only present the *symmetric* versions of these rules. In this formulation the rules for complex propositions do not distinguish between Proponent and Opponent moves. Lorenzen and Roetti following Lorenzen usually prefer a so-called *strict* version of the *asymmetric* formulation which introduces a distinction between the Opponent and the Proponent: Both of the argumentation partners may only defend the last attacked formula but the Proponent may also attack a formula which is not the last one (cf. Roetti 1997, p. 64.) It can be shown that in intuitionistic logic the symmetric rules produce the same theorems as the asymmetric (cf. Barth/Krabbe [1982], Krabbe [1985], Felscher [1985] and Rahman [1993]).

introduced in the structural rules so as to make contradictions neither provable nor refutable: that is, $\neg\bigwedge A(A\wedge\neg A)$ should hold instead of $\bigwedge A\neg(A\wedge\neg A)$[6]. Such changes can indeed be introduced and they yield a dialogical formulation of paraconsistency. Rahman/Carnielli [1998] introduced a dialogical formulation of the permissive interpretation of paraconsistency with the help of the following rule:

> *Formal rule for negative literals:* The Proponent is allowed to attack the negation of an atomic (propositional) statement if and only if the Opponent has already attacked the <u>same</u> statement before.

This rule yields a permissive interpretation of paraconsistency in the sense that if the Opponent concedes a contradiction, the Proponent can state it too: Stating contradictions and negations is a purely formal matter: If you do so, so can I. This idea was also expressed in Roetti [1997] in a slightly different way: if someone attacks a negation he thereby concedes that the principle of non-contradiction holds for this particular proposition. That is why if the Opponent states a contradiction based on this literal the Proponent is then allowed to attack it[7] - Roetti speaks then of *singular paraconsistency*[8]. Notice that this rule yields a paraconsistent logic for literals only. To extend paraconsistency to complex contradictions the following rule has to be added:

> *Dual intuitionistic rule:* In any move, each player may attack *only the last* (complex) formula asserted by his partner or he may defend himself against any attack.

This rule was stated for the first time by Lorenz in his dissertation of 1961. Lorenz calls it the *antieffektive* (i.e. antiintuitionistic) rule, but he did not seem to realise then the connections of the resulting system with Jaskowski's and da Costa's work on logics allowing inconsistencies. In the previously mentioned paper of 1997 Roetti called it the *dual intuitionistic* rule. This denomination was introduced, as far we know, in 1981 by N. D. Goodman for a non-dialogical paraconsistent system.

We formulate now this rule more precisely:

> *Dual intuitionistic rule*:
> - In any move, each player may defend himself against any attack or he may attack *the last (complex) defence.*

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[6] Cf. Roetti [1997]. Actually this leads to the standard definition of paraconsistent logics which distinguishes inconsistency of triviality (cf. da Costa / Bueno / French [1998a], 46).

[7] These ideas can also be related with da Costa's and Arruda's definition of the paraconsistent negation. $\neg^*A =_{def.} \neg A\wedge\neg(\neg A\wedge A)$ (cf. da Costa [1980]., 241 and Arruda [1984], 14).

[8] Roetti speaks also of a *universal* paraconsistency. The idea behind this type of paraconsistency can be expressed as follows: Iff one argumentation partner attacks a negation he thereby concedes that the principle of non-contradiction holds for *every* formula. This yields a dialogical system where the Proponent is allowed to attack a negation iff the Opponent has attacked any negation before. The corresponding system can be formulated as a minimal logic.

- After an attack of the Proponent on move n of the Opponent no other formula stated by the Opponent before n may be used.

The result of combining the literal with the dual intuitionistic rule yields a new dialogical system of paraconsistent logic[9]. Let us consider two examples:

Opponent			***Proponent***	
			$(a\wedge\neg a)\to\neg a$	(0)
(1) $a\wedge\neg a$	0		$\neg a$	(2)
(3) a	2		⊗	
(5) $\neg a$		1	?R	(4)
⊗		5	a	(6)
			The Proponent wins	

Example 1

Notation: The numbers between brackets keep track of the moves. The numbers without brackets indicate which move of the partner is thereby attacked (defences have no such numbers).

The Proponent wins because move 3 allows him to start an attack on move 6.

Opponent			***Proponent***	
			$a\to(\neg(b\to a)\to c)$	(0)
(1) a	0		$\neg(b\to a)\to c$	(2)
(3) $\neg(b\to a)$	2			
⊗		3	$(b\to a)$	(4)
(5) b	4			
The Opponent wins				

Example 2

The Opponent wins because the Proponent is not allowed to use a.

This paraconsistent logic actually combines two different ways of dealing with contradictions. One way - namely the literal rule - blocks or isolates the contradiction so that it cannot produce any harm. The other allows retractions - the dual rule. Because you may retract a proposition stated early the attacker is not allowed to recall the other proposition stated before and now retracted. In fact, complex contradictions rather than literal contradictions

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[9] Strategies systems for these logics are easily done by adapting the tableaux of Rahman/Carnielli [1998] to the present combination of logics. Actually we present this system to keep the argumentation line simpler. In fact this combination of rules does not quite do the job of extending the effects of the literal rule to the complex case. The problem can be exemplified with the formula $\neg A\to(A\to b)$ - where A is a conjunction of two atomic formulae. Here the Proponent wins although - if we consider the literal case - it should not. One way to avoid this is adding the following rule: Only the last open round may be defended by the Proponent. Notice that this only applies to opens rounds, nevertheless defences of closed rounds can be repeated (of course, only if the repetition yields a change of the dialogical situation).

are in this view related to retractions and related actions of reviewing argumentative moves.

Another way to see the literal rule is to think of it as distinguishing between the internal or copulative negation from the external or sentential negation.[10] That is, in the standard approaches to logic, the elementary proposition A_n has the internal logical form: $n\varepsilon A$ (where ε stands for the copula: n is A) and the negation of it the form: $n\varepsilon' A$ (n is not A). Now in this standard interpretation the negative copula is equivalent to the expression $\neg A$, where A can also be complex. Such an equivalence rejects the distinction between the internal (copulative) form and the external or sentential form of elementary propositions. This seems to be the core of an interpretation of paraconsistency which takes seriously da Costa's proposal of paraconsistent logic free of ontological commitments[11]. Now it makes sense to ask for the ontological commitment (or non-commitment) of elementary contradictions not of complex ones. The distinction between a copulative and a sentential negation reflects this fact.

2 Paraconsistency without ontological commitments

The issue of this chapter is a dialogical formulation of free logic which allows a straightforward combination of paraconsistent and intuitionistic logic - this combination was called by Rahman *Frege's Nightmare*[12]. The ideas behind this combination can be expressed in a few words: in an argumentation, it sometimes makes sense to restrict the use and introduction of singular terms in the context of quantification to a formal use of those terms. That is, the Proponent is allowed to use a constant for a defence (of an existential quantifier) or an attack (on a universal quantifier) iff this constant has been already introduced by the Opponent's attack (on a universal quantifier) or the Opponent's defence (of an existential quantifier). When the Opponent concedes any constant occurring in an atomic formula he concedes tertium non datur (for this formula) too. This yields a free logic which combines classical

[10] The difference between internal and external negation has been worked out for other purposes by A. A. Sinowjew (Sinowjew [1970] and Wessels/Sinowjew [1975]).

[11] *I suggest to address the inconsistency issue differently. We may well explore the rich representational devices allowed by the use of paraconsistency in inconsistent domains, but withholding any claim to the effect that there are 'inconsistent objects' in reality.* (Da Costa [1998], 33).

This allows for the accommodation of inconsistency by acknowledging that it is not a ***permanent*** *feature of* ***reality*** *to which theories must correspond, but is rather a* ***temporary*** *aspect of such* ***theories*** [...]. *In this view, to accept a theory is to be committed, not to believing it to be true* ***per se***, *but to holding it as* ***if*** *it were true, for the purposes of further elaboration, development and investigation.* (Da Costa / Bueno / French [1998b], 616-617).

[12] Cf. Rahman [1999b].

logic (for propositions with singular terms for realities) with intuitionistic logic (for propositions with singular terms for fictions)[13]. The idea now is to combine the concept of the formal use of constants in free logics and that of the formal use of elementary negations in paraconsistent logics.
Thus, the non-ontological commitment approach results from two rules. One restricts the use and introduction of singular terms to its formal use, the other establishes how to combine the literal rule with this restriction.

Formal use of constants: The Proponent is allowed to use a constant for a defence (of an existential quantifier) or an attack (on a universal quantifier) iff this constant has been already introduced by the Opponent's attack (on a universal quantifier) or the Opponent's defence (of an existential quantifier).

Non-ontological commitment rule: The literal rule applies only to formulae in which constants occur that have not been introduced in the sense of the rule for the formal use of constants.

These rules have the awkward effect that we have to decide between an intuitionistic and a classical version of the resulting logic. Now as Stephen Read remarked in his book *Thinking about Logic* the realist position in classical logic has some plausability for existents which it definitively lacks for non-existents, fictional and beyond. Consider the proposition *Don Quijote could whistle very loudly*. Is this proposition the case or not? If one seriously believes Don Quijote is a fictional creature, one must prepared for there being no answer to this question[14]. Why should we presuppose tertium non datur for non-existents? One possible way of handling this has been mentioned already: the classical rule applies to existents and the non-classical to non-existents. But how to implement this in the dialogical formulation of paraconsistent free logic? In answering this question we will follow an idea of the Spanish philosopher Francisco Suárez (1548-1647) about the non applicability of the tertium non datur to propositions containing *privative* predicators. That is, Suárez distinguishes - as Aristoteles did before - predicators which can naturally be said or not of an object from those that can not be naturally applied to this object. The predicator *blind* for example can be said of Oedipus but not of a stone: You can say of a man that he is blind because the contrary is normally the case. Suárez followed from this understanding of privative predicators that tertium non datur does not apply in those propositions containing such predicators. Thus, some predicators apply and it can be decided if a given proposition built up from these predicators is the case or not. But some other predicators do not apply, for example it does not make any sense to say of Oedipus that he is an even

[13] Cf. Rahman/Rückert/Fischmann [1999] and Rahman [1999a].
[14] Cf. Read [1994], 137.

number or not. In other words, if you are allowed to use arbitrary predicators tertium non datur applies, if not (as in the case of propositions with privative predicators) then it does not[15]. Suárez used his theory of *privationes* for existents. We do not. Nevertheless we will take his advice and will not presuppose in the context of dialogical free logic that any predicator can be applied to any object. We will presuppose only that any predicator can be applied to any existent object. In the language of dialogical logic: if the Opponent conceded the existence of a given object by introducing a singular term he also conceded that any predicator or its negation can be said of this object.

One way to implement this is to add to the dialogical intuitionistic paraconsistent free logic the following structural rule:

Tertium non datur for constants which have already been introduced: Once the Opponent has introduced a constant he has also conceded that tertium non-datur holds for any predicator for this constant (we express this concession for an introduced constant τ with the disjunction $\mathfrak{R}_\tau \vee \neg \mathfrak{R}_\tau$, where $\mathfrak{R}$ works as a variable for a predicator which the Proponent can substitute for any suitable predicator)

This rule allows the Proponent to choose any predicator at his convenience for the attack on the conceded tertium non-datur. This can be made clear with an example (recall that we are playing with the intutionistic rule):

	Opponent			***Proponent***	
				$\bigwedge_x(A_x \vee \neg A_x)$	(0)
(1)	$?_\tau[\mathfrak{R}_\tau \vee \neg \mathfrak{R}_\tau]$	0		$A_\tau \vee \neg A_\tau$	(2)
(3)	?	2		A_τ	(6)
(5)	A_τ		1	$?_{1/A}$	(4)
				The Proponent wins	

Example 3

In move 1 the Opponent introduced the constant τ and conceded with this introduction the disjunction $\mathfrak{R}_\tau \vee \neg \mathfrak{R}_\tau$. In move 4 the Proponent attacks this disjunction choosing the predicator A as substitution for the predicator variable $\mathfrak{R}$ and wins - the reader can easily verify that if in move 5 the Opponent chooses to defend $\neg A_\tau$ he loses too.

One important aim of the present paper and other related papers which are due to appear in a special issue of *Synthese* under the title *New Perspectives in Dialogical Logic*[16] is to show how to build with the help of dialogical logic a common semantic language for different non-standard logics in such a way that 1. the semantic intuitions behind these logics can be made

[15] Suárez [1960], Disputatio LIV, Sectio IV, VII, 432-438.
[16] Cf. Rahman/Rückert [2000].

transparent, 2. combinations between these logics can be easily achieved, 3. a common basis is proposed for discussion of the philosophical consequences of these logics - the philosophical point here being to undertake the task of discussing the semantics of non-classical logics from a pragmatical point of view which commits itself neither to a correspondence theory of truth nor to a possible-world-semantics. But here we arrived at the end of this paper, which we hope will lead to a fruitful discussion tolerant enough to admit some but not all sorts of contradictory arguments.

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