

Deontic logic and communication

An unfinished collage

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MIND, WORLD, ACTION
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OVERVIEW

- 1 A historical introduction
- 2 Language and worlds
- 3 Logic for the theory of language
- 4 Linguistic commitments: the logical part of communication ethics

Samuel Pufendorf (1632–1694) in *De officio hominis et civis juxta legem naturalem libri duo* [1673] lists one general duty of the users of language (1), and two special ones (2–3), of which the last one is conditional duty:

- 1. ... *no man should deceive another by language or by other signs which have been established to express the sense of his mind.*
- 2. ... *everyone is obliged to use words in his common discourse in the sense they bear in the accepted usage of that language.*
- 3. ... *in speaking to someone one should disclose the sense of one's mind to him in such a way that he may clearly know it.*

CAPVT X.
DE
OFFICIIS SERMO-
CINANTIVM.

1. Praeceptum generale, de maximo sermonis usu seruando.
2. Declaratur per praecipuum speciale primum de sermone iuxta vsum communem formando, vt alter intelligere possit.
3. Per speciale secundum, de sermone ad animi sensus exprimendos accommodando, ne alter decipiatur.
4. Limitatio horum praceptorum in dissimulatione.
5. In simulatione.
6. In

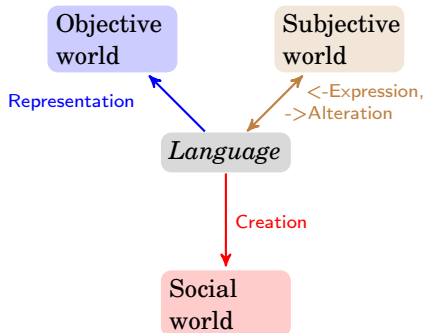
HABERMAS ONTOLOGY: OBJECTIVE, INTERSUBJECTIVE, SUBJECTIVE

Objective world	Social world	Subjective world
physical facts	norms	mental facts
external world		internal world

Jürgen Habermas (1981) “Social Action, Purposive Activity, and Communication”

... I have proposed that we differentiate the external world into an objective world and a social world, and that we introduce the internal world as a complementary concept to the external world. The corresponding validity claims of truth, rightness, and truthfulness (Wahrhaftigkeit) can then serve as a guide in the choice of theoretical perspectives for justifying the basic modes of language use, or functions of language, and classifying the speech acts that vary with individual languages.

DIVERSITY OF LANGUAGE RELATIONS



THE METHODOLOGICAL APPROACH OF DYNAMIC LOGIC

- Language relations to non-objective worlds are twofold:
 - with respect to subjective worlds there is the relation of expression of one's own intentional state and the relation of alteration of intentional state of the Other,
 - with respect to social world there is the relation of assigning deontic status to acts (by norm promulgation or by commanding) and the relation of modification of linguistic commitments (by language use).
- With the exemption of expressive relation, the tree remaining language relations are inter-subjective (presupposing the existence of at least two language-users).
- The language for description of “doing things with words” is the language of action theory.

PRIMITIVE THEORY OF ACTION

- Propositional dynamic logic **PDL** is logic of action language in its “primitive form” (Krister Segerberg).
- The basic idea is to associate actions with modal operators:
 - [action]effect
 - [α]C
 - Always after action α it is the case that C .
 - Doing α brings it about that C .
- Axioms **PDL** show inter alia how actions can be composed.

Some axioms from Segerberg's **PDL** (1993)

Disjunction-like composition of actions is “indeterministic choice”-composition. Conjunction-like composition of actions is sequencing or concatenation type of composition. **PDL** includes primitive “epistemic action”(it brings no change into the world; it tests the truth of a proposition).

$$[\alpha + \beta]C \leftrightarrow ([\alpha]C \wedge [\beta]C) \quad (1)$$

$$[\alpha; \beta]C \leftrightarrow ([\alpha][\beta]C) \quad (2)$$

$$[?A]C \leftrightarrow (A \rightarrow C) \quad (3)$$

THE DEL LOGIC

- The approach of propositional modal logic is extended in van Benthem's dynamic epistemic logic **DEL**.
- Here actions are proper epistemic actions: they change “subjective worlds”, i.e. they change knowledge. Their repertoire includes: observation, communication, and reasoning.
- The effects of epistemic actions are described in epistemic terms using the modal language. The model: epistemic action — update mechanism, knowledge — modal model.

Quote

First, a class of models is chosen representing the relevant information structures, together with some appropriate static language for describing these. Usually, these are models for some version of standard epistemic logic. Next, an update mechanism is proposed which transforms given models under some chosen set of epistemic actions.



[Johan van Benthem and Fenrong Liu \(2007\)](#)

Dynamic logic of preference upgrade.

Journal of Applied Non-Classical Logics 17:157–182.

In dynamic epistemic logic relevant “informational structures” are structures $\langle W, R \rangle$ where $R \subseteq W \times W$ is an equivalence relation. The reason for selecting the family of structures with equivalence relation is the consequence of accepting S5 model of knowledge.

1 About W :

- 1 $K\top$
- 2 $K(\varphi \rightarrow \psi) \rightarrow (K\varphi \rightarrow K\psi)$

2 About R :

- 1 $K\varphi \rightarrow \varphi$
- 2 $K\varphi \rightarrow KK\varphi$
- 3 $\neg K\varphi \rightarrow K\neg K\varphi$

The axioms 1 and 2 do not describe the character of a frame-type but define structure-points as “logical points” obeying logical truths 1 and deductive closure 2. The frame-type is determined by 1–2 as being: reflexive by 1, transitive by 2, and ‘triangular’ (i.e. Euclidean) by 3. The three frame-properties define the relation of equivalence.

Suppose we accept S5 model of knowledge! In that case the normative concept of knowledge of is defined by the following meaning postulates:

1 Knowledge

- 1 *accepts logical truths*
- 2 *accepts its own logical consequences.*

2 Knowledge

- 1 contains only truths.
- 2 Knowledge is introspective (or self-aware) since anything known is known as being known, and
- 3 anything unknown is known as being unknown.

Knowledge changes in two ways. First, it grows by expansion when new truths are added. Second, when known proposition turns out not to be true, $K\varphi \wedge \neg\varphi$, the deceptive character of purported knowledge is revealed. In this case, the internal equilibrium is disturbed and this gives a *prima facie* reason for the revision of the purported knowledge. The real knowledge is a process and the axiom of veridicality (1) determines the desired state.

The first type (expansion) is both simple and deterministic while the second type (revision) is neither. Let us examine the first type! What can start an expansion? There are three possible origins of inputs: observation, reasoning, communication. Let us assume that the inputs are codified as sentences. The AGM theory of theory expansion gives a bird's eye view of the whole. The epistemic sentences (sentences about knowledge) are not included in the language of AGM theory and it is, consequently, blind to the difference between origins. The instruction for expansion is: add the new sentence and expand the knowledge with all consequences resulting from the addition, i.e.

$$\mathcal{F} \oplus \varphi = Cn(\mathcal{F} \cup \{\varphi\})$$

The difference between origins is relevant for the theory of knowledge. First, there is no pure expansion of knowledge. The introspective part of knowledge must be revised with each expansion.

Example

Let \mathcal{T}_{AGM} denote the non-introspective content and \mathcal{T}_K . The full knowledge \mathcal{T} is composed of two parts: —a first-order theory \mathcal{T}_{AGM} , a “story about something but not about story itself”, and —a reflexive theory \mathcal{T}_K , a “story about a story”.

Let us denote by $\mathcal{T} \oplus p$ the knowledge “refreshed (updated) by p ”, i.e. $p \notin \mathcal{T}$ and $p \in \mathcal{T} \oplus p$.

On the one side, it is safely to assume that refreshed knowledge equals joining its refreshed parts:

$\mathcal{T} \oplus p = \mathcal{T}_{AGM} \oplus p \cup \mathcal{T}_K \oplus Kp$. It would be wrong to define expansion of introspective part in analogy to AGM expansion as simple addition followed by deductive closure since introspective theory $\mathcal{T}_K \cup \{Kp\}$ is inconsistent since new knowledge that p replaces *not knowing that p* with *knowing that p* .

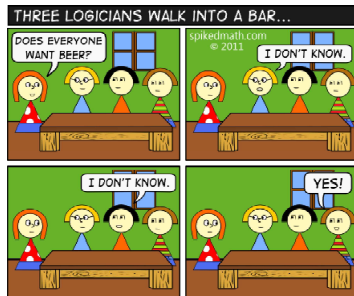
$\mathcal{T}_K \oplus p = Cn_K(\mathcal{T}_{AGM} \oplus p)$, where Cn_K denotes S5 consequence relation for knowledge modality.

	1	2	3
	<i>From non-introspective part of knowledge</i>		
	previous knowledge	observation	reasoning
expansion path	$p \rightarrow q$	p	q
	<i>From introspective part of knowledge</i>		
revision path	$\neg Kp, \neg Kq$	Kp	Kq

Communication is different from private sources of knowledge like observation and reasoning. Knowledge communicated by a truthful announcement within a group changes not only their introspective knowledge but also their intersubjective knowledge. Announced truth $!P$ becomes known to everyone in the group, and it also becomes commonly known, i.e. each member of the group knows of each member that she knows of each member of the group ... that P .

COMMUNICATED IGNORANCE BECOMES KNOWLEDGE

$\varphi \leftrightarrow (B_i \wedge B_j \wedge B_k)$ stands for 'Everybody wants bear.'



$$K_k B_k \quad (4)$$

$$[!(\neg K_i \varphi \wedge \neg K_i \neg \varphi)] K_k B_i \quad (5)$$

$$[!(\neg K_i \varphi \wedge \neg K_i \neg \varphi)][!(\neg K_j \varphi \wedge \neg K_j \neg \varphi)] K_k B_j \quad (6)$$

$$[!(\neg K_i \varphi \wedge \neg K_i \neg \varphi)][!(\neg K_j \varphi \wedge \neg K_j \neg \varphi)] K_k B_\varphi \quad (7)$$

SOME OF PAL REDUCTION AXIOMS (VAN BENTHEM)

Announcements do not change objective world.

$[!P]q \leftrightarrow (P \rightarrow q)$ for atomic fact q



Announced truths are persistent truths.

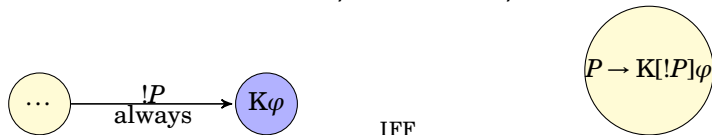
$[!P]\neg\varphi \leftrightarrow (P \rightarrow \neg[!P]\varphi)$

$\langle !P \rangle \varphi \leftrightarrow (P \wedge [!P]\varphi)$



Knowledge includes knowledge of communication language.

$[!P]K\varphi \leftrightarrow (P \rightarrow K[!P]\varphi)$



DENEGATION

- The “meaning” of a speech act cannot be reduced to the meaning of “sentence radical”.
- We understand what a speech act means if we know the change it makes. We explain the meaning of a speech act by showing its logical structure, i.e. by showing how elementary acts are composed. The principle of compositionality holds: the effects of a complex act depend on the effects of elementary acts and the mode of their composition. Since these acts are “semantical” at the very end they irreducibly depend on representational content.

Example

Denegated speech act within a given type is a retreat to mental state upon which the contrary speech act of the same type can be happily performed. Formally, relation $\text{cnt}_2(\delta\varphi)$ is moving back along relation $\delta\varphi$ to a point lying in the domain do of the relation $\delta \sim \varphi$.

$$\llbracket \text{cnt}_1(\delta\varphi) \rrbracket = \{\langle x, y \rangle \mid y \sqsubseteq x \wedge y \not\models \delta\varphi\} \quad (8)$$

$$\llbracket \text{cnt}_2(\delta\varphi) \rrbracket = \llbracket \text{cnt}_1(\perp) \rrbracket; \llbracket (\text{do}(\delta \sim \varphi)) \rrbracket \quad (9)$$

Actors (agents, subjects, . . .) $i \in \text{Actor}$; propositional letters $p \in \text{Atom}$; \otimes_i stands for modal operators of intentionality; $i \text{ stit}$: stands for modal operator of action; \odot_i stands for deontic modal operators.

$\mathcal{L}_{\text{reality}}$	$\varphi ::= p \mid \perp \mid \otimes_i \varphi \mid i \text{ stit} : \varphi \mid \odot_i \varphi \mid \neg \varphi \mid (\varphi \wedge \varphi) \mid \chi$
$\mathcal{L}_{\text{utterance}}$	$\xi ::= !i \text{ stit} : \varphi \mid \cdot \varphi \mid \xi \rightarrow \xi$
$\mathcal{L}_{\text{locution}}$	$\chi ::= i : \underline{\xi} \mid \chi \chi$
$\mathcal{L}_{\text{effect}}$	$\epsilon ::= [\chi] \varphi \mid \neg \epsilon \mid (\epsilon \wedge \epsilon) \mid \varphi$

The sentential form $[\chi] \varphi$ of $\mathcal{L}_{\text{effect}}$ describes an effect of locution χ of $\mathcal{L}_{\text{locution}}$ in terms of description φ of $\mathcal{L}_{\text{reality}}$.

Definition

i is committed to ξ_n after i 's discourse $\xi_0 \dots \xi_{n-1}$ iff

- $[i:\underline{\xi_0 \dots \xi_{n-1}}]\mathbf{P}_i i:\underline{\xi_n}$, and
- $[i:\underline{\xi_0 \dots \xi_{n-1}}]\mathbf{F}_i i:\underline{\xi'}$ for all utterances ξ' such that $\perp \in Cn(\{\xi_n, \xi'\})$, and
- $[i:\underline{\xi_0 \dots \xi_{n-1}}]\mathbf{O}_i(\chi \rightarrow i:\underline{\xi_n})$ for some locution χ .

Let us define $\lambda^{i:\xi_1 \dots \xi_n} = \lambda_{\mathbf{P}}^{i:\xi_1 \dots \xi_n} \cup \lambda_{\mathbf{F}}^{i:\xi_1 \dots \xi_n} \cup \lambda_{\mathbf{O}}^{i:\xi_1 \dots \xi_n}$ as the set of general linguistic commitments of *i* generated in any case where *i* performs discourse $\xi_1 \dots \xi_n$. The set $\lambda^{i:\xi_1 \dots \xi_n}$ of general linguistic commitments created by *i*'s discourse $\xi_1 \dots \xi_n$ is composed of sets of possible utterances of *i* that are deontically valued as permitted or forbidden. In addition, there are also conditional obligations where a permissible locution plays the role of *faciendum*—an utterance that *i* is obliged to execute if asked to.¹ Linguistic obligations are conditional and triggered only in communication. Since communication involves at least two actors, the notion of linguistic obligation has no pair among logical notions from one-mind or one-agent category.

¹ $\lambda_{\mathbf{O}}^{i:\xi_1 \dots \xi_n} = \{\mathbf{O}_i i:\xi \mid \mathbf{P}_i i:\xi \in \lambda_{\mathbf{P}}^{i:\xi_1 \dots \xi_n} \text{ and for some } j \text{ and some } \xi' \text{ } [i:\xi_{0 \dots \xi_n} \mathbf{O}_i(j:\xi' \rightarrow i:\xi)]\}$.

We call inconsistent commitment sets those that have both a permission and a prohibition for the same locution and those that have no permitted locutions. The class of all inconsistent commitment sets will be denoted by \mathcal{F} . Suppose that a discourse $\xi_0 \dots \xi_{n-1}$ is consistent.² Then the possible transformations of linguistic commitments are:

- ① the confirmatory continuation of discourse $\xi_0 \dots \xi_{n-1}$ with ξ_n :

$$\lambda^{i:\xi_0 \dots \xi_{n-1}} = \lambda^{i:\xi_0 \dots \xi_{n-1} \xi_n};$$
- ② the rejective continuation of discourse $\xi_0 \dots \xi_{n-1}$ with ξ_n :

$$\lambda^{i:\varphi_1 \dots \varphi_n \xi_n} \in \mathcal{F};$$
- ③ the constructive continuation of discourse $\xi_0 \dots \xi_{n-1}$ with ξ_n :

$$\lambda^{i:\xi_0 \dots \xi_{n-1}} \neq \lambda^{i:\xi_0 \dots \xi_{n-1} \xi_n} \text{ and } \lambda^{i:\xi_0 \dots \xi_{n-1} \xi_n} \notin \mathcal{F}.$$

²We take that $n \geq 1$ denotes the length of discourse. The discourse $\xi_0 \dots \xi_{n-1}$ is empty for $n = 1$.

CONSEQUENCE RELATION

The following propositions are closely related:

$$(T) \quad \xi_0 \dots \xi_{n-1} \vdash_L \xi_n.$$

$$(DS) \quad [i:\underline{\xi_0 \dots \xi_{n-1}}] \varphi \leftrightarrow [i:\underline{\xi_0 \dots \xi_{n-1}} \underline{\xi_n}] \varphi \quad \text{for all linguistic commitments } \varphi \text{ of } i.$$

$$(NP) \quad \lambda^i: \underline{\xi_n} \subseteq \lambda^i: \underline{\xi_0 \dots \xi_{n-1}}.$$

$$(IL) \quad \Psi(i:\underline{\xi_0}) \cup \dots \cup \Psi(i:\underline{\xi_{n-1}}) \vdash_{ML} \varphi \text{ for all } \varphi \in \Psi(i:\underline{\xi_n}).$$

Proposition (T) states that there is consequence relation (of the logic L) from utterance sequence $\xi_1 \dots \xi_{n-1}$ to utterance ξ_n . Proposition (DS) states that the discourse $\xi_0 \dots \xi_{n-1}$ and its continuation by ξ_n generate exactly the same general linguistic commitments for the speaker. Proposition (NP) states that the speaker's linguistic commitments of the discourse $\xi_0 \dots \xi_{n-1}$ include the linguistic commitments of the utterance ξ_n . Proposition (IL) states that the descriptions of the psychological states expressed by $\{i:\underline{\xi_0}, \dots, i:\underline{\xi_{n-1}}\}$ implies (in some modal logic ML of intentionality) each description from the set of states expressed in $i:\underline{\xi_n}$. According to Brandom's normative pragmatics, (T) holds in virtue of (NP) and similar facts about other interlocutors commitments. For Searle's and Vanderveken's illocutionary logic, (DS) holds because of (IL). In contrast to both, the position taken in this paper is that (T) explains (DS), (NP) and (IL).

BE TRUE! VS. BE CONSISTENT!

A requirement of cooperative communication ethics

Under the category of *Quality* falls a supermaxim — “Try to make your contribution one that is true” — and two more specific maxims:

1. Do not say what you believe to be false.
2. Do not say that for which you lack adequate evidence.

Paul Grice (1975) *Logic and conversation*. In: *Studies in the Way of Words*, p.27, 1989.

- The logical obligations are different in category. They are general requirements of communication ethics. They hold both for cooperative and non-cooperative communication, they regulate both communication oriented to success and communication oriented to reaching understanding (strategic actions and communicative actions, Habermas).
- Language use changes normative (social) world. At any stage of constructive discourse linguistic commitments change: their deontic status is updated or downdated by the new locution.
- The logical part of communication ethics is exactly this re-distribution of deontic statuses over locutions.

A COMPARISON

Example

Grice: “Don’t say what you believe to be false!”

$$B_i \neg \varphi \rightarrow \mathbf{F}_i \underline{i:\varphi} \quad (10)$$

$$\{B_i \neg \varphi, \underline{i:\varphi}\} \neq \perp \quad (11)$$

Example

Deontic reading of Moore’s sentence: “Don’t deny the sincerity conditions of your acts!” Formula (12) shows one among many linguistic commitments created by the assertive locution. Theorem (13) shows incoherence of the denial of sincerity conditions of an assertion. Theorem (14) gives a general form for any locution type.

$$[i:\varphi] \mathbf{F}_i \underline{i:B_i \neg \varphi} \quad (12)$$

$$[i:\varphi][i:\neg B_i \varphi] \perp \quad (13)$$

$$\text{If } \circledast_i \varphi \in \Psi(i:\underline{\xi}), \text{ then } [i:\underline{\xi}] \mathbf{F}_i \underline{i:\neg \circledast_i \varphi}. \quad (14)$$

CONCLUSION

- Language is a normative source.
- Language differs from other normative sources whose codes possibly can violate the logic of language in which they are expressed.
- Violation of logical requirements in language use destroys communication.
- Language user has no option but to satisfy her/his linguistic commitments. We either comply with the logical requirements of communication ethics or we fail in our attempt to use the language.