Programme: Workshop on Hyperintensional Logic and Semantics

Time Slot	Name	Affiliation	Title
9.30–10.30	**K. Fine**	N.Y.U.	Truthmaker Semantics for Conditional Obligation and Chisholm's Contrary-to-duty Puzzle
10.30–11.15	**A. Anglberger**	Bayreuth U.	Truthmakers and Normative Conflicts
11.15–11.30	*coffee break*		
11.30–12.15	**L. Hornischer**	ILLC, U. of Amsterdam	Logics of Synonymy
12.15–13.00	**J. Korbmacher**	Utrecht U.	Tableau Rules for the Logic of Exact Entailment
13.00–14.00	*lunch*		
14.00–14.45	**M. Deigan**	Yale U.	A Plea for Inexact Truthmaking
14.45–15.30	**S. Krämer**	U. of Glasgow	Truthmakers and the Whole Truth
15.30–15-45	*coffee break*		
15.45–16.30	**R. van Rooij & K. Schulz**	ILLC, U. of Amsterdam	Truthmakers for Generics
16.30–17.15	**P. Verdée**	U.C. Louvain-la-neuve	Relevant logic and grounding: a pluralistic approach to hyperintensionality

Workshop

Hyperintensional Logics and Truthmaker Semantics

Book of abstracts

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Organization:

Centre for Logic and Philosophy of Science
(Ghent University)

Local Organizing Committee

Frederik Van De Putte, Federico L.G. Faroldi

About the workshop

This workshop is supported by the Faculty of Arts and Humanities of Ghent University

Abstracts

Invited speaker

Kit Fine
New York University

Truthmaker Semantics for Conditional Obligation

I shall discuss some problems involved in providing a truthmaker semantics for conditional obligation. I shall pay special attention to Chisholm's contrary-to-duty puzzle.

Contributed Talks

Albert Anglberger

Truthmakers and Normative Conflicts

The aim of this talk is to develop an intuitively plausible logic for normative conflicts. A *normative conflict* consists of a number of obligations that can be individually met, but not jointly. A *conflict tolerant deontic logic* (CTDL) is a deontic logic in which normative conflicts are consistent. In his recent survey of CTDLs, Lou Goble gives a list of desiderata for CTDLs [5]:

Consistent Conflicts. At least some normative conflicts should to be consistent, i.e. $\vdash \neg(A_1 \wedge \ldots \wedge A_n)$ doesn't entail $OA_1, \ldots, OA_n \vdash \bot$ [5, p. 297].

No Deontic Explosion. Normative conflicts should not result in *deontic explosion*, i.e. $\vdash \neg(A_1 \wedge \ldots \wedge A_n)$ doesn't entail $OA_1, \ldots, OA_n \vdash OB$ [5, p. 298].

Minimal Deontic Laws. Certain minimal laws of deontic logic, which are plausible from considerations independent of any particular view of deontic conflicts, should be validated [5, p. 302]. As examples, Goble explicitly mentions:

(DDS)	$O(A \vee B), O\neg A \vdash OB$,
(M)	$O(A \wedge B) \vdash OB$, and
(AGG)	$OA, OB \vdash O(A \wedge B)$.

A particularly interesting class of CTDLs that Goble discusses are logics that don't allow for the substitution of logical equivalents in deontic contexts, i.e. logics that fail to validate the following *rule of replacement* [5, p. 315]:

$$\frac{\vdash A \leftrightarrow B}{\vdash OA \leftrightarrow OB} \tag{RE}$$

Any logic that validates (RE) and (M), will also validate the following *rule of monotonicity* [5, p. 244]:

$$\frac{\vdash A \rightarrow B}{\vdash OA \rightarrow OB} \tag{RM}$$

In fact, (RM) is *equivalent* to (RE) and (M) in the sense that any deontic logic that has (RM) has (RE) and (M) and vice versa. Having the rule (RM), however, would disastrous consequences for any CTDLs, since it immediately would give us deontic explosion, violating the desideratum **No Deontic Explosion**. This observation motivates giving up (RE) as a rule for CTDLs, giving us the class of CTDLs with *limited replacement*, c.f. [5, §5.4].

Goble proposes an interesting CTDL with limited replacement, which instead of using logical equivalence as the condition for replacement, as in the rule (RE), uses a weaker concept of 'analytic equivalence' $\Leftrightarrow_A$ as the condition for replacement.[1] Goble axiomatizes this notion of analytic equivalence in the following system [5, p. 316]:

Axioms:

$A \Leftrightarrow_A A$	$A \Leftrightarrow_A \neg\neg A$
$A \Leftrightarrow_A (A \wedge A)$	$A \Leftrightarrow_A (A \vee A)$
$(A \wedge B) \Leftrightarrow_A (B \wedge A)$	$(A \vee B) \Leftrightarrow_A (B \vee A)$
$(A \wedge (B \wedge C)) \Leftrightarrow_A ((A \wedge B) \wedge C)$	$(A \vee (B \vee C)) \Leftrightarrow_A ((A \vee B) \vee C)$
$(A \wedge (B \vee C)) \Leftrightarrow_A ((A \wedge B) \vee (A \wedge C))$	$(A \vee (B \wedge C)) \Leftrightarrow_A ((A \vee B) \wedge (A \vee C))$
$(\neg A \wedge \neg B) \Leftrightarrow_A \neg(A \vee B)$	$(\neg A \vee \neg B) \Leftrightarrow_A \neg(A \wedge B)$
$(A \to B) \Leftrightarrow_A (\neg A \vee B)$	

Rules:

$A \Leftrightarrow_A B \vdash B \Leftrightarrow_A A$	$A \Leftrightarrow_A B, B \Leftrightarrow_A C \vdash A \Leftrightarrow_A C$
$A \Leftrightarrow_A B \vdash (A \wedge C) \Leftrightarrow_A (B \wedge C)$	$A \Leftrightarrow_A B \vdash (A \vee C) \Leftrightarrow_A (B \vee C)$
$A \Leftrightarrow_A B \vdash \neg A \Leftrightarrow_A \neg B$	

Goble defines the system **BDL** of 'basic deontic logic' as having all the rules of classical logic, plus the rules (DDS), (M), and (AGG) and the following restricted rule of replacement [5, p. 314]:

$$\frac{\vdash A \Leftrightarrow_A B}{\vdash OA \leftrightarrow OB} \tag{RBE}$$

BDL is an interesting candidate for a CTDL, which, in particular, satisfies the desiderata **Consistent Conflicts** and **No Deontic Explosion**. But, as Goble remarks:

> On the formal front, **BDL** [...] so far lack any semantics or model theory, and it is difficult to see how that might be developed, while

[1] The notion of analytic equivalence is only applied to statements that don't contain the obligation operator O.

respecting the limits necessary to protect their treatment of normative conflicts. [5, p. 318]

In this paper, we will provide a sound and complete *truth-maker* semantics **BDL** *minus* the rule (DDS) ($\mathbf{BDL}^-$). The first insight that motivates our approach is that the system for $\Leftrightarrow_A$ that Goble presents is, in fact, deductively equivalent to the system AC of analytic containment, described by RB Angell [1]. This means that we can use the following, more simple axiomatization of $\Leftrightarrow_A$, due to [1, p. 124]:

Axioms:

$A \Leftrightarrow_A \neg\neg A$	(Double Negation)
$A \Leftrightarrow_A A \wedge A$	(Conjunctive Idempotence)
$A \wedge B \Leftrightarrow_A B \wedge A$	(Conjunctive Commutation)
$A \wedge (B \wedge C) \Leftrightarrow_A (A \wedge B) \wedge C$	(Conjunctive Association)
$A \vee (B \wedge C) \Leftrightarrow_A (A \vee B) \wedge (A \vee C)$	(Distribution)

Rules:

$A \Leftrightarrow_A B \vdash C \leftrightarrow C[A/B]$	(Replacement)

where in the rule of (Replacement) the $C[A/B]$ is the result of replacing arbitrarily many instances of A in C by B.

In a recent paper, Kit Fine gives a natural semantics for AC in terms of *exact truth-makers* [3]. Roughly, a state (of affairs) is said to be an exact truth-maker of a statement just in case it necessitates the truth of the statement while being wholly relevant to it [4, p. 558]. This idea traces back to a paper by Bas van Fraassen [6], and has recently gotten some traction in philosophical semantics.[2] The idea of Fine's semantics for AC is that two statements A and B are analytically equivalent, i.e. $A \Leftrightarrow_A B$ is true, just in case every truth-maker of the one contains a truth-maker of the other, every truth-maker of the other is contained in a truth-maker of the one, and vice versa. Fine shows that this condition is equivalent to the *convex closure* of the sets of truth-makers of the two statements being identical (Lemma 9, [3, p. 208]).[3]

In another, earlier paper, Fine uses the idea of *permitted states* to provide

[2] For an overview of the formal details of and recent developments in (exact) truth-maker semantics, see [4].

[3] A set of states S is said to be *convex* just in case for all states $s, t \in S$ and all states u, if s is part of u and u is part of t, then $u \in S$.

an intuitive semantics for statements of permission. The idea is as follows [2, p. 335]:

PA is true iff every exact truth-maker of A is permitted.

Fine argues that this gives us an intuitively plausible semantics for statements of permission that allows us to take statements of permission to be *action guiding*.

In this paper, we combine the two previous ideas to obtain what we argue is an intuitively plausible semantics for $\mathbf{BDL}^-$. For this purpose, following Fine [2], we introduce a distinguished set of *permitted* states into the set of truth-makers. As a natural counterpart to Fine's clause for permission mentioned before, we obtain the following semantic clause for obligation:

OA is true iff no state in the convex closure of $\neg A$'s truth-makers is permitted.

The main formal result of our paper is that this construction yields a sound and complete semantics for $\mathbf{BDL}^-$, answering, at least partially, Goble's challenge to find a semantics for $\mathbf{BDL}$. On the *in*formal side, we argue that this clause provides an intuitively plausible semantics for a conflict tolerant notion of obligation. We sustain this claim by means of various examples that get a natural treatment in our proposed semantics.

We complete our analysis with a discussion of (DDS). We argue, contrary to Goble, that (DDS) is *not* a plausible principle for CTDLs. In particular, we first argue that the reasons that speak for (DDS) outside the contexts of CTDL, don't support the principle in the context of CTDL. And we finally conclude by giving two arguments that strongly suggest that DDS is not a principle a plausible CTDL should contain.

References

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Michael Deigan
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A Plea for Inexact Truthmaking

[4] distinguishes between *exact* truthmaking ($\Vdash_e$), which requires that every part of the truthmaker be relevant to making the sentence true, and *inexact* truthmaking ($\Vdash_i$), which lacks this requirement (and is akin to situation semanticists' notion of (persistent) verification). He argues that because we can define the latter in terms of the former, but not *vice versa*, we should take exact truthmaking to be the fundamental notion. I argue that this gets things backwards: inexact truthmaking can be used to define exact truthmaking, but not *vice versa*. So truthmaker semanticists should build their theories on a foundation of inexact truthmaking.

How to Define Exact Truthmaking: Fine considers some ways to define exact truthmaking using inexact truthmaking, but thinks that "all such attempts are doomed to failure", since the exact but not the inexact truthmakers of A and the logically equivalent $A \vee (A \wedge B)$ can be distinguished. And this remains so even if we impose some minimality condition on inexact truthmakers:

$$s \text{ is } p\text{-minimal}^4 \quad =_{\text{df}} \quad (s \Vdash_i p) \wedge \forall s'(s' \sqsubset s \supset s' \nVdash_i p).$$

$$s \text{ exemplifies}^5\ p \quad =_{\text{df}} \quad s \text{ is } p\text{-minimal} \vee \forall s'(s' \sqsubseteq s \supset s' \Vdash_i p).$$

If we try either $s \Vdash_e p \;\; =_{\text{df}} \;\; s$ is p-minimal, or $s \Vdash_e p \;\; =_{\text{df}} \;\; s$ exemplifies p, we will still fail to make the distinction, as Fine observes.

	A	$A \vee (A \wedge B)$
a	✓	✓
$a \sqcup b$		✓

Table 0.1: Exact Verifiers

	A	$A \vee (A \wedge B)$
a	✓	✓
$a \sqcup b$	✓	✓

Table 0.2: Inexact verifiers

The inexact truthmaker semanticist is not doomed, however, she just needs to do something more complicated. Here's the start of a more promising definition of exact truthmaking: Where s, t, and u are states, p and q are sentences, and r is an atomic sentence,

[4] See [1] and [5].
[5] See [6].

	A	$A \vee (A \wedge B)$
a	✓	✓
$a \sqcup b$		

Table 0.3: (Quasi-)Minimal verifiers

$$
\begin{array}{llll}
\text{(d.i)} & s \Vdash_e r & =_{\text{df}} & s \text{ exemplifies } r \\
\text{(d.ii)} & s \Vdash_e p \wedge q & =_{\text{df}} & t \Vdash_e p, u \Vdash_e q, \text{ and } s = t \sqcup u \\
\text{(d.iii)} & s \Vdash_e p \vee q & =_{\text{df}} & s \Vdash_e p \text{ or } s \Vdash_e q
\end{array}
$$

This identifies exact truthmaking with exemplification for the atomic case, then builds the rest of the definition recursively from there, mimicking the definition of exact truthmaking for complex sentences from exact truthmakers of atomic sentences.[6] This will not fall prey to the original problematic case: it distinguishes A and $A \vee (A \wedge B)$ just as well as primitive exact truthmaking does. More generally, if (d.i) works for the atomic sentences, the above definition will work just as well as the exact truthmaker semanticist's account for the truthmakers of complex sentences.

In the paper I address doubts about (d.i) due to cases like:

(1) There are infinitely many stars. (from [6])

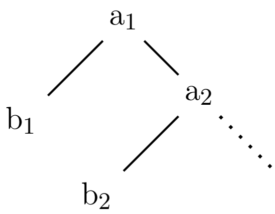
We can pursue the same strategy: use exemplification for the atomic case, then recursively define exact truthmakers for quantified sentences from there, in the same way an exact truthmaker semanticist would define exact truthmakers for quantificational sentences.

How Not to Define Inexact Truthmaking: Fine proposes that we define inexact truthmaking as follows: "*s inexactly verifies* A, if s contains an exact verifier of A." But there are structures of state-spaces we may wish to allow for which there can be inexact truthmaking without exact truthmaking. For illustration,[7] imagine a mixture with the following structure.[8]

[6]See [7] and [4].

[7]Worries about *objects* being truthmakers can be avoided if we shift to the semantics for imperatives and consider the notions of exact and inexact compliance, as discussed in [3] and [?].

[8]This requires a mereology which allows gunk-like structures and proper parthood without supplementation, but regardless of our metaphysical views, these seem not to be things our semantics should rule out.



Every bit of a-stuff in the mixture has a b-part and an a-part. what parts of the mixture are the exact verifiers for (2)?

(2) There is some a-stuff.

It seems that none of them are. The obvious candidates for truthmakers of (2) are the a-parts: a_1, a_2, ... But none of these can be (or be parts of) *exact* truthmakers, since any a_n has a part, b_n, that is irrelevant to the truth of (2). And exact truthmakers must be wholly relevant to the statements they verify. Nevertheless, there are plenty of inexact verifiers (e.g, a_1).

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Levin Hornischer
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Logics of Synonymy

In this talk, we're concerned with logics describing the notion of synonymy in the strong sense of content identity (and not just meaning similarity). We start by observing something paradoxical about this notion of synonymy. The following two intuitive principles are jointly inconsistent: (i) If we cannot imagine any scenario whatsoever in which two sentences differ in truth-value, then they are synonymous, and (ii) if two sentences are synonymous, they have the same subject matter.

To understand this paradox, we start by looking at logics of synonymy that satisfy one of the two principles. A famous logic satisfying (ii) is Kit Fine's system of analytic containment (AC) with a sound and complete truthmaker semantics. To get a logic satisfying (i), we develop a formal notion of a scenario yielding a semantics that is extensionally equivalent to four-valued semantics—as used for the logic of First Degree Entailment (FDE). We show that the corresponding notion of synonymy (i.e. FDE-equivalence) is axiomatized by $AC + \varphi \vee (\varphi \wedge \psi) \equiv \varphi$. We see that these two logics are related by moving one level up in the set-theoretic hierarchy: If we take sentences not to be true at a scenario but at sets of scenarios, we get a semantics that is extensionally equivalent to Kit Fine's truthmaker semantics.

Next, having found a logic that exactly satisfies (i), we want to investigate the class of logics where synonymy (or equivalence) entails identity in subject matter in the sense of having the same atomic sentences. We show that AC is *not* the most coarse-grained such logic. Instead, this is given by

$$\mathcal{M} := AC + \varphi \vee (\varphi \wedge \psi) \equiv \varphi \vee (\varphi \wedge \neg\psi).$$

In other words, $\mathcal{M}$ is the first logic more fine-grained than FDE where equivalence entails having the same atoms. (In AC not only atoms but also, roughly, literals have to overlap.)

We can resolve the paradox by showing how the above logics of synonymy come close to satisfying both (i) and (ii). On the one hand, scenario synonymy exactly satisfies (i) and the instances violating (ii) can be traced back to exactly one axiom: $\varphi \vee (\varphi \wedge \psi) \equiv \varphi$. On the other hand, AC satisfies (ii) and $\mathcal{M}$ even exactly satisfies (ii), and both satisfy a weaker version of (i): If neither scenarios nor sets of scenarios can distinguish two sentences, then they are synonymous. A consequence of the paradox is that it yields an argument for a pluralistic conception of synonymy and for a certain type of non-compositionality of truth according to a scenario, logic program or state of a neural network.

Johannes Korbmacher
Utrecht University

Tableau rules for the logic of exact entailment

In recent years, Kit Fine has championed the use of *exact truthmakers* in philosophical semantics [3]. A state s is said to be an exact truthmaker of a statement A just in case s necessitates the truth of A and s is wholly relevant to the truth of A. This concept gives rise to the interesting, non-classical consequence relation of *exact entailment*, where a set of premises $A_1, A_2, \ldots$ is said to exactly entail a conclusion C if and only if every exact truthmaker of each of the premises $A_1, A_2, \ldots$ is also an exact truthmaker of the conclusion C.

The resulting *logic of exact entailment* is relatively weak. While we have, for example, the law of conjunction introduction—A and B together exactly entail $A \wedge B$—we do not have the law of conjunction elimination—$A \wedge B$ neither exactly entails A nor exactly entails B. But at the same time, the logic is of great philosophical interest. Exact truthmakers are closely related to important philosophical concepts, like the concept of *metaphysical ground* [1, p. 71–74], for example, and so we would like to know what their logic looks like.

In a recent manuscript, Kit Fine and Mark Jago provide an in-depth study of the logic of exact entailment [4]. They give a syntactic characterization of exact entailment (Theorem 4.8), they show that the logic enjoys a compactness theorem (Theorem 5.2),[9] they show that the logic is decidable (Theorem 5.3),[10] and they give a sound and complete sequent calculus for the logic (Theorems 9.1 and 9.5), which enjoys the cut-elimination property (Theorem 9.6).[11] So, I think it's fair to say that the logic of exact entailment is relatively well understood.

In this paper, I develop an alternative *tableau system* for the logic of exact entailment. The system is easy to use and algorithmic in nature. In fact, it is an alternative decision procedure for the question whether Δ exactly entails C, given that Δ is finite, giving us an alternative proof for the decidability theorem. Furthermore, the system *can* be used even if Δ is infinite. In such a situation, the system allows us to give a simpler proof of the compactness theorem. The soundness and completeness proofs for the system are straight-forward and provide further insight into the workings of exact truthmakers.

The tableau system has many interesting applications in truthmaker semantics. For example, it allows us to determine what it means for $A_1, A_2, \ldots$ to have a *shared* exact truthmaker. Moreover, it can easily be modified to accommodate additional operators that have a semantics in terms of exact truthmakers. I show how this can be done for the *weak ground* operator $\leq$ from [1]. The truth-conditions for $A_1, A_2, \ldots \leq C$ are that every *fusion* of exact truthmakers of $A_1, A_2, \ldots$ also has to be an exact truthmaker of C. I determine a tableau rules for this connective and sketch the procedure for obtaining tableau rules for truthmaker connectives in general.

Finally, let me point out the tableau system is of the same kind as the tableau systems that Graham Priest provides for various non-classical logics in [5]. In this way, the results of the paper will help to incorporate the logic of exact entailment into the canon of non-classical logics.

[9] The theorem states that if Δ exactly entails C, then there is a finite subset of Δ that exactly entails C.

[10] The logic is decidable in the sense that there is an effective method for determining if Δ exactly entails C, for finite Δ.

[11] A proof system has the cut-elimination property if everything that can be proven in the system can be proven without the *cut rule*, which allows us to infer from Δ exactly entailing C and $\{C\} \cup \Gamma$ exactly entailing D that $\Delta \cup \Gamma$ exactly entails D.

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Stephan Krämer
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Exact Truthmaking and The Whole Truth

My talk investigates the logic and semantics of totality statements $T(P)$ – to be read "P, *and that's it*" or "it is *the whole truth* that P". Such statements, and the notions of totality they invoke, are of interest partly in virtue of the role they play in ordinary, non-philosophical discourse, and partly in virtue of certain theoretical roles they have been put to within philosophy. For instance, it has been proposed that the best way to understand physicalism is as the claim that every truth, and only the truths, are entailed by $T(PHYS)$, where $PHYS$ is the conjunction of all physical truths. The T operator is needed because $PHYS$ on its own does not imply certain negative (putative) truths such as that there are no (non-physical) angels. We may close this loophole, the thought goes, by saying that $PHYS$ *and that's it* (cf. [1, 317]).

Extant approaches to this topic operate within the intensional framework of standard possible worlds semantics (cf. e.g. [3]), and are variations on the idea that $T(P)$ is true with respect to a world w iff w is a *minimal* P-world — metaphorically speaking, the only way to obtain another world at which P is true is to add some stuff on top of w. The first aim of my talk is to show, against this tradition, that under its most natural construal, T is a *hyperintensional* operator, which is sensitive to what *parts* of worlds are *wholly relevant*, *exact verifiers* of the proposition to which it is applied.

The basic argument is as follows. Let $ANGELS$ be the proposition that there are angels, so $PHYS$ implies neither $ANGELS$ nor $\neg ANGELS$. Suppose $T(PHYS)$ is true at a world w. Then intuitively, $T(PHYS \vee (PHYS \wedge ANGELS))$ is *not* true at w. But since $PHYS$ and $PHYS \vee (PHYS \wedge ANGELS)$ are logically equivalent, they are true at the same worlds (and hence have the same minimal verifying worlds). So the intensional approach conflicts with our intuition.

What, though, *is* the difference between $PHYS$ and $PHYS \vee (PHYS \wedge ANGELS)$ to which T reacts? I argue it is roughly this: a world verifying $PHYS \wedge ANGELS$ is wholly relevant to the truth of $PHYS \vee (PHYS \wedge ANGELS)$, but not to the truth of $PHYS$. (Crucially, being a wholly relevant verifier does not imply being a minimal verifier.) This observation suggests that a more satisfactory account of the totality operator T may be obtained by employing an exact truthmaker semantics of the sort developed in [2]. The second aim of my talk is to offer a sketch of how this might go, and to point out some of the distinctive implications of the resulting logic, most notably the failure of the monotonicity principle that if $T(P) \wedge Q$ then $T(P \wedge Q)$.

References

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Truthmakers for Generics

Descriptive analysis of generics. Generic sentences (which we take to have the form 'Gs are f') are sentences that, by their very nature, express useful generalizations. But they express generalizations that allow for exceptions: although not all birds fly (Penguins don't), 'Birds fly' is a good generic. Generics like 'Birds lay eggs' show that it also need not be the case that almost all, or *most* Gs have feature f in order for the generic 'Gs are f' to be true. Moreover, even if most Gs are (or are taken to be) f, the corresponding generic sentence still doesn't have to be true, as exemplified by '*Italians are right-handed'. According to a natural alternative quantificational proposal, the generic is true exactly if all, or most, *normal* Gs are f. But without an independent analysis of what it is to be a normal G, such an analysis hardly makes any empirical predictions. Second, such an analysis cannot account for the intuition that both 'Ducks lay eggs' and 'Ducks have colorfull feathers' are *both* true, because a normal duck cannot be both female *and* male. Van Rooij (2017) argued that all of these problems can be accounted for by demanding that for a generic 'Gs are f' to be true, the measure $\Delta^* P^f_g$ has to be significantly higher than 0, or significantly higher than $\Delta^* P^h_g$, with h any (contextually) relevant alternative feature to f, and with $\Delta^* P^f_g =_{df} \frac{P(f/g)-P(f/\neg g)}{1-P(f/\neg g)}$ with $\neg g = \bigcup Alt(g)$: the natural alternatives to g, and $g \notin Alt(g)$. Notice that (i) $P(f/g) - P(f/\neg g) = \Delta P^f_g$ has to be positive for 'Gs are f' to be true (which explains why 'Italians are right-handed' is a bad generic), which means that the generic has to be true on what Cohen (1996) calls the 'relative reading' of generics, and (ii) that in contrast to ΔP^f_g, for $\Delta^* P^f_g$ the value of $P(f/g)$ counts for more than the value of $P(f/\neg g)$, as intuitively it should be.

Causal powers as truthmakers. Now assume (with Cheng, 1997) that objects of type g have unobservable causal powers to produce features of type f, denoted by p_{gf}. It is the probability with which g produces f in the absence of any alternative cause. We denote by a the union of alternative potential causes of f, and by p_{af} the causal power of a to produce f. We will assume that p_{gf} is independent of p_{af}, and that both are independent of $P(g)$ and $P(a)$. The latter independence assumptions are crucial: by making them we can explain the stability and context-independence of generic statements.

To derive p_{gf}, we will first define $P(f)$ assuming that f does not occur without a cause and that there are only two potential causes, g and a and that g and a are independent: $P(f) = P(g) \times p_{gf} + P(a) \times p_{af} - P(g) \times p_{gf} \times P(a) \times p_{af}$. Then we can derive $P(f/g) = p_{gf} + (P(a/g) \times p_{ag}) - p_{gf} \times P(a/g) \times p_{af}$ and $P(f/\neg g) = P(a/\neg g) \times p_{af}$. As a result, $\Delta P^f_g = P(f/g) - P(f/\neg g) = p_{gf} + (P(a/g) \times p_{af}) - (p_{gf} \times P(a/g) \times p_{af}) - (P(a/\neg g) \times p_{af})$ and thus $\Delta P^f_g = [1 - (P(a/g) \times p_{af})] \times p_{gf} + [P(a/g) - P(a/\neg g)] \times p_{af}$. From this last formula we can derive $p_{gf} = \frac{\Delta P^f_g - [P(a/g) - P(a/\neg g)] \times p_{af}}{1 - P(a/g) \times p_{af}}$.

Because a is taken to be probabilistically independent of g, $P(a/g) - P(a/\neg g) = 0$. Moreover, $P(a/g) \times p_{af} = P(f/\neg g)$. As a result, p_{gf} comes down to $\frac{\Delta P^f_g}{1-P(f/\neg g)} = \Delta^* P^f_g$. We have **explained** the above descriptive analysis of generics, and **grounded** it by providing truth-makers for it: the causal powers.

The pros and cons of the causal power analysis of generics. As for the pros, (i) the causal power theory is **explanatory** where the frequency analysis using $\Delta^* P$ is not; (ii) the theory can **distinguish** good *generics* from *accidental generalizations*, (iii) having truth-makers means that generics have stable, context-independent meanings and can thus **express propositions** as well when embedded, (iv) the analysis is **more general**. For the latter, notice that using p_{gf} one is not required to assume independence of a from g. For instance, if g and a (the assumed alternative cause of f) are *incompatible*, one can show that $p_{gf} = P(f/g) \neq \Delta^* P_g^f$. This explains, we will argue, why people assume generics to come with a high conditional probability (cf. the similarity with Adam's thesis for the analysis of conditionals). We'll argue that this is relevant especially once powers are associated with *essences* of kinds. As for the cons, in contrast to an analysis using $\Delta^* P_g^f$, the causal power analysis has to assume that even if all and only all Gs are F, at most one of the two generics 'Gs are F' and 'Fs are G' can be true on the standard reading, because in contrast to frequency measure $\Delta^* P_g^f$, the causal measure p_{gf} is essentially **asymmetric**.

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Relevant logic and grounding: a pluralistic approach to hyperintensionality

In this talk, I investigate the relation between relevance logic on the one hand and grounding (GR), non-causal explanation (NCE), and hyperintensionality (HI) on the other hand. This relation has largely been overlooked in the literature, although there are some striking connections. One of the most important issues in GR, NCE and HI is that usual modal strict implications or strict equivalences are too coarse grained to explicate the subtle differences involved in these concepts. Relevant implications and equivalences allow for a much more fine-grained analysis. Moreover, a non-causal explanation is by definition always relevant for its explanandum, a ground is always relevant for its consequent, and sentences expressing the same hyperintension are always relevant for one another (an intuitive notion of "relevant" suffices here).

In the second part of the lecture I will first present a logic independent notion of relevance: X-relevance. An implication or equivalence relation is said to be X-relevant iff it is of some type such that (all) antecedent(s) and consequent(s) are necessarily present for the type relation to hold (in the given logic). Given this notion of relevance, I will explain how the apparent "relevance" aspects present in GR, NCE and HI can be characterized. I will also show that traditional relevance logics fall short in doing this, due to their unnecessarily weak negation connective.

By means of an intuitive goal directed diagrammatic proof method for X-relevance developed by Inge De Bal and myself, I will finally illustrate how X-relevance can help to better understand logical aspects of GR, NCE and HI. The proof diagrams are conceived as trees in which one tries to find formulas in a goal node (the root) by recursively trying to find subgoals that are represented in descendant nodes. Analytic descendants of a node could be said to ground that node, and the leafs of the tree could be said to non-causally explain the main goal. I will argue that these notions of GR and NCE, while still very preliminary, shed a promising new light on the existing literature.