X

IMPERATIVE NEGATION AND DYNAMIC SEMANTICS

Berislav Žarnić, University of Split, Croatia

1 INFORMATIONAL CONTENT OF IMPERATIVES

Negative imperatives seem to be a tough nut to crack. However, a comprehensive theory of meaning should be able to do so. There are several controversial questions in the logic of imperatives, one of them being the informational content of imperatives. What information is conveyed to a recipient by an imperative? Does the informational content of a negative imperative reproduce the structure of the positive one?

The philosophical thesis that will be defended in this paper is the thesis that an atomic sentence and its negation belong to the same category. In the case of imperatives, the thesis implies that an imperative and its negation are equipotent with respect to their binding force and layers of informational content. Several influential approaches to imperative semantics will be examined (in chronological order) and criticized for being in discordance with the thesis. At the same time, a variant of dynamic semantics will be argued for. In order to reduce complexity, the analysis will be focused on three types of information: α-information about the initial state that is to be acted upon (typically an actual state), γ-information about goal state or the state that is to be brought about, and π-information about possible states or states entailed (not excluded) by the laws of nature.

Two negations in Lemmon's change semantics

In Lemmon's (1965) account imperatives are a kind of change expressions[1]. In a change expression A/B, the left part contains a state description A of the prior situation and the right part a state description B of the posterior situation. Any expression !(A/B) is to be counted as an imperative. In this respect Lemmon seems to endow natural language imperatives with more expressive power than they actually have. It will be argued in this paper that there are only two "atomic forms" of imperatives: the *symmetric* form where left and right side of embedded change expression are equivalent and the *complementary* form where either side is the negation of the other.

Imperatives are obtained by prefixing change expressions with the imperative mood indicator. E.g. '!(A/A)' should be read as 'sustain A!'. The semantic value of imperative on Lemmon's account is obeyed or disobeyed (**O** and D). An imperative !(A/B) is obeyed if and only if change A/B takes place.

before	later			**negation?**	
p	p	~p/p	!(~p/p)	!(~p/~p)	!~(~p/p)
⊤	⊤	⊥	D	D	**O**
⊤	⊥	⊥	D	D	**O**
⊥	⊤	⊤	**O**	D	D
⊥	⊥	⊥	D	**O**	**O**

Two imperatives count as plausible candidates for negation of imperative !(~p/p). For example, 'do not open the door' is ambiguous between 'leave the door closed' and 'refrain from opening the door'. The ambiguity of the negative imperative 'do not bring it about that p' is captured by 'sustain ~p' or !(~p/~p), and 'refrain from producing p', i.e. !~(~p/p). If one pays attention to the informational content, it can be noticed that refraining variant, i.e. !~(~p/p) does not inform on the situation that is to be acted upon. It is equivalent to !(p/p)∨!(p/~p)∨!(~p/~p), which has no contingent assertoric entailment, and in that respect it could be a cautious way of commanding !(~p/~p). Such an imperative bears no information on the initial situation in which eventual action should be executed; rather it makes an action dependent on a particular situation type. Therefore, the informational content of !(p/p)∨!(p/~p)∨!(~p/~p) may be expressed by 'sustain ~p if ~p is the case'. The conditional imperative does not command anything if p is the case, and therefore cannot be expressed by 'make sure that ~p!' or 'see to it that ~p!', whose informational content can be represented by !(⊤/~p). If one assumes that negation of an atomic sentence should share with it the same informational layers, then imperatives that bear no information on the initial state do not seem to be plausible candidates for the role of negation of the sentence that does bear information of that kind.

Contrary to Lemmon's assumption, in natural language some change expressions cannot be used as imperative content, namely those that do not use the same proposition either for

[1] The notation that is used in this paper always follows the notation used in the papers that are being referred to.

symmetric or combined privative-attributive description of initial and goal situation[2]. Nevertheless, there are ways in which natural language copes with the problem of precise determination of commanded change. One of the ways is the contextual restriction of meaning, the other imperative conjunction. For example, the sequence 'Bring Pluto inside the dog-house! Pluto and Fido cannot be in the same dog-house. Fido is inside.' pre-theoretically entails 'Take Fido outside and bring Pluto inside!' (see Figure 1 where white boxes represent γ-information and gray boxes represent α-information). Now, the imperative conclusion in the example should be expressed as !(f∧~p/~f∧p), but that kind of imperative is inexpressible in natural language. Instead of one comprehensive yet in natural language unavailable form, one should either use two imperatives, i.e. !(f/~f)∧!(~p/p) or otherwise create a context which modifies the initial command !(~p/p) in such a way that a change f∧~p/~f∧p is actually commanded in the context. The context dependency receives a natural treatment within the update semantics, which takes sentences not to be truth functions, but rather context functions. A sentence uttered in an empty context preserves as many interpretative options as possible, but some interpretative options may become eliminated by context changes[3]. In the example above, *to bring Pluto inside and to leave Fido inside* was an interpretative option endorsed by the initial imperative !(f/~f) but eliminated by the subsequent change of context.

Expressiveness of natural language imperatives seems to be restricted to two types of change expressions: symmetric or *maintain* imperative !(A/A), and complementary, *proper change* or *produce* imperative !(~A/A). Nevertheless, there are ways to produce an imperative not belonging to the mentioned types. The typical examples are *sustain-change* imperative !(A∧~B/A∧B) and *change-change* imperative !(~A∧~B/A∧B). The motivational effect similar to the effect that unrestricted change expressions would produce can be achieved by modifying a context and by conjoining imperatives. In the above example, the text !(~p/p);~(p∧f)/~(p∧f);(f/⊤) entails !(~p∧f/p∧~f) and thus produces the same motivational, although cognitively different impact as imperative conjunction !(~p/p) ∧!(f/~f).

---

[2] If one accepts the received view, then natural language sentences can be decomposed into one modal element (tropic) and one sentence radical (phrastic). From this deep-rooted assumption it follows that sentence radical for imperatives cannot have two logically independent parts as permitted by the syntax of change expressions.

[3] Let empty context 0 be a context for a discourse topic in which no sentence has been uttered so far. Call the effect of accepting a sentence φ in an empty context 0 – full intension $||\varphi||^0$ of a sentence. Eventual subsequent sentences $\psi_1;...;\psi_n$ will act upon the context $||\varphi||^0$ and they may create a new context C which will restrict the intension of φ, i.e. $||\varphi||^C \subset ||\varphi||^0$. The full intension of an imperative need not be preserved and in such a way a particular change permitted by initial imperative may become unacceptable later.

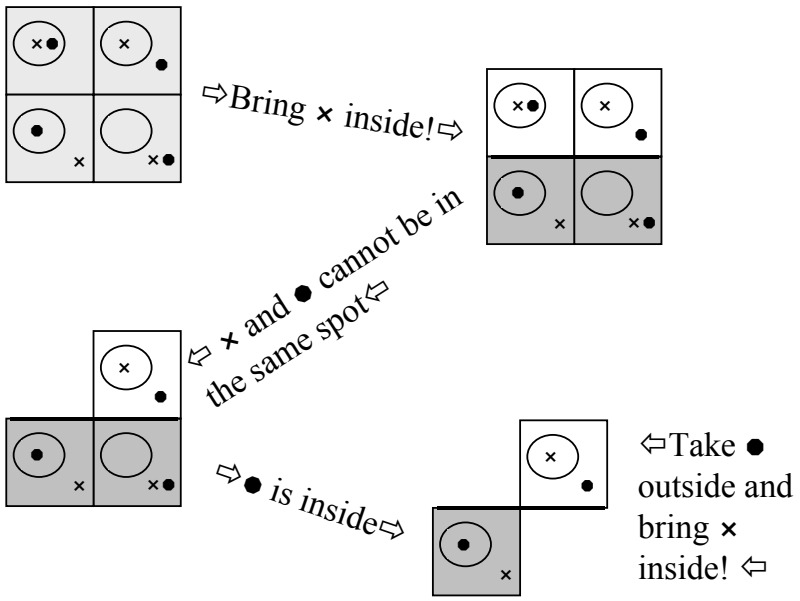

Figure 1 Changing contexts.

Chellas: imperative obligation and imperative permission

In an early modal approach, Chellas (1971) reduces the informational content of imperatives to γ-information.

- Imperative obligation: $||!\varphi||(w,t)=1$ iff $||\varphi||(w',t)=1$ for every w' such that $R_t(w,w')$
- Imperative permission: $||¡\varphi||(w,t)=1$ iff $||\varphi||(w',t)=1$ for some w' such that $R_t(w,w')$
- $!\varphi \equiv \neg ¡ \neg \varphi$

Negation of an imperative obligation !φ is imperative permission ¡¬φ. While it seems natural to say that imperative !φ obliges the addressee to bring about a φ-situation, it is disputable whether the negative imperative could be narrowed down to permission to bring about a ¬φ-situation. For example, if one takes 'Don't close the door!', rather than 'You do not have to close the door', to be the negation of 'Close the door!', then the binding force seems to be equal in both cases. On the other hand, imperative permission seems to be connected with putting out of force an imperative already issued, and therefore it does not exemplify a self-sufficient imperative.

Belnap et al. : choice semantics

In *stit* semantics (Belnap and Perloff, 1988; Horty and Belnap, 1995) the content of an imperative is identified with an *agentive*, i.e. agency ascribing sentence. The variant of *stit* semantics most closely related to imperatives seems to be "deliberative" one. It uses

instant/history pair on the branching time tree as point of evaluation for [α *dstit*: A] and checks for positive and negative condition, namely: existence of an agent's choice that can guarantee the truth of A and existence of a history in which A is not true.

- *M,m/h* ⊨ [α *dstit*: A] iff $Choice_{\alpha}^{m}(h) \subseteq |A|_{m}^{M}$ and $|A|_{m}^{M} \neq H_{m}$ (where H_{m} is a set of histories passing through *m*, $|A|_{m}^{M}$ is subset of H_{m} in which *A* holds, and $Choice_{\alpha}^{m}(h)$ represents a possible choice available for agent α at the pair instant *m* and history *h*).

As for negation, several options are available. Still, if "content of every imperative must be an agentive" (Belnap, 1971, p.183) and if negative imperative is a kind of imperative, then ¬[α *dstit*: A], being a denial of agency, does not fit the purpose. The choice is reduced to refraining from seeing to it that *A*, *i.e.* [α *dstit*: ¬[α *dstit*: A]], which is equivalent to (¬[α *dstit*: A]∧◊[α *dstit*: A]), on one side, and to seeing to it that ¬*A*, *i.e.* [α *dstit*: ¬A], on the other side. In both cases, unlike Chellas' approach, imperative and its negation are equal in their binding force: negative imperative is not an imperative permission, but rather an imperative obligation.

The *dstit* semantics gives no importance to α-information, information on the state in which a choice is to be made. Assuming that the content of the negative imperative is a commit-agentive and not a refrain-agentive, there should be a context in which both 'Open this window!' and 'Close this window!' could be meaningfully uttered, and that does not seem to be intuitive. Refrain-agentive seems to be a better candidate for the content of a negative imperative. Still, the commit-refrain pair, *choose-do not choose* does not accommodate the intuition that positive and negative imperatives point to alternative goal situations.

Due to its disregard for α-information, *stit* semantics validates principles like *See to it that A!; A is the case. Therefore, see to it that A!* In contrast to this, it seems that informational contents of an imperative and an indicative can interact. For example, if the Commander (Imperator) says 'Close the door!, and then adds 'It is already closed', then the second sentence puts the first one out of force. If one reformulates the imperatives in α-information free approach like 'Make sure that the door is closed!' or 'See to it that the door is closed', then reflexivity goes through under the assumption that their α-information free reading is equivalent to 'Produce that A or sustain that A!' or 'Change to A if ~A is the case, and if A is the case, sustain A'. The shortcomings in dealing with "interaction of practical and theoretical reasoning" and the inexpressible distinction between 'Produce...!' and 'Sustain...!' seem to create problems for the γ-information oriented approach.

Segerberg: actions, events and processes

In Segerberg's (1990) approach imperatives are treated as "prescribed actions". Imperative !p gets formal notation !δp, where δp is a singular term denoting an action type (generic action) and where action δp is a set of pairs of situations such that the second one verifies p.

- $\Gamma \models_{x} !\delta p$ iff $\{<x,y>: y \in \|p\|\} \in \Gamma_{x}$

The informal reading of imperative !δp is 'Do anything to bring it about that p!'. Negative imperative !δp ⊃⊥ is allowed by syntax and, following proposed semantics, does not turn out to be equivalent to any specific imperative, and, in particular, it is not equivalent to !δ(p⊃⊥), or informally: 'Do anything to bring it about that ¬p!'

The action approach was refined in (Segerberg, 1996) by distinguishing between events of producing and destroying a state of affairs, on one side, and processes of maintaining and suppressing a state of affairs, on the other side (the members of each pair are interdefinable). The event of producing (destroying) S is a set of paths, i.e. set of sequences of total states ending with a state of affairs S (¬S). The process of maintaining (suppressing) S is a set of complexes, i.e. convex sets of paths such that all path elements belong to S (none of path elements belong to S). Commands are requests for an event (a process) to be brought about and their "complement" is always (usually) a process to be brought about. Unlike commands to produce a state of affairs, maintain commands always give the information about the state that is to be acted upon. Therefore, produce imperative !δp brings no α-information about initial state while its negation, maintain imperative !μ¬p does so. This dissimilarity in the informational content of positive and negative imperatives does not meet the second of the two pre-theoretical expectations: positive and negative imperatives are equipotent with respect to their binding force and their informational complexity.

2 ARGUMENTS FOR CHANGE SEMANTICS

In order to discuss some philosophical consequences of different imperative semantics, one may introduce a variant of simple update system, Veltman (1996). The simple update system is basically a "one move" system with basic instruction $\sigma[\varphi]=\sigma\cap\|\varphi\|^W=\|\varphi\|^\sigma$, where $\|\varphi\|^W\subseteq W$ is a set of valuations verifying φ in the standard sense, and W is the powerset of the set of atomic sentences in the part of language under consideration[4].

The core phenomena of "interaction of practical and theoretical reasoning" can be captured using three sets for modelling informational impact. Set α represents available information about the state of affairs that is to be acted upon, set γ represents available information about the state of affairs that is to be brought about or preserved, i.e. information about the goal state, and set π represents available information about the states of affairs that are entailed by the

[4] Within the framework of dynamic semantics one is not supposed to think of meaning only as a relation between a sentence and the world (including possible ones). Rather meaning is conceived as the result of an interpretation process. In this case, interpretation is understood as an elimination process. In a metaphor, the interpreter entertains different candidate pictures of a yet unknown situation, declarative sentences are picture fragments, and their interpretation consists of comparing picture fragments with candidate pictures and removing the ones that do not fit. The number of remaining pictures measures the amount of information; the more pictures remain the less information a text conveys. The residual pictures create a context for the next step in the interpretation process. The truth-value of a sentence may be unsettled at a particular stage if the context contains both pictures having and pictures lacking the fragment. For a sentence to be true in a context, it means that the context is not empty and that the sentence does not have a power to eliminate any picture fragment from it.

laws of nature. In the framework[5] the informational content of a sentence can be decomposed into three elements. The extreme positions in one-way navigation through the space of cognitive-motivational[6] states $\Sigma=\{<\alpha,\gamma,\pi>:\alpha\subseteq\pi,\ \gamma\subseteq\pi,\ \pi\subseteq W\}$ are the information free point $0=<W,W,W>$, and the set of final points $F=\{\sigma\in\Sigma:\alpha=\varnothing$ or $\gamma=\varnothing\}$ including "absurd state" $1=<\varnothing,\varnothing,\varnothing>$.

Imperatives[7] as change expressions bring information about the state of affairs that is to be acted upon and information about the state that is to be brought about or preserved:

- Produce imperative: $<\alpha,\gamma,\pi>[!^{P}\varphi]=<\alpha-||\varphi||^{W},\gamma\cap||\varphi||^{W},\pi>=<||\neg\varphi||^{\alpha},||\varphi||^{\gamma},\pi>$
- Maintain imperative (see Figure 2): $<\alpha,\gamma,\pi>[!^{M}\varphi]=<||\varphi||^{\alpha},||\varphi||^{\gamma},\pi>$ if $||\varphi||^{\alpha}\neq\pi$; $<\alpha,\gamma,\pi>[!^{M}\varphi]=1$ if $||\varphi||^{\alpha}=\pi$

It is an empirical fact that imperatives using verbs in the imperative mood have either a complementary or a symmetric semantic impact with respect to their informational content. The one-sided γ-information imperatives are untypical in so far as they use a general action verb phrase ('Make sure that...!', 'See to it that ...!'). From the analytical point of view, if a natural language sentence is decomposable into modal element and sentence radical (Stenius, 1967), then there must be only one sentence radical that is used for a semantic action. Therefore, only three forms of eliminative semantic actions of imperatives are possible with respect to the pair of α-information and γ-information[8].

The same one-dimensional semantic impact of γ-information imperatives may be induced by a conjoining two conditional imperatives. 'Make sure that φ!' can be understood as a shorthand expression for 'If $\neg\varphi$ is the case, produce φ, and if φ is the case, maintain φ'. In that respect the introduction of the third type of imperative, i.e. γ-imperative, may be superfluous.

- γ-imperative: $<\alpha,\gamma,\pi>[!^{G}\varphi]=<\alpha,||\varphi||^{\gamma},\pi>$

Declarative sentences about the state that is to be acted upon have one-dimensional informational content:

- $<\alpha,\gamma,\pi>[\bullet\varphi]=<||\varphi||^{\alpha},\gamma,\pi>$

Declarative sentences about the state that is entailed by the laws of nature restrict the range of possible present and future situations:

- $<\alpha,\gamma,\pi>[\bullet^{N}\varphi]=<||\varphi||^{\alpha},||\varphi||^{\gamma},||\varphi||^{\pi}>$

---

[5] The limitations of this kind of modeling are numerous. By using variations of these structures, i.e. triples of sets of valuations, one neither can give the semantics for conditional imperative nor represent regularities as sequences of event types.

[6] The proposed semantics guarantees that information on initial situation type or on goal situation type carries also the information that those situation types are alethically possible.

[7] Syntax. If φ is a proposition in the standard language of propositional logic, then $!^{P}\varphi$, $!^{M}\varphi$, $\bullet\varphi$, $\bullet^{N}\varphi$ are sentences of the language $L_{!P!M\bullet\bullet N}$. Nothing else is in $L_{!P!M\bullet\bullet N}$.

[8] The three types are: complementary $!^{P}$ –type (relative complement-intersection and intersection-relative complement), symmetric $!^{M}$-type (relative complement-relative complement and intersection-intersection), and one-sided $!^{G}$-type (identity-intersection and identity-relative complement).

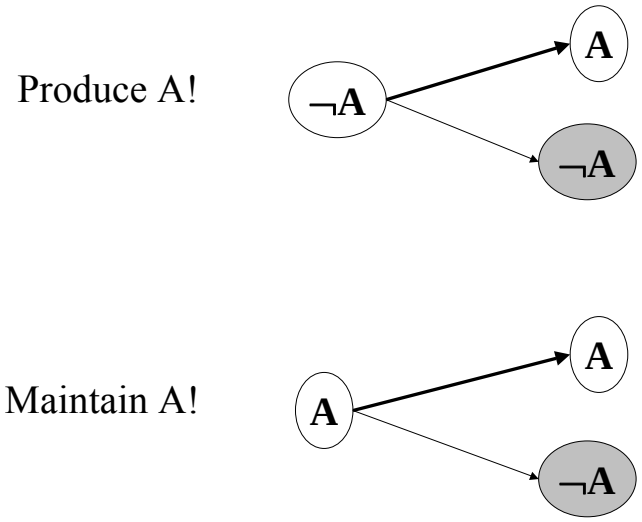

Figure 2 Goal situation must be possible and avoidable.

Negative imperative: equipotent in binding force and informational layers

The task of dynamic semantics is to provide a connection between a structure that verifies a sentence and operations that produce verifying structural variation. To update a structure with a sentence means to produce a minimal modification of the structure needed for the verification of the sentence. Following that line of thought, negation of a sentence can be understood as an operation that will prevent any successful[9] modification by that sentence. In that sense, negation changes a structure in a way that makes accepting of the negated sentence impossible.

There are different ways of making an imperative unacceptable. According to the proposed dynamic semantics for imperatives as change directives the produce-imperative $!^{P}\varphi$ is not acceptable in any state $<\alpha,\gamma,\pi>$ such that $||\neg\varphi||^{\alpha}=\varnothing$ or $||\varphi||^{\gamma}=\varnothing$. Since the fulfilment of one condition suffices, declarative sentence $\bullet\varphi$ could be regarded as a variant of a dynamic negation of $!^{P}\varphi$. It is natural to assume that negation of an imperative is an imperative too, and thus to rule out $\bullet\varphi$. The opposition $!^{P}\neg\varphi$ is not a good candidate for the role of negated change instruction if it is intuitively acceptable that the 'negated change' amounts to 'no change'. The opposition $!^{M}\varphi$ is not a good candidate either in so far it has the same goal content as $!^{P}\varphi$. The "one-sided" negation $!^{G}\neg\varphi$ has special attractiveness since in combination with $\bullet$-type sentences it can make all cognitive-motivational states $\sigma\in\Sigma$ reachable. On the other hand, within the proposed semantics for imperatives as change instructions negation $!^{G}\neg\varphi$ turns out to be indeterminate between variants of conditional imperatives: (i) if $\bullet\varphi$, then $!^{P}\neg\varphi$, (ii) if $\bullet\neg\varphi$, then $!^{M}\neg\varphi$, and (iii) if $\bullet\varphi$, then $!^{P}\neg\varphi$ and if $\bullet\neg\varphi$, then $!^{M}\neg\varphi$. So, we opt for $!^{M}\neg\varphi$ as a plausible candidate for the negation of $!^{P}\varphi$ since only $!^{P}\varphi$ and $!^{M}\neg\varphi$ impose different imperative alternatives for the same type of initial situation.

[9] 'Successful' means 'not landing into a final state'.

On our account, there are two kinds of imperatives, i.e. $!^{P}\varphi$ and $!^{M}\varphi$, and their negative counterparts are $!^{M}\neg\varphi$ and $!^{P}\neg\varphi$, respectively.

- $\neg!^{P}\varphi \equiv !^{M}\neg\varphi$
- $\neg!^{M}\varphi \equiv !^{P}\neg\varphi$

See Figure 3 where pairs of positive and negative imperatives lie on the same side of the picture. For example, 'Do not sustain p!' is equivalent to 'Destroy p!', and 'Do not destroy p!' is equivalent to 'Sustain p!'.

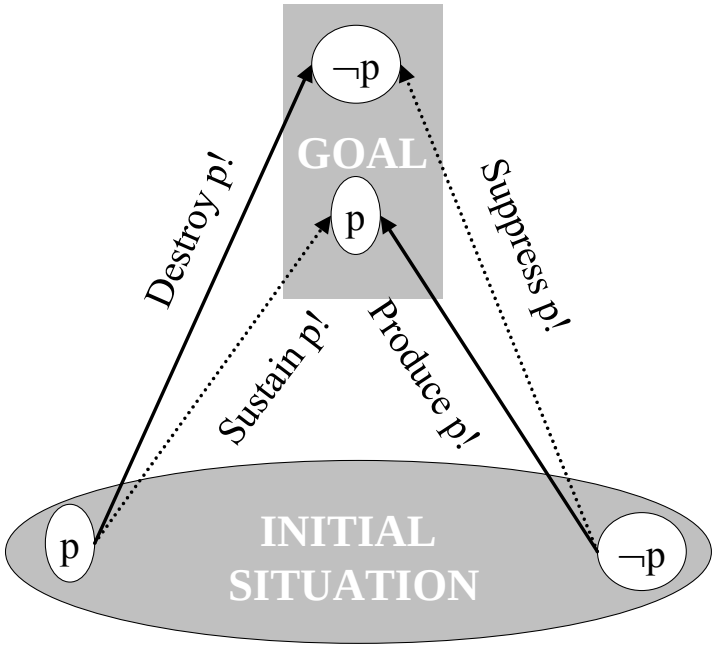

Figure 3 Imperative alternatives.

Connection with desire-belief logic

The change semantics that takes into account two kinds of information (information on the situation to be acted upon and situation to be brought about) provides a bridge for connecting imperative logic with desire-belief logic.

If we take imperatives to be instructions for changing or sustaining a type of situation, then $!^{P}\varphi$ means 'change initial $\neg\varphi$ situation into φ situation', and $!^{M}\varphi$ means 'do not change initial φ situation into $\neg\varphi$ situation'. These double semantic moves, the asymmetric and symmetric one, seem to be a more accurate account of natural language imperative semantics when compared to the act-on-goals-only approach. There is another motivation for this kind of imperative semantics: by connecting imperative logic with belief-desire logic one may characterize the agent's motivational state by the imperative the agent accepts.

The asymmetric imperative can characterize the state of desire, since "…every one who desires, desires that which he has not already, and which is future and not present," (Plato, Symposium, 200e). This double informational content of desire Cross (1997) has captured in the formal way by introducing Δ-modality for "desire in the sense of incompatible goal-belief discrepancy".

- $V^*(\Delta p,w)=T$ iff $V^*(p,w')=T$ and $V^*(p,w'')=F$ for all w', w'' such that $<w,w'>\in R^1$ and $<w,w''>\in R^2$ (where $<w,w'>\in R^1$ and $<w,w''>\in R^2$ should be understood as w' is satisfactory state of affairs and w'' is epistemically possible from the agent's point of view at w)

On the other side, one may want to sustain an aspect of a given situation, in which case it is the $!^M$-type imperative that can be used to characterize that kind of a motivational state. Such motivational state finds no place in Cross' (1997) approach. He uses $\oplus$-modality (satisfaction modality) to cover such cases.

- $V^*(\oplus p,w)=T$ iff $V^*(p,w')=T$ and $V^*(p,w'')=T$ for all w', w'' such that $<w,w'>\in R^1$ and $<w,w''>\in R^2$

Following Cross, if one desires that $p\wedge q$ and believes that p, then s/he should be satisfied that p. On our approach, it is rather the desire to preserve p than satisfaction with p to be inferred in the example. Motivational extension can be conceived of as a process in which the goal "remains fixed" while "subgoals change". Cross' assertion that every realization of a subgoal leads to the state of satisfaction does not seem acceptable. The motivational force of a desire (in the sense of incompatible goal-belief discrepancy) is exhausted by the realization of its content, and it is only that final point of motivation extension that could be identified with the state of absolute satisfaction, rather than an intermediate motivational state in which an agent desires to sustain something.

The semantics and pragmatics of imperatives

The combined fact-goal approach to imperative semantics seems to be justified by assuming a harmony between semantics and pragmatics. If a speaker suggests a goal s/he believes to be impossible or she commands that the state s/he believes to be actual is to be brought about, then the logic of suggestions and commands is violated. When the Imperator is not sure whether φ is the case, in order to be cooperative, s/he should say 'Change to φ if φ is not the case.' If one does not choose mixed, goal-and-fact semantics for imperatives, then s/he must endorse the idea that an imperative $!^P\varphi$ commands two actions: first, an epistemic one consisting in checking whether φ is the case, and the second, conditional one consisting in seeing to it that φ if it turns out that φ is not the case. On this approach, but not on ours, a conditional imperative 'Produce φ if $\neg\varphi$' is equivalent to 'Produce φ!'

Groenendijk (1999) advocates shifting the logical perspective, from valid reasoning to cooperative communication. Following the idea, if there is an example of uncooperative information exchange, then given different semantics, those that can explain away uncooperativeness are more convincing. Suppose that a wife tells her husband to close the window in another room. The husband returns and tells her that the window had already been closed when he got there. She answers: "I knew that it was closed". Is the wife's communication cooperative? Obviously, it is not. The violation of a rule in this language

game can be accounted for if we assume that imperatives provide information on the state of affairs to be acted upon. In this example, the information conveyed by the wife's imperative was not true.

REFERENCES

Belnap, N. and M.Perloff (1988). Seeing to it that: a canonical form of agentives. *Theoria*, **54**: 175-199.

van Benthem, J. (1993). *Exploring Logical Dynamics*. CSLI Publications, Stanford, California.

Chellas, B. (1971). Imperatives. *Theoria*, **37**: 114-129.

Cross, C.B. (1997). The modal logic of discrepancy. *Journal of Philosophical Logic*, **26**: 143-168.

Groenendijk, J. (1999). The Logic of Interrogation (classical version). *ILLC Scientific Publications PP-1999-19*. Institute for Logic, Language and Computation, Amsterdam

Horty, J.F. and N. Belnap (1995). The deliberative STIT: a study of action, omission, ability and obligation. *Journal of Philosophical Logic*, **24**: 583-644.

Lemmon, E.J. (1965). Deontic logic and the logic of imperatives. *Logique et Analyse*, **8**: 39-71.

Segerberg, K. (1990).Validity and satisfaction in imperative logic. *Notre Dame Journal of Formal Logic*, **31**: 203-221.

Segerberg, K. (1996). To do and not to do. In: *Logic and Reality: Essays on the Legacy of Arthur Prior* (B.J. Copeland, ed.), pp.301-313. Clarendon Press

Stenius, E. (1967). Mood and language game. *Synthese*, **19**: 27-52.

Veltman, F. (1996). Defaults in update semantics. *Journal of Philosophical Logic*, **25**: 221-261.