

in C. Dégrémont, L. Keiff & H. Rückert (eds.) *Dialogues, Logics and Other Strange Things*
Essays in Honour of Shahid Rahman Volume 7 of series *Tributes*, College Publications, 2008

A GENERAL LOGIC OF PROPOSITIONAL ATTITUDES

Daniel Vanderveken (Université du Québec) www.vanderveken.org¹

Abstract

Contemporary logic and analytic philosophy are confined to a few paradigmatic propositional attitudes such as belief, knowledge, desire and intention. How could we develop a larger theory of all kinds of attitudes directed at objects and facts? Descartes in *les passions de l'âme* analyzes attitudes in terms of beliefs and desires. In my analysis, psychological modes of propositional attitudes have other components than the *basic Cartesian categories of cognition and volition*. Complex modes like expectation, knowledge and intention have a *proper way of believing or desiring, proper conditions on their propositional content or proper preparatory conditions*. Thanks to these other components one can well distinguish stronger and weaker modes. I will *recursively define the set of all psychological modes* of attitudes. As Descartes anticipated, the two primitive psychological modes are those of *belief and desire*. They are the simplest modes. Other more complex modes are obtained from the two primitives by adding to them special cognitive and volitive ways, special conditions on the propositional content or special preparatory conditions. I will *define inductively the conditions of possession and of satisfaction* of all kinds of propositional attitudes. To that end, I will exploit the resources of a non standard *predicative logic* that distinguishes propositions with the same truth conditions that do not have the same cognitive value. We need to consider *subjective* as well as *objective possibilities* in philosophical logic in order to account for the fact that human agents are not perfectly but only minimally rational. I will state fundamental valid laws of my logic of attitudes.

Descartes in his treatise on *Les passions de l'âme*² analyzed a large number of propositional attitudes. His work is a major contribution to modern philosophy of mind. Contemporary logic and analytic philosophy only consider a few paradigmatic attitudes such as belief, knowledge, desire and intention. Could we use Cartesian analysis to develop a larger theory of all propositional attitudes? Searle in *Intentionality*³ criticized Descartes who tends to reduce all such attitudes to beliefs and desires. Many different kinds of attitudes such as fear, regret and sadness reduce to the same sums of beliefs and desires. Moreover, our intentions are much more than a desire to do something with a belief that we are able to do it. Of course, all cognitive attitudes contain beliefs and all volitive attitudes desires. But we need more than the two traditional categories of cognition and volition in order to analyze attitudes. By nature, attitudes have *intentionality*: they are *directed at* objects and facts of the world (Brentano). For

¹ I have presented this logic of attitudes at the International Colloquium *Computers and Philosophy* at Laval (France) in May 2006 and at the Meeting of the International Institute of Philosophy at Zadar (Croatia) in August 2007. I am grateful to H. Bergier, Paul Gochet, David Kaplan, K. MacQueen and John Searle for their comments.

² The treatise *Les passions de l'âme* is reedited in R. Descartes *Œuvres complètes* La Pléiade Gallimard 1953.

³ See J. Searle *Intentionality* Cambridge University Press 1982.

that reason, they have *conditions of possession* and of *satisfaction* that are logically related. Beliefs and convictions are *satisfied* whenever they are *true*, desires and wishes whenever they are *realized* and intentions and plans whenever they are *executed*. In order that an agent *possesses* an attitude, he or she must be in a certain mental state. Whoever has an attitude is able to determine what must happen in the world in order that his or her attitude is satisfied. The main purpose of this paper is to contribute to analytical philosophy of mind and to the foundations of logic in formulating a *recursive theory of conditions of possession and of satisfaction of all propositional attitudes*. *Propositional attitudes* are the simplest kinds of individual attitudes directed at facts. They are possessed by a single agent at a moment or during an interval of time. From a logical point of view, they consist of a *psychological mode M* with a *propositional content P*. I will first proceed to an explication of the nature of psychological modes. In my analysis, psychological modes divide into other components than the *basic categories of cognition and volition*. Complex modes also have a *proper way* of believing or desiring, *proper conditions on their propositional content* or *proper preparatory conditions*. Thanks to these other components one can well distinguish stronger and weaker modes. I will also *recursively define the set of all modes* of attitudes. There are more *complex individual attitudes* than propositional attitudes. So are *denegations of attitudes* like discontent, *conditional attitudes* like intentions to buy in the case of a good offer and *conjunctions of attitudes* like doubt. I will not consider here such complex attitudes.

I will exploit the resources of a non standard *predicative logic* that distinguishes propositions with the same truth conditions that do not have the same cognitive value. We need to consider *subjective* as well as *objective possibilities* in the logic of attitudes and action in order to account for the fact that human agents are not perfectly but only minimally rational. By virtue of their logical form, attitudes are logically related in various ways. There are four different kinds of relations of inclusion between conditions of possession and of satisfaction of attitudes. Some attitudes strongly commit the agent to having others: an agent cannot possess them at a moment without possessing others at the same moment. No one can enjoy something without desiring it. Some attitudes have more satisfaction conditions than others. Whenever an aspiration is fulfilled so is the corresponding hope. Certain attitudes cannot be possessed unless others are satisfied. Whoever knows something has a true belief. Conversely, certain attitudes cannot be satisfied unless others are possessed. Whoever executes a plan has the intention of executing that plan. My

primary objective here is to formulate the principles of a recursive theory of the conditions of possession and of satisfaction of propositional attitudes. I will present the ideography and state fundamental valid laws of my logic of attitudes in the last section.

Section 1 Analysis of the propositional content of attitudes

Following Carnap⁴, standard propositional logic tends to identify so called strictly equivalent propositions that have the same truth values in the same possible circumstances. However it is clear that such propositions are not the contents of the same attitudes just as they are not the senses of synonymous sentences. We need a much finer criterion of propositional identity than strict equivalence for the purposes of philosophy of mind, action and language. Indeed we do not know *a priori* by virtue of competence the necessary truth of many propositions. We have to learn a lot of essential properties of objects. By *essential property* of an object I mean here a property that it *really* possesses in any possible circumstance. So are our properties of having certain parents. We learn *a posteriori* their identity. Certain children do not know their natural mother. Others are wrong about her identity; they have a necessary false belief. However when we are inconsistent, we always remain paraconsistent. As the Greek philosophers pointed out, we cannot believe every proposition (the sophist's paradox). Any adequate logic of attitudes has to account for such facts. Few necessarily true propositions are pure *tautologies* such as the proposition that mothers are mothers that we know *a priori* to be true.

A second important problem of the standard logic of attitudes is related to the way in which it analyzes satisfaction and possession conditions of agents' attitudes. According to the standard analysis, relations of psychological compatibility with the truth of beliefs and the realization of desires are modal relations of accessibility between agents and moments, on one hand, and possible circumstances, on the other hand. Thus according to Hintikka⁵, possible circumstances are compatible with the truth of agents' beliefs at each moment of time. To each agent *a* and moment *m* there corresponds in each model a unique set *Belief(a,m)* of possible circumstances where all beliefs of that agent at that moment are true. Such possible circumstances are by definition compatible with what that agent then believes. In short, an agent *a* believes a proposition *P* at a moment *m* according to Hintikka when that proposition *P* is true in

⁴ See R. Carnap *Meaning and Necessity* University of Chicago Press 1947.

all circumstances of the set *Belief (a,m)*. Given that approach, all human agents are logically omniscient. They believe all necessarily true propositions and their beliefs are closed under logical implication. Whoever believes a proposition *P eo ipso* believes all propositions that *P* logically implies. Moreover, according to standard epistemic logic, we, human agents, are either *perfectly rational* or *totally irrational*. We are perfectly rational when at least one possible circumstance is compatible with what we believe. Otherwise, we are totally irrational. Whoever believes a necessary falsehood *eo ipso* believes all propositions. But all this is incompatible with standard philosophy of mind and empirical psychology. Clearly we ignore most logical truths and we do not draw all logical inferences. Moreover, when we are inconsistent, we never believe everything. Problems are worse in the case of the logic of desire if we proceed according to the standard approach. For we keep desires that we know to be unsatisfied or even insatisfiable.

One could introduce in epistemic logic so-called *impossible circumstances* where necessarily false propositions would be true. However, such a theoretical move is very *ad hoc* and it is moreover neither necessary nor sufficient. In my approach, all *circumstances* remain *possible*: they are *objective possibilities*, as Belnap says. So objects keep their essential properties (each of us keeps his real parents) and necessarily false propositions remain false in all circumstances. In order to account for human inconsistency, logic needs no impossible circumstances. It has to consider *subjective* in addition to *objective possibilities*. Many obvious subjective possibilities are not objective. Whales are not fishes and every property does not correspond to a characteristic set of entities. So we can be inconsistent in ordinary life and in science. In order to explicate subjective possibilities and to define adequately the notion of truth according to an agent, I will now present a non classical logic that better analyzes the logical form of propositions as well as conditions of possession and satisfaction of attitudes.

New principles of predicative propositional logic

My propositional logic is *predicative* in the general sense that it analyzes the logical form of propositions by taking into account predications that we make in expressing them.⁶

- In my view, each proposition has a finite *structure of constituents*. It contains a positive number of elementary propositions predicating *attributes* of degree *n* (properties or relations) of *n objects subsumed under concepts* in a certain order. As Frege and Russell pointed out, we understand an elementary proposition when we understand which attributes objects of reference must possess in

⁵ J. Hintikka "Semantics for Propositional attitudes" in L. Linsky (ed) *Reference and Modality* Oxford U.P. 1971.

a possible circumstance in order that this proposition be true in that circumstance. There is no propositional formula without a predicate expressing an attribute in my ideography. Most often the degree n of the predicated attribute is positive. In that case one cannot predicate the attribute without making a reference to objects under concepts. Properties are attributes of degree one. The elementary proposition that Socrates is a philosopher predicates the property of being philosopher of a person. Binary relations are attributes of degree two. The elementary proposition that Brutus killed Julius Caesar predicates a binary relation of two persons. Simplest elementary propositions predicate an attribute of degree zero of no object under concept. So is the proposition that it rains.

- In addition to taking into account the structure of constituents of propositions, we also need a *better explication of their truth conditions*. We understand most propositions without knowing in which possible circumstances they are true, because we ignore *real denotations* of most attributes and concepts in many circumstances. One can refer to a colleague's wife without knowing who she is. However we can always in principle think of persons who could be that wife. Sometimes we even have evidence. His wife could be that or that woman. So in any possible use and interpretation of language, there are a lot of *possible denotation assignments to attributes and concepts* in addition to the standard *real denotation assignment* which associates with each propositional constituent its actual denotation in every possible circumstance. They are functions of the same type that, for example, associate with each individual concept a unique individual or no individual at all in every possible circumstance. According to the real denotation assignment, my colleague's wife is the woman with whom he is really married when there is such a person.⁷ According to other possible denotation assignments, his wife is another person or even he is not married. In spite of such differences, all possible denotation assignments respect *meaning postulates*. According to any, a wife is a married woman. One cannot express the property of being a wife without knowing *a priori* by virtue of competence such essential features of that property.

We ignore the value of the real denotation assignment for most concepts and attributes in many possible circumstances. But we can in principle think of denotations that they could have. Moreover, when we have in mind certain concepts and attributes, only some possible denotation

⁶ For more information on predicative logic see the book *Logic Thought & Action* that I edited at Springer, 2005

⁷ Some individual concepts do not apply to any object according to the real denotation assignment in certain possible circumstances. In that case either that assignment is from a model theoretical point of view a partial function which is undefined for these concepts in these circumstances or that concept is given an arbitrary denotation like the empty individual in such circumstances.

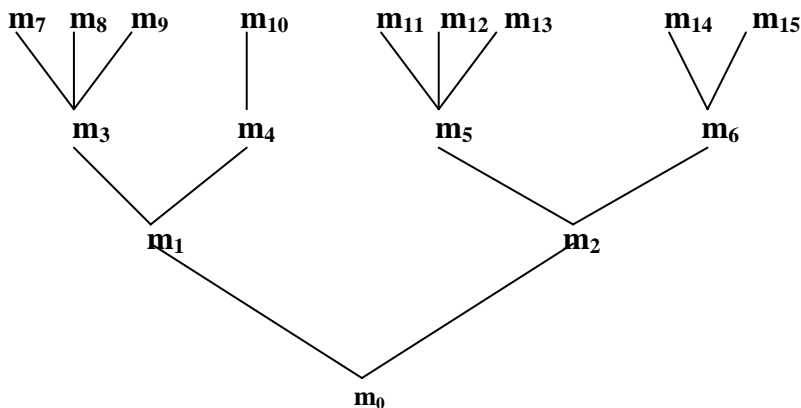
assignments to these senses *are then compatible with* our beliefs. Suppose that according to an agent Smith's wife is either Paula or Ursula. In that case, possible denotation assignments according to which Smith is married to another woman are then incompatible with that agent's beliefs. So in my approach, possible denotation assignments rather than possible circumstances are compatible with the beliefs of agents. This is my way of accounting for subjective possibilities in predicative propositional logic where the basic truth definition is relative to both possible circumstances and denotation assignments.

- In understanding propositions we in general do not know whether they are true or false. We just know that their truth in a circumstance is compatible with certain possible denotation assignments to their concepts and attributes, and incompatible with all others. Thus an elementary proposition predicating an extensional property of an object under a concept is true in a circumstance according to a denotation assignment when according to that assignment the individual who falls under that concept has that property in that circumstance. Otherwise, it is false in that circumstance according to that assignment. Most propositions have therefore *a lot of possible truth conditions*. Suppose that a proposition is true according to a possible denotation assignment to its constituents in a certain set of circumstances. That proposition would be true in all and only these circumstances if that denotation assignment were the real one. Of course, in order to be *true in a circumstance* a proposition has to be *true in that circumstance according to the real denotation assignment*. So among all possible truth conditions of a proposition, there are its *real Carnapian truth conditions* which correspond to the set of possible circumstances where it is true according to the real denotation assignment *val**.

- In my view, propositions are *identical* when they contain the same elementary propositions and they are true in the same circumstances according to the same possible denotation assignments. Such a finer criterion of propositional identity explains why many strictly equivalent propositions have a different cognitive value. Propositions whose expression requires different predications have a different structure of constituents. We do not express them at the same moments. My identity criterion also distinguishes strictly equivalent propositions that we do not understand to be true in the same possible circumstances: these are not true according to the same possible denotation assignments to their constituents. Consequently, few necessarily true propositions are *pure tautologies* that we know *a priori*. By hypothesis, a proposition is *necessarily true* when it is true in every possible circumstance according to the real denotation assignment. In order to be

tautologically true, a proposition has to be true in every circumstance according to every possible denotation assignment to its constituents. Unlike the proposition that Oedipus' mother is his mother, the necessarily true proposition that Oedipus' mother is Jocasta is not a pure tautology. It is false according to possible denotation assignments. We now can distinguish formally subjective and objective possibilities. A proposition is *subjectively possible* when it is true in a circumstance according to a possible denotation assignment. In order to be *objectively possible* a proposition has to be true in a circumstance according to the real denotation assignment.

Attitudes and actions of human agents are not determined. Whenever we do or think something we could have done or thought something else. For that reason, the logic of attitudes requires a ramified conception of time compatible with indeterminism and the apparent liberty of human agents. In branching time, a *moment* is a complete possible state of the actual world at a certain instant and the *temporal relation* of *anteriority* between moments is partial rather than linear. There is a single causal route to the past. So all moments are historically connected: any two distinct moments have a common historical ancestor in their past. However, there are multiple future routes: several incompatible moments might be posterior to a given moment. For facts, events or actions can have incompatible future effects. Consequently, the set *Time* of moments of time has the formal structure of a *tree-like frame* of the following form:



A maximal chain *h* of moments of time is called a *history*. It represents a *possible course of history of our world*. When a history has a first and a last moment, the world has according to it a beginning and an end. As Belnap⁸ pointed out, a *possible circumstance* is a pair of a moment *m* and of a history *h* to which that moment belongs. Thanks to histories temporal logic can analyze important modal notions like settled truth and historic necessity and possibility. Certain

⁸ See Belnap, M. Perloff & Ming Xu *Facing the Future Agents and Choices in Our Indeterminist World*, Oxford University Press, 2001.

propositions are true at a moment according to all histories. Their truth is then *settled at that moment* no matter how the world continues. So are past propositions because the past is unique. Their truth does not depend at all on histories. So are also propositions attributing attitudes to persons. Whoever believes or desires something at a moment then believes or desires that thing no matter what happens later. Contrary to the past, the future is open. The world can continue in various ways after indeterminist moments. Thus the truth of future propositions is not settled at such moments. It depends on which historical continuation of that moment is under consideration. When there are different possible historic continuations of a moment, its actual future continuation is not then determined. However, as Occam⁹ pointed out, if the world continues after a moment, it will continue in a unique way. The actual historic continuation of each moment is unique even if it is still undetermined at that moment. Indeterminism cannot prevent that unicity. So each moment m has a *proper history* h_m in my temporal logic. If m is the last moment of a history h , that history is of course its proper history h_m . If on the contrary the moment continues, then by hypothesis all moments of its proper history have the same real historic continuation. For $m' \in h_m$ iff $h_{m'} = h_m$. In my terminology, a proposition is *true at a moment* according to a possible denotation assignment when it is then true according to that assignment in the history of that moment. Among all possible courses of history of this world, one will be its actual course of history. It is the proper history of the present actual moment *now*.

Two moments of time m and m' are *coinstantaneous* when they belong to the same instant.¹⁰ Coinstantaneous moments m and m' represent two complete possible states of the world in which things could then be. They are on the same horizontal line in each tree-like frame. One can analyze *historic necessity* by quantifying over coinstantaneous moments. The proposition that P is then necessary (in symbols $\Box P$) - in the sense that it is then inevitable that P is true at a moment in a history when P is true at all coinstantaneous moments according to all histories.

My new approach in the logic of attitudes

In my view, the relation of compatibility with the satisfaction of attitudes of agents is not a modal relation of accessibility. First of all, attitudes of human agents are about objects that they represent under concepts. Each agent has consciously or potentially in mind a certain set of

⁹ See A.N. Prior *Past, Present and Future*, Oxford, Clarendon Press, 1967.

¹⁰ The set of *instants* is a partition of the set *Time* which satisfies *unique intersection* and *order preservation*. So to any instant ι and history h there corresponds a unique moment $m(\iota, h)$ belonging to both ι and h .

attributes and concepts at each moment. (That set is empty when the agent does not exist.) No agent can have a particular propositional attitude without having in mind all attributes and concepts of its content. Otherwise, he would be unable to determine under which conditions that attitude is satisfied. As Wittgenstein and Searle pointed out, an attitude with entirely undetermined satisfaction conditions would be an attitude without content; so it would not be a proper attitude. In order to believe or desire to be archbishop one must understand characteristic features determined by the meaning of the predicate “archbishop” that are common to all entities that have that property. Such features are internalized when one learns the meaning of that predicate. They are respected by all possible denotation assignments to the expressed property of being an archbishop.¹¹

Secondly, possible denotation assignments to propositional constituents rather than possible circumstances are compatible with the satisfaction of agents’ attitudes. So there corresponds to each agent a and moment m in each model a unique set $Belief(a,m)$ of possible denotation assignments to attributes and concepts that are compatible with the truth of beliefs of that agent at that moment. By hypothesis, $Belief(a,m)$ is the set Val of all possible denotation assignments to senses when the agent a has no attribute or concept in mind at the moment m . In that case, that agent has then no attitudes. Otherwise, $Belief(a,m)$ is a *proper non empty* subset of Val . Whenever an agent has in mind propositional constituents, he or she respects meaning postulates and there always are possible denotation assignments to these senses compatible with what that agent then believes. In my approach, an agent a *believes a proposition* at a moment m when he or she has then in mind all its concepts and attributes and that proposition is true at that moment according to all possible denotation assignments belonging to $Belief(a,m)$. We all ignore what will happen later. But we now have a lot of beliefs directed at the future. As Occam pointed out, such beliefs are true when things will be as we believe in *the actual future continuation* of the present moment. Other possible historic continuations do not matter.

One can analyze desire according to the same approach. To each agent a and moment m there corresponds in each model a unique non empty set $Desire(a,m)$ of possible denotation assignments to attributes and concepts that are compatible with the realization of all desires of that agent at that moment. There is however an important difference between desire and believe. We can believe, but we cannot desire, that objects are such and such without believing that they

¹¹ Many essential features of objects of reference like for example essential biological properties of human beings are

could be otherwise. For any desire requires a *preference*. Whoever desires something distinguishes two different ways in which represented objects could be in the actual world. In a first preferred way, objects are in the world as the agent desires, in a second way, they are not. The agent's desire is satisfied in the first case, it is unsatisfied in the second case. Thus in order that an agent *a* desires the fact represented by a proposition at a moment *m*, it is not enough that he or she has then in mind all its constituents and that the proposition is true at that moment according to all possible denotation assignments of *Desire(a,m)*. That proposition must also be false in a circumstance according to possible denotation assignments of *Belief(a,m)*. Otherwise that agent would not prefer the existence of that fact.

My explication of belief and desire is well supported by received accounts in the philosophy of mind. Given new meaning postulates and the nature of possible denotation assignments, it accounts for the fact that *human agents are not perfectly rational*. We do not have in mind all concepts and attributes. So we ignore logical as well as necessary truths. Our knowledge is limited: we ignore which objects possess certain properties in many circumstances. In that case assignments associating different denotations to these properties in these circumstances are then compatible with our beliefs. We have false beliefs and unsatisfied desires. Many possible denotation assignments compatible with our beliefs and desires do not assign real denotations to attributes that we have in mind. Such assignments can even violate essential properties of objects of reference. In that case we have necessarily false beliefs and insatisfiable desires. My analysis solves traditional paradoxes.

However *human agents cannot be totally irrational*. On the contrary, they are *minimally rational* in a well determined way. First of all, agents cannot believe or desire everything since in all models some possible denotation assignments are always compatible with the satisfaction of their beliefs and desires. Consequently some propositions are false according all such denotation assignments. Moreover, they cannot possess certain beliefs and desires without *eo ipso* possessing others. Indeed by hypothesis all possible denotation assignments compatible with their beliefs and desires respect meaning postulates. So we, human agents, are *minimally logically omniscient*, in the sense that we cannot have in mind a pure tautology without knowing for certain that it is necessarily true. Represented objects could not be in another way according to us. Similarly, *pure contradictions* (negations of tautologies) are false in every possible

not determined by meaning. When I refer to a particular archbishop I do not have in mind his genetic code.

circumstance according to any possible denotation assignment. We can neither believe nor desire contradictory things. Things could never be in certain ways according to us. Contemporary logicians still wish that arithmetic were complete (a necessarily false proposition if Gödel's proof is right). But they never believe nor desire both the completeness and the incompleteness of arithmetic (a pure contradiction). Sometimes we desire something (to be somewhere at a moment) for one reason and another incompatible thing (to be elsewhere at the same moment) for another reason. When the logical form of such attitudes is fully analyzed, they are not categorical desires with a contradictory content. Agents believe all tautological propositions that they express. However they cannot desire the existence of inevitable facts represented by tautologies. In order to desire something one must believe that it could not occur. One can desire to drink; one can also desire not to drink. But one cannot desire to drink or not drink.

One can define in predicative logic a new *strong* propositional *implication* much finer than Lewis' strict implication that is important for the analysis of psychological commitment. A proposition *strongly implies* another when it contains all its elementary propositions and it cannot be true in a circumstance according to a denotation assignment unless the other proposition is also true in that circumstance according to that assignment. Strong implication is finite, tautological, paraconsistent, decidable and *a priori known*. Any agent who believes a proposition *P* also believes all the propositions that *P* strongly implies. For he or she cannot apprehend that proposition without understanding that it cannot be true unless these others are. Unlike belief, desire is not closed under strong implication. For no one can desire tautological things.

Section 2 Analysis of propositional attitudes

The notion of psychological mode is too rich to be taken as a primitive notion. As Descartes pointed out, the two traditional categories of cognition and volition are essential components of psychological modes. But they divide into other components that I will now analyze.

The general categories of cognition and volition

All propositional attitudes are cognitive or volitive. Among cognitive attitudes, there are conviction, faith, confidence, knowledge, certainty, presumption, pride, arrogance, surprise, amazement, stupefaction, presupposition, prevision, anticipation and expectation. All of them contain beliefs in the truth of their propositional content. Among volitive attitudes, there are wish, will, intention, ambition, project, hope, aspiration, satisfaction, pleasure, enjoyment, delight,

gladness, joy, elation, amusement, fear, regret, sadness, sorrow, grief, remorse, terror. All of them contain desires. Like Searle, I advocate a very general category of volition applying to all kinds of desires directed towards the past (shame), the present (lust) and the future (aspiration), even to desires known or believed to be satisfied (pleasure, joy) or unsatisfied (disappointment, regret) including desires directed at past actions that the agent would wish not to have done (remorse).

In philosophy of mind, *beliefs* have the proper *mind-to-things direction of fit*. Whoever possesses a cognitive attitude intends to represent how things are then in the world. Such an attitude is satisfied when its propositional content corresponds to things as they are in the world. On the other hand, *desire* has the opposite *things-to-mind direction of fit*. Volitive attitudes are satisfied only if things in the world fit their propositional content. Each direction of fit between mind and the world determines which side is at fault in case of dissatisfaction. When a belief turns out to be false, it is the agent who is at fault, not the world. He should have had other thoughts about the world. In such a case, the agent easily corrects the situation in changing his beliefs. On the contrary, when a desire turns out to be unsatisfied, it is not the agent but the world which is at fault. Objects should have been different. The agent then rarely corrects the situation in changing his or her desire. Most often, he or she keeps that desire and remains unsatisfied.

One can explicate formally the two general categories of cognition and volition in terms of compatibility relations with respect to the truth of beliefs and the realization of desires of agents. So far we have only spoken of real beliefs and real desires of agents. Agents of course have real attitudes about objects at certain moments in this actual world. They really have such and such beliefs and desires at certain moments. But they could have had other attitudes about the same or even about other objects. Often other agents attribute to us attitudes that we do not really have. In order to get a general theory, we need to define the sets $Belief_m^a$ and $Desire_m^a$ with respect to all possible denotation assignments. Agents can have different attitudes according to different possible denotation assignments. Their real attitudes depend on the real denotation assignment. First of all, each agent could have many concepts and attributes in mind. According to any possible denotation assignment val , every agent a has in mind at each moment m in each model a *certain set* $val(a,m)$ *of propositional constituents*. Thus $val^*(a,m)$ is the set of concepts and attributes that agent a really has in mind at moment m in the model. By definition, $Belief_m^a(val)$ is the non empty set of all possible denotation assignment that are compatible with the truth of beliefs that agent a has at moment m according to denotation assignment val . In particular,

$Belief_m^a(val^*)$ contains all possible denotation assignment that are compatible with the truth of beliefs that agent a really has at moment m . Similarly, $Desire_m^a(val)$ is the non empty set of all possible denotation assignments that are compatible with the realization of desires that agent a has at moment m according to assignment val . Of course, $Belief_m^a(val)$ and $Desire_m^a(val)$ are the whole set Val of all possible denotation assignment when the set of propositional constituents $val(a,m)$ is empty. In that case, the agent has then no attitude at all according to val . In my view, an agent a *believes* or *desires* that P at a moment m (no matter what is the history) according to a denotation assignment val when firstly he or she has in mind all concepts and attributes of proposition P (they belong to the set $val(a,m)$) and secondly P is true at that moment according to all denotation assignments of $Belief_m^a(val)$ or $Desire_m^a(val)$. In the case of desire, proposition P has moreover to be non tautological according to that agent at that moment. Agents have conscious and unconscious beliefs and desires. Whenever an agent's attitude is conscious, he or she has then consciously in mind all its attributes and concepts. We have unconsciously in mind at each conscious moment of our existence a lot of concepts and attributes that we could express at that moment given the language that we speak. We then have a lot of unconscious tautological beliefs about such unconscious propositional contents.

One can explicate the nature of attitudes by determining formal properties of psychological compatibility relations that correspond to them. Whoever has a belief believes that he has that belief. The relation $Belief_m^a(val)$ is then transitive in each model. On the contrary, we often feel desires that we would wish not to feel. So the relation $Desire_m^a$ is not transitive. Some of our beliefs are false; many of our desires are unsatisfied. The compatibility relations $Belief_m^a(val)$ and $Desire_m^a(val)$ are then not reflexive. They are also not symmetric. We can have new beliefs and new desires according to denotation assignments that are compatible with our read beliefs and desires now.

Different ways of having cognition or volition

Our beliefs and desires can be more or less strong and we feel them in a lot of ways. Certain psychological modes require a special *cognitive or volitive way* of believing or desiring. *Knowledge* is a belief based on *strong evidence* that guarantees truth. The agent has a real perception of what he or she knows or it is part of his or her conceptual network or background.

With such kind of sensorial, analytic or background evidence, whoever knows something is sure of it and whatever is known has to exist. Whoever has an *intention* feels such a strong desire that he or she is disposed to *act* in the world in order to satisfy that desire. Intentions commit the agent to a present or future action. Whoever is *pleased* feels a satisfied desire whose very satisfaction puts him or her in a state of pleasure. Whoever *enjoys* is in a conscious state of enjoyment. In the case of *lust* he or she is in a state of sensual enjoyment. On the contrary, whoever is *sad* feels an unsatisfied desire whose dissatisfaction puts him or her in a sad state; whoever is *terrified* is in a worst conscious state of terror. Language distinguishes many psychological modes with different cognitive or volitive ways. Thus regret, sadness, sorrow and terror put the agent in more and more unpleasant states.

From a logical point of view, a *cognitive or volitive way* is a function f_{ϖ} which restricts basic psychological categories. Whoever feels a belief or desire in a certain way has of course that belief or that desire. By definition, $f_{\varpi}(a,m,val) \subseteq Belief_m^a(val) \cup Desire_m^a(val)$. The set U_{ϖ} of cognitive and volitive ways is a *Boolean algebra*. It contains the *neutral way* $1_{\varpi} : 1_{\varpi}(a,m,val) = Belief_m^a(val) \cup Desire_m^a(val)$. And it is closed under the operation of conjunction. A psychological mode has the *conjunction* $f_{\varpi} \cap h_{\varpi}$ of two ways when it has each of them. Thus $f_{\varpi} \cap h_{\varpi}(a,m,val) = f_{\varpi}(a,m,val) \cap h_{\varpi}(a,m,val)$. The way of a mode is *special* when it is not neutral. Certain ways are *stronger than* others. Whoever is certain of something knows it: $\varpi_{certainty}(a,m,val) \subseteq \varpi_{knowledge}(a,m,val)$. Because knowledge is true, its proper cognitive way is reflexive: $val \in \varpi_{knowledge}(a,m,val)$. Whoever has an intention intends to execute that intention. So the volitive way of the intention mode is transitive : if $val' \in \varpi_{intention}(a,m,val)$ and $val'' \in \varpi_{intention}(a,m,val')$ then $val'' \in \varpi_{intention}(a,m,val)$. Agents can feel more or less strong beliefs and desires. We must distinguish different degrees of beliefs and desires. The two basic relations of psychological compatibility are then indexed by the set Z of integers. Whoever believes or desires with a degree of strength believes or desires with weaker degrees. Thus $Belief_m^a(val)(k+1) \subseteq Belief_m^a(val)(k)$ and similarly for $Desire_m^a$. Certain cognitive or volitive ways require a minimal degree of strength. Any knowledge contains a strong belief, any intention a strong desire. $\varpi_{knowledge}(a,m,val) \subseteq Belief_m^a(val)(1)$ and $\varpi_{intention}(a,m,val) \subseteq Desire_m^a(val)(1)$.

Propositional content conditions

Like illocutionary forces, psychological modes have propositional content conditions. The propositional content of attitudes having certain modes must satisfy certain conditions. Thus we can only at a moment *foresee*, *anticipate* or *expect* a fact that is future with respect to that moment. Whoever possesses an *intention* at a given moment desires to carry out a present or future action in the history of that moment. Propositional content conditions of attitudes depend on the moment of such attitudes. I can have today the intention to wake up early tomorrow morning. The day after tomorrow I cannot anymore have that intention, because the intended action will then be past. The propositional content of certain attitudes concerns the very person of the agent. We can be *disappointed* or *sorry* about something that has nothing to do with our person. But we can only feel *shame* or *remorse* for something that is personal.

From a logical point of view, a *condition on the propositional content* is a function f_θ from the set $Agent \times Time$ into the power set $\mathcal{P}(U_p)$ of the set U_p of all propositions that associates with each agent and moment a set of propositions. By definition, the *propositional content conditions of a mode M* is the function θ_M which associates with each agent and moment the set of propositions that could be the propositional content of an attitude of that mode of that agent at that moment. By hypothesis, illocutionary forces have propositional content conditions of all psychological modes that enter into their sincerity conditions. Thus the force of *prediction* and the modes of *prevision*, *anticipation* and *expectation* have the condition that their propositional content represents a future fact. Similarly, the force of promise and the modes of *intention* and *project* have the condition that their propositional content represents a present or future action of the agent. The set U_θ of propositional content conditions is a *Boolean algebra*. It contains the *neutral propositional content condition* $1_\mu : 1_\theta(a,m)$ is the whole set U_p of propositions. And it is closed under the operation of *intersection*. The psychological mode has the intersection $(f_\theta^1 \cap f_\theta^2)$ of two conditions when it has each of them. $(f_\theta^1 \cap f_\theta^2)(a,m) = f_\theta^1(a,m) \cap f_\theta^2(a,m)$. A mode M has a *special* propositional content condition when its condition θ_M is not neutral. Certain psychological modes have more propositional content conditions than others. Thus a *prior intention* is an intention with the additional condition that its content represents a future action of the agent. So $\theta_{\text{PriorIntention}}(a,m) \subset \theta_{\text{Intention}}(a,m)$.

Preparatory conditions

Like illocutionary forces, psychological modes also have *preparatory conditions*. Whoever possesses an attitude or performs an illocutionary act *presupposes* certain propositions. His or her attitude and illocutionary act would be *defective* if these propositions were then false. Thus the force of *promise* and the mode of *intention* have the preparatory condition that the agent is then able to do the action represented by the propositional content. When this is not the case, the promise and the intention are defective. This defect shows itself in the fact that it is quite paradoxical to promise an action and to deny simultaneously that one is able to do it. In the illocutionary case, the speaker can lie in order to mislead the hearer. In the psychological case, however the agent cannot lie to himself. He must both presuppose and believe that the preparatory conditions of his attitudes are fulfilled. Whoever has an intention really believes that he is able to execute it. Otherwise, he would not have that intention. The volitive mode of *hope* has the preparatory condition that the propositional content is then possible. Whoever hopes something desires that thing while believing that it could happen. The volitive modes of *will* and *intention* have the preparatory condition that agent has means. In the case of wish, on the contrary, the satisfaction of the agent's desire is independent of his own will. All depends on the course of nature or on the good will of someone else.

From a logical point of view, a preparatory condition is a function f_{Σ} from the set $Agent \times Time \times U_p$ into the set $\mathcal{P}(U_p)$ associating with each agent, moment and propositional content a set of propositions. Illocutionary forces have the preparatory conditions of modes which are their sincerity conditions. Thus the preparatory condition $\sum_{intention}$ common to the mode of *intention* and to the force of *promise* associates with each agent, moment and propositional content a set containing the proposition that that agent is then able to do the represented action. The set U_{Σ} of preparatory conditions is also a *Boolean algebra*. It contains the *neutral preparatory condition* $1_{\Sigma} : 1_{\Sigma}(a,m,P) = \emptyset$. It is closed under the operation of *union*. A psychological mode has the union $(f_{\Sigma}^1 \cup f_{\Sigma}^2)$ of two preparatory conditions when it has each of them. $(f_{\Sigma}^1 \cup f_{\Sigma}^2)(a,m,P) = f_{\Sigma}^1(a,m,P) \cup f_{\Sigma}^2(a,m,P)$. A preparatory condition is *special* when it is not neutral. Many volitive or cognitive ways have special preparatory conditions. The cognitive ways of the modes of certainty and knowledge and the volitive ways of the modes of pleasure, joy and enjoyment all determine the preparatory condition that the fact represented by the propositional content exists.

Criterion of identity for psychological modes

On the basis of my analysis, one can formally distinguish different psychological modes whose attitudes apparently reduce to the same sums of beliefs and desires. One can also proceed to a lexical systematic analysis of many ordinary verbs or terms naming propositional attitudes. Two psychological modes M_1 and M_2 are identical when they have the same basic psychological categories, the same cognitive and volitive ways, the same propositional content conditions and the same preparatory conditions. So $M_1 = M_2$ when $Cat_{M_1} = Cat_{M_2}$, $\varpi_{M_1} = \varpi_{M_2}$, $\theta_{M_1} = \theta_{M_2}$ and $\Sigma_{M_1} = \Sigma_{M_2}$. As we will see later, attitudes about the same proposition whose modes divide into the same components have the same conditions of possession and of satisfaction. Such modes play the same role in psychological life.

Conditions of possession of propositional attitudes

Each component of a mode determines a particular necessary possession condition of attitudes with that mode, all the components together possession conditions that are both necessary and sufficient. By definition, an agent a possesses a cognitive (or volitive) attitude of the form $M(P)$ at a moment m when he or she then believes (or desires) the propositional content P , he or she feels that belief or desire that P in the cognitive or volitive way ϖ_M proper to psychological mode M , the proposition P then satisfies propositional content conditions $\theta_M(a,m)$ and finally that agent then presupposes and believes all propositions determined by the preparatory conditions $\Sigma_M(a,m,P)$ of mode M with respect to the content P . For example, an agent intends that P at a moment when proposition P then represents a present or future action of that agent, he or she desires so much that action that he or she is committed to carrying it out and moreover that agent then presupposes and believes to be able to carry it out.¹² The basic psychological category of every attitude determines of course its primary condition of possession. We can desire without having an intention. But we could not have an intention without a desire.

Definition of strong and weak psychological commitment

An attitude strongly commits an agent to another at a moment when he or she could not then have that attitude without having the second. For example, whoever believes that it will rain tomorrow then foresees rain tomorrow. For the propositional content is then future with respect to

¹² The proposition [a Possesses $M(P)$] according to which the agent a possesses attitude $M(P)$ is true in a circumstance m/h according to a denotation assignment val iff each constituent of $P \in val(a,m)$, P is true at moment m according to all assignments of $(Cat_M)_m^a(val) \cap \varpi_M(a,m,val)$, $P \in \theta_M(a,m)$ and all propositions $Q \in \Sigma_M(a,m,P)$ are true at moment m according to all assignments of $Bel_m^a(val)$ and moreover agent a then presupposes them.

the moment of the attitude. Some attitudes strongly commit the agent to another only at certain moments. Whoever believes now that it will rain tomorrow foresees rain tomorrow. The day after tomorrow the same belief won't be a prevision. It will just be a belief about the past. An attitude *contains another* when it strongly commits any agent to that other attitude at any moment. Whoever possesses the first attitude possesses the second. Thus any cognitive attitude contains a belief and any volitive attitude a desire with the same propositional content.

As Searle and I pointed out¹³, one must distinguish in speech act theory between the *overt performance of an illocutionary act* and a simple *illocutionary commitment to the act*. For example, whoever asserts that every man is mortal is weakly committed to asserting that the man called Nebuchadnezzar is mortal, even if he has not made any reference to Nebuchadnezzar and if he has not overtly made the second assertion. The same holds in the theory of attitudes. One must distinguish between the overt possession of an attitude and a simple psychological commitment to that attitude. There are *strong and weak psychological commitments* just as there are strong and weak illocutionary commitments. Some attitudes *weakly commit* the agent to others at certain moments: the agent could not then possess these attitudes without being committed to the others. For example, whoever believes that every man is mortal is weakly committed to believing that Nebuchadnezzar is mortal, even if he has not Nebuchadnezzar's concept in mind and if he does not then possess the second belief. Clearly no one could simultaneously believe the first universal proposition and the negation of the second. So there is a general parallelism between strong and weak illocutionary and psychological commitments. When an illocutionary act strongly commits the speaker to another, the attitudes that the speaker expresses in performing the first act strongly commit him to attitudes that are sincerity conditions of the second act. And similarly for weak commitments.

One can explicate weak psychological commitments of each agent a at each moment m in the logic of attitudes by quantifying over the set $Compatible_m^a$ of moments that are psychologically compatible with his or her attitudes at that moment. Two moments m and m' are *psychologically compatible as regard an agent a* in a model according to a denotation assignment val [in symbols: $m' \in Compatible_m^a(val)$] when that agent could then have all the attitudes that he has at both moments according to that assignment. In that case, there is a coinstantaneous moment where that agent has all such attitudes according to that assignment. The relation of *psychological*

compatibility between moments of time as regards any agent is by definition reflexive and symmetric like that of illocutionary compatibility. Thus an agent could have an attitude at a moment when he or she has that attitude at some moment that is psychologically compatible with that moment as regards to him or her. In my view, an agent is *weakly committed to an attitude at a moment m* (in symbols: $[a \triangleright M(P)]$) when he could then possess that attitude at each moment that is psychologically compatible with that moment as regards that agent.

Recursive definition of the set of psychological modes

Psychological modes are not a simple sequence of a basic psychological category, a cognitive or volitive way, a propositional content condition and a preparatory condition. For their components are not logically independent. Indeed certain components *determine* others of the same or of another kind. Thus the volitive way of the mode of *intention* determines the propositional content condition that it represents a present or future action of the agent and the preparatory condition that that agent is then able to carry out that action. That last preparatory condition determines another, namely that the agent has means. The cognitive way of the mode of *pride* determines the condition that the propositional content concerns the very person of the agent and the preparatory condition that the represented fact exists and is good for the agent. In my ideography, each formula of the form $[Cat_M, f_{\overline{\omega}}, f_{\theta}, f_{\Sigma}]$ represents the psychological mode M having the four components $Cat_M, f_{\overline{\omega}}, f_{\theta}, f_{\Sigma}$ and all other components which are determined by them. Such a mode M has then often other ways than $f_{\overline{\omega}}$, other propositional content conditions than f_{θ} and other preparatory conditions than f_{Σ} .

The two primitive modes of *belief* and *desire* are the simplest cognitive and volitive modes. Descartes was right to take them as primitive modes. They have no special cognitive or volitive way, no special condition on the propositional content and no special preparatory condition.¹⁴ According to my ideography $M_{belief} = [Belief, 1_{\overline{\omega}}, 1_{\theta}, 1_{\Sigma}]$ and $M_{desire} = [Desire, 1_{\overline{\omega}}, 1_{\theta}, 1_{\Sigma}]$. All other psychological modes are more complex. They are obtained by adding to primitive modes special cognitive or volitive ways, propositional content conditions or preparatory conditions.

In my logic, the set of all possible psychological modes is then *defined recursively*. It is the smallest set *Modes* containing the two primitive modes of *belief* and *desire* that is closed under a

¹³ See J. Searle & D. Vanderveken *Foundations of Illocutionary Logic* Cambridge University Press 1985.

¹⁴ I have formulated the logic of primitive propositional attitudes in “Belief and Desire: A Logical Analysis” forthcoming in Colin Schmidt (ed) *Proceedings of the International Colloquium Computers and Philosophy* held at Laval (France) in May 2006.

finite number of applications of the three Boolean operations of adding new cognitive or volitive ways, new propositional content conditions or new preparatory conditions. Thus the psychological mode of *prevision* $M_{foresee}$ is obtained by adding to the primitive mode of belief the propositional content condition θ_{future} that associates with each agent and moment the set of propositions that are future with respect to that moment. In symbols $M_{foresee} = [\theta_{future}]Belief$. The mode of *expectation* is obtained from that of prevision by adding the special cognitive way that the agent is then in a state of expectation. $M_{expect} = [\varpi_{expectation}]M_{foresee}$. The mode of *being sure* is obtained from that of belief by adding the special way that the agent is in a state of confidence for he has strong reasons. Whoever is *convinced* is sure while being in a stronger state of conviction (special cognitive way). Whoever has *faith* is convinced that God exists (propositional content condition). In the case of *knowledge* the agent has more than confidence, he has strong evidence that guarantees truth (special cognitive way and preparatory condition).

The mode of *hope* is obtained from that of *desire* by adding the special cognitive way that the agent is then uncertain as regards the existence and the inexistence of the represented fact and the preparatory condition that that fact is then possible. The mode of *aspiration* is obtained from that of hope by adding the condition that the propositional content concerns the very person of the agent and the preparatory condition that it is a pursued goal, sometimes even an ultimate or ideal aim. The mode of *satisfaction* is obtained from that of *desire* by adding the *preparatory condition* that the desired fact exists. The mode of *pleasure* has, in addition, the *volitive way* that the satisfaction of the desire puts the agent in a state of pleasure and the preparatory condition that it is good for the agent. The mode of *enjoyment* is obtained from that of pleasure by adding the special way of being in a conscious state of enjoyment. *Lust* has the special volitive way that it is a *sensual* enjoyment. *Concupiscence* is a lust of the flesh (propositional content condition).

Because all operations on psychological modes add new components, they generate stronger modes. Each attitude $M(P)$ with a complex mode *contains* attitudes $M'(P)$ whose modes have less components. For the psychological mode $[\varpi]M$ that is obtained by adding to mode M the special way ϖ has the *conjunction* $\varpi \cap \varpi_M$ as proper way. Similarly the psychological mode $[\theta]M$ that is obtained by adding to mode M the propositional content condition θ has the *intersection* $\theta \cap \theta_M$ as proper propositional content condition. Finally the mode $[\Sigma]M$ that is obtained by adding to mode M the preparatory condition Σ has the *union* $\Sigma \cup \Sigma_M$ as a proper preparatory condition. Whoever has an attitude of the form $[\varpi]M(P)$, $[\theta]M(P)$ or $[\Sigma]M(P)$ has *eo ipso* the simpler

attitude $M(P)$. Thus whoever expects, knows, is sure, certain or convinced of something believes that thing. Whoever hopes, wishes, enjoys, is happy, satisfied or pleased of something desires it.

Semantic tableaux

A lexical analysis of terms for attitudes based on the decomposition that I advocate can systematically explain which name stronger psychological modes. One can even show comparative strength by drawing semantic tableaux having the form of trees whose nodes are ordinary names or verbs for attitudes. Here are two semantic tableaux showing relations of comparative strength between cognitive and volitive modes respectively. The initial node of the first tableau is the term “belief” which names the primitive cognitive mode, just as the initial node of the second is the term “desire” that names the primitive volitive mode. Any immediate successor of a term is another term naming a stronger psychological mode obtained by applying one or more operations whose nature is indicating by symbols in the branch between the two terms. I have already specified special components in examples that I have given. Here are a few additional examples. To have *appetite* in one sense of the term is to desire to eat (special propositional content condition). To be hungry is to desire to eat in feeling a strong need of food (special volitive way). *Plans* are partial prior intentions formed after a deliberation (preparatory condition) to achieve ends that agents fill in, as time goes by, with more specific intentions concerning means and preliminary steps. They have a hierarchical structure¹⁵: plans concerning ends require subplans concerning means, preliminary steps and specific actions (volitive way). *Projects* on the other hand are general plans (propositional content condition).¹⁶

¹⁵ See M. Bratman *Intentions, Plans and Practical Reason* Harvard University Press 1987.

¹⁶ See my next book *Speech Acts in Dialogue* for more explanation.

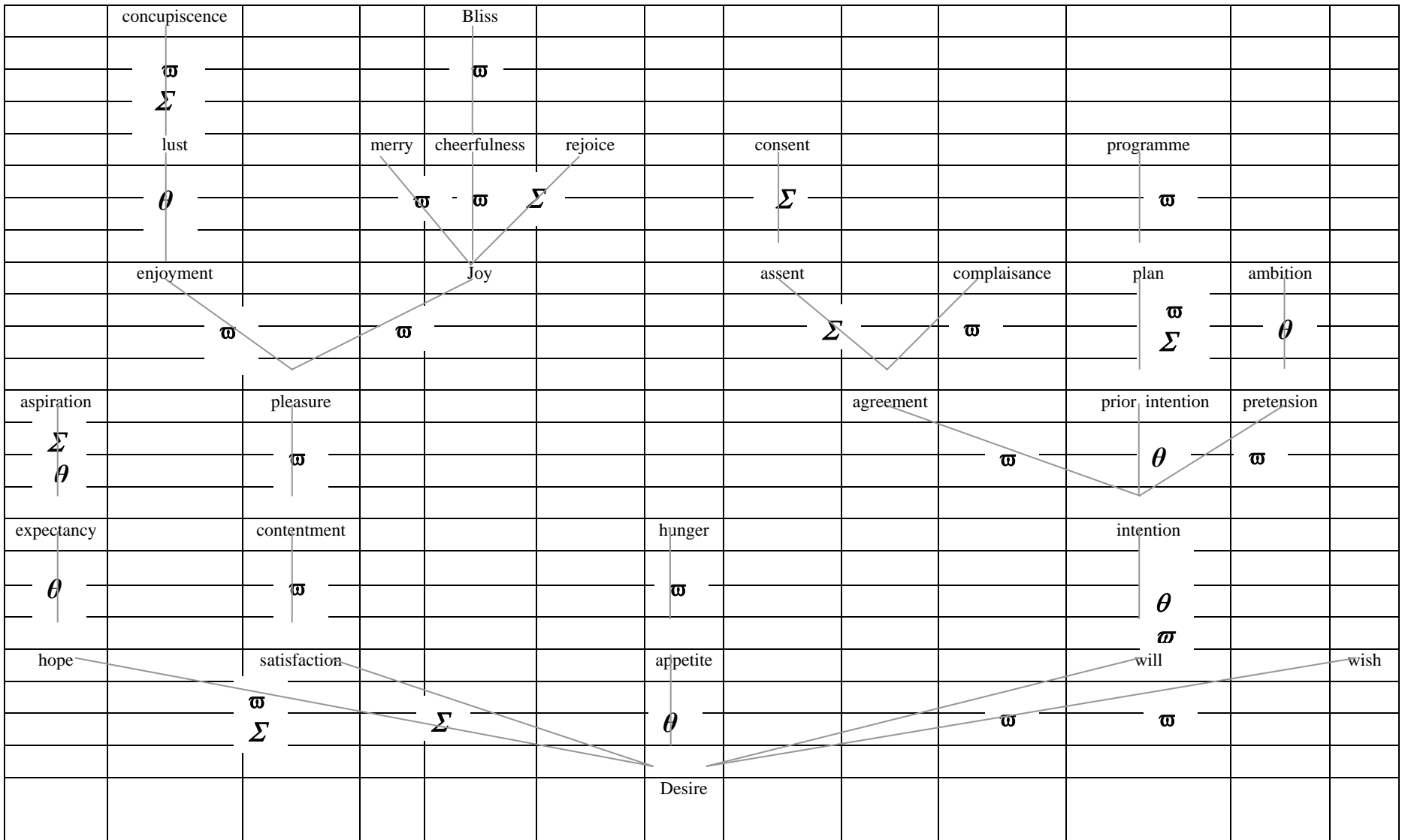


Figure 2. Volitive Modes

Each term of a branch of a semantic tableau names a stronger psychological mode than terms that are lower in the same branch. Certain modes can be obtained by adding components to modes named by terms occurring in different branches of the tableau. Whoever *trusts* someone is *convinced* that he is honest, that he will keep his word, etc. These are new propositional content conditions to add to the mode of *conviction* to get that of *trust*. Whoever *trusts* someone also *expects* him to behave in a certain way. By adding this new cognitive way to the mode of *expectation* we also get that of *trust*.

Ideography

The object language of my logic of attitudes is *ideographical*. The apparent syntactic forms of formulas naming psychological modes show their components and logical form. My ideography shows in particular which modes are stronger than others. Thus a mode-formula that contains another one names *eo ipso* a stronger psychological mode. We all know that an *expectation* is a *prevision* and a *prevision* a *belief*. That strong psychological commitment is not shown by the graphic form of the verbs “expect”, “foresee” and “believe”. But it is visible in my ideography where $M_{foresee} = [\theta_{future}]M_{belief}$ and $M_{expect} = [\omega_{expectation}]M_{foresee}$. There is *no one-to-one correspondence* between possible psychological modes and ordinary language names or verbs for attitudes. On one hand, certain modes are not lexicalized. Only certain possible components of modes are significant in each natural language. On the other hand, certain terms for attitude are ambiguous. For example, “agreement”, “confidence” and “consent” name mental *acts* as well as mental *states*. One can *give* one’s agreement as well as *be* in agreement. In such a case, the state named by the verb is a sincerity condition of the speech act. Whoever performs the act expresses the corresponding state. Certain verbs like “to be sure” and “to agree” are ambiguous between different modes. One can be *sure* of the existence of a fact (cognitive mode); one can also be *sure* that one will act (volitive mode). In that case, the cognitive and volitive modes have the same additional component (the special way of being in a state of *confidence*). Moreover terms like *fear*, *sorrow*, *regret* that have the same syntactical surface behavior do not name psychological modes but rather forms of propositional attitudes. My ideography clarifies the deep structure of natural languages in showing the logical nature of attitudes. Thus in my ideography, a *deception* that *P* is not an attitude with the propositional content *P*. It is a desire of the negation $\neg P$ of *P*

with the preparatory conditions that its propositional content is false and that the agent previously believed that it would be true.

Conditions of satisfaction of propositional attitudes

The general notion of *satisfaction condition* in logic is based on that of *correspondence*. Propositional attitudes and elementary illocutions are directed towards facts of the world represented by their propositional content. Most often agents establish a correspondence between their ideas and things in the case of attitudes and between their words and things in the case of illocutions. Their attitudes and illocutions have for that reason *satisfaction conditions*. In order that the attitude or illocution of an agent at a moment is *satisfied*, there must be a correspondence between that agent's ideas or words and represented things in the world in the history of that moment. Agents live and persist in an indeterminist world. Their future is open. At each moment where we think and act we ignore how the world will continue. However, our attitudes and actions are directed toward the real historic continuation of these moments. In order that a present desire directed at the future is satisfied, it is not enough that things will be at a posterior moment as the agent now desires. They must be so later in the real future. So the *satisfaction* of propositional attitudes and elementary illocutions of an agent at a moment requires the *truth at that very moment* of their propositional content. The notion of *satisfaction* is a generalization of the notion of *actual truth* that covers attitudes and elementary illocutions with a not empty direction of fit.¹⁷ Just as a *belief* at a moment is *satisfied* when it is *then true*, a *wish* and a *desire* are *satisfied* when they are *then realized*; a *prevision*, an *expectation*, a *hope* and an *aspiration* are satisfied when they are *fulfilled*; an *intention*, a *project* and a *plan* when they are *then executed*; a *fear* and a *fright* when the thing that is feared does not *then* happen.

There are four possible directions of fit between mind and things, just as there are four possible directions of fit between words and things. Like assertive illocutions, *cognitive attitudes* have the *mind-to-things direction of fit*. They are *satisfied* when their propositional content is *true* at the moment under consideration. The agent's ideas correspond to things as they are then in the world. In the cognitive case, when the agent realizes that there is no correspondence, he immediately changes his ideas. This is why the *truth predicates* characterize so well *satisfaction* and *dissatisfaction* in the case of *cognitive* attitudes. However, such truth predicates do not apply to *volitive* attitudes whose direction of fit goes from things to words. For the world and not the

agent is at fault in the case of dissatisfaction of volitive attitudes. In that case, the agent can keep his ideas and remains dissatisfied. Most often, agents having a *volitive attitude desire the fact* represented by the propositional content *no matter how that fact turns to be existent in the world*. So most volitive attitudes that agents have at a moment are *satisfied* when their content is then true, no matter for which reason. Things are then such as the agent desires them to be, no matter what is the cause of their existence.

The only exceptions to this rule are *volitive attitudes* like *will, intentions, projects, plans* and *programs* whose proper volitive way requires that things fit the agent's ideas because he or she wants them in that way. Such attitudes as well as illocutionary acts (orders, commands, pledges and promises) that express them have *self-referential satisfaction conditions*. Their satisfaction requires more than the real existence of the fact represented by their propositional content. It requires that the represented fact turns to be existent in order to satisfy the agent's attitude. For example, in order to execute a prior intention, an agent must do more than carry out later the intended action in the real future; he or she must carry out that action because of that previous intention. If the agent does not act for that reason, (if he or she is obliged to act), his or her prior intention is not then executed. Like speech act theory, the logic of attitudes can explain such cases of self-referential satisfaction by relying on the notion of *intentional causation*. The agent's attitude must then be a *practical reason* why the represented fact turns to be existent.

As Searle pointed out in *Intentionality*, certain *volitive* modes like *joy, gladness, pride, pleasure regret, sadness, sorrow, and shame* have the *empty direction of fit*. Agents who have such attitudes do not want to establish a correspondence between their ideas and things in the world. They just take for granted either correspondence or lack of correspondence. In the case of *joy, gladness, pride* and *pleasure*, the agent believes that the desired fact exists. In the case of *regret, sorrow* and *shame*, he or she believes on the contrary that it does not exist. The first attitudes have the special preparatory condition \sum_{Truth} that their propositional content is then true. The second attitudes have the opposite preparatory condition $\sum_{\text{Falsehood}}$ that their content is then false. So $\sum_{\text{Truth}}(a,m,P) = \{\text{Actually}P\}$ and $\sum_{\text{Falsehood}}(a,m,P) = \{\text{Actually}\neg P\}$.) Volitive attitudes with such special *preparatory condition* have the *empty direction of fit* because their agent could not have the intention of achieving a success of fit. This is why they do not have *satisfaction*

¹⁷ We need an actuality connective for a right account of satisfaction conditions. A proposition of the form *Actually* P is *true* in a circumstance m/h when it is true at the moment m according to its history h_m .

conditions. Instead of being satisfied or dissatisfied, they are just *appropriate* or *inappropriate*. They are inappropriate when their preparatory condition of actual truth or falsehood is wrong or when their proper psychological mode does not suit the fact represented by their content. No agent should be ashamed of an action that he has not made or that is exemplary and good for all. As Candida de Sousa Melo pointed out¹⁸, declaratory acts of thought have the *double direction of fit between mind and things*. In making verbal and mental *declarations*, the speaker changes represented things of the world just by way of thinking or saying that he is changing them. Whoever gives by declaration a new name to a thing acts in such a way that that thing has then that name. In such a case, the very act of the mind brings about the represented fact. Unlike illocutions, *attitudes are states and not actions of the mind*. So they could not have the double direction of fit.

Identity criteria for propositional attitudes

In my view, propositional attitudes are not pairs of a psychological mode and a propositional content. Whoever possesses a propositional attitude of the form $M(P)$ *applies* in a certain way the mode M to the content P so as to determine under which conditions it is satisfied. In order that two propositional attitudes are identical, it is not necessary that their psychological mode be identical. What matters is that their content represents the same fact and that whoever possesses one attitude also possesses the other. Attitudes with the same propositional content and possession conditions fulfill the same function in psychological life. Thus the *belief* that it will always be the case that $2 + 2 = 4$ is also a *prevision*. These two attitudes have the same content but different modes. Contrary to the mode of belief, that of prevision has the special propositional content condition that the represented fact is future. However the content of the belief in question is future with respect to any moment. This is why it is also a prevision.

Section 3 Main laws of my logic of propositional attitudes

The *ideographical* object language \mathcal{L} of my logic contains formulas of the following forms.

Terms representing components of psychological modes

Constants of type ϖ name *ways* of believing or desiring. In particular, *Bel* and *Des* are two logical constants of type ϖ naming respectively the general categories of cognition and volition

¹⁸ Candida de Sousa Melo « Possible Directions of Fit between Mind, Language and the World » in D. Vanderveken & S. Kubo (dirs) *Essays in Speech Act Theory* Benjamins 2002.

of *belief* and *desire*. K_{σ} names the *special cognitive way of knowledge* and $Want_{\sigma}$ and Int_{σ} the *special volitive ways of will and intention*. Constants of type θ name *propositional content conditions* and constants of type Σ *preparatory conditions*. Thus $Past_{\theta}$ names the propositional content condition that the propositional content is past and $Future_{\theta}$ that it is future. The logical constant Int_{θ} names the *special propositional content condition of intentions*. $Truth_{\Sigma}$ names the preparatory condition that the propositional content is then true. 1_{σ} , 1_{θ} and 1_{Σ} name *neutral components*. If A and B are component terms of \mathcal{L} of the same type, the new terms $(A \cup B)$ and $(A \cap B)$ name respectively the *intersection* and the *union* of the components named by A and B. Thus, $(A_{\theta} \cap B_{\theta})$ names the *intersection of propositional content conditions* A_{θ} and B_{θ} .

Formulas naming cognitive and volitive psychological modes

$[(A_{\sigma}, A_{\theta}, A_{\Sigma}, Bel)]$ names the weakest cognitive psychological mode having the way named by A_{σ} , the propositional content condition named by A_{θ} and the preparatory condition named by A_{Σ} . Similarly, $[(A_{\sigma}, A_{\theta}, A_{\Sigma}, Des)]$ names the weakest volitive mode with these components.

Propositional formulas

- (i) If R_n is a predicate of degree n and t_1, \dots, t_n is a sequence of n individual constants, then $[R_n t_1 \dots t_n]$ is a propositional formula expressing the *elementary proposition* that predicates the attribute expressed by R_n of the n individuals under concepts expressed by t_1, \dots, t_n in that order.
- (ii) If A_p and B_p are propositional formulas and a an individual constant naming an agent, then $\neg A_p$, $\Box A_p$, $Was A_p$, $Will A_p$, $Actually A_p$, $Tautological A_p$, $(A_p \wedge B_p)$, $(A_p \dot{\vee} B_p)$, $[Bela A_{\sigma} A_p]$, $[Des a A_{\sigma} A_p]$, $\diamond a A_p$, $([\rho A_p B_p])$, $(A_{\theta} a A_p)$, $(A_{\Sigma} a A_p B_p)$ and $(a \gg A_p)$ are new propositional formulas.

$\neg A_p$ expresses the truth functional negation of proposition A_p . $Will A_p$ expresses the *future* proposition that *it will be the case* that A_p . $Was A_p$ expresses the *past* proposition that *it has been the case* that A_p . $Settled A_p$ expresses the modal proposition that *it is settled* that A_p , namely that A_p is true according to all histories. $\Box A_p$ means that *it is historically necessary* that A_p , in the sense that it could not then have been otherwise than A_p . $Actually A_p$ expresses in each context the indexical proposition that *it is then actual* that A_p , that is to say that proposition A_p is true at the moment and in the proper history of that context.¹⁹ $Tautological A_p$ means that proposition A_p is a tautology. $(A_p \wedge B_p)$ expresses the *conjunction* of the propositions expressed by A_p and B_p and

$(A_p \wr B_p)$ means that proposition A_p contains all elementary propositions of proposition B_p . $[Bela_{A_{\text{mod}}}A_p]$ and $[Desa_{A_{\text{mod}}}A_p]$ respectively mean that agent a believes and desires the proposition A_p with the mode named by A_{mod} .

$\diamond aA_p$ means that A_p could be true given all attitudes of the agent a . Thus $\diamond aA_p$ is true in a circumstance m/h when A_p is true in at least one coinstantaneous circumstance where the agent a has all attitudes that he or she has at the moment m . $[\rho A_p B_p]$ means that A_p is true because of B_p . $(A_{\theta}aA_p)$ means that proposition A_p satisfies the propositional content condition named by A_{θ} as regards the agent a . $(A_{\Sigma}aA_p)$ expresses in each context a proposition that is true in a circumstance m/h when the preparatory conditions named by A_{Σ} are fulfilled as regards the agent a and the moment m of that circumstance. In other words, $(A_{\Sigma}aA_p)$ expresses in each context the conjunction of all propositions that agent a would presuppose if he or she had then an attitude with the propositional content A_p and the preparatory condition named by A_{Σ} . Finally, $[a \gg A_p]$ means that agent a presupposes that A_p .

Most fundamental truth functional, modal, propositional, and psychological notions that are important for the analysis of propositional attitudes can be derived from my few primitive notions. Here are well known or new important abbreviation rules. Some are laws of identity.

Always $A =_{\text{def}} \neg Was\neg A \wedge A \wedge \neg Will\neg A$

Actual future (Occam): Later $A =_{\text{def}} \text{ActuallyWill}A$

Universal Necessity $\blacksquare A =_{\text{def}} \text{Always}\Box A \wedge \Box \text{Always}A$

Strict implication $(A \text{---} \in B) =_{\text{def}} \blacksquare(A \Rightarrow B)$ *Historical possibility:* $\Diamond A =_{\text{def}} \neg \Box \neg A$

Strong implication: $(A_p \mapsto B_p) =_{\text{def}} (A_p \wr B_p) \wedge \text{Tautological}(A_p \Rightarrow B_p)$

Same structure of propositional constituents: $A_p \equiv B_p =_{\text{def}} (A_p \wr B_p) \wedge (B_p \wr A_p)$

The preparatory condition of actual falsehood of the propositional content

Falsehood $_{\Sigma}aA_p =_{\text{def}} \text{Truth}_{\Sigma}\neg A_p$

The preparatory condition that the propositional content is then possible

$\Diamond_{\Sigma}aA_p =_{\text{def}} \text{Truth}_{\Sigma}a\Diamond A_p$

The preparatory condition that the propositional content is not then necessary

¹⁹ In my view, the use and interpretation of future tensed sentences makes a reference to the particular history supplied by the context of utterance.

$$\neg \Box_{\Sigma} a A_p =_{\text{def}} \text{Truth}_{\Sigma} a \neg \Box A_p$$

The primitive mode of belief: $\text{Belief} =_{\text{def}} [1_{\boxtimes}, 1_{\theta}, 1_{\Sigma}, \text{Bel}]$

The primitive mode of desire: $\text{Desire} =_{\text{def}} [1_{\boxtimes}, 1_{\theta}, 1_{\Sigma}, \text{Des}]$

The operation of imposing a cognitive or volitive way to a psychological mode

$$[B_{\boxtimes}][A_{\boxtimes}, A_{\theta}, A_{\Sigma}, \mathcal{G}] =_{\text{def}} [(B_{\boxtimes} \cap A_{\boxtimes}), A_{\theta}, A_{\Sigma}, \mathcal{G}] \text{ where } \mathcal{G} \text{ is } \text{Bel} \text{ or } \text{Des}.$$

The operation of adding a new propositional content condition to a psychological mode

$$[B_{\theta}][A_{\boxtimes}, A_{\theta}, A_{\Sigma}, \mathcal{G}] =_{\text{def}} [A_{\boxtimes}, (B_{\theta} \cap A_{\theta}), A_{\Sigma}, \mathcal{G}]$$

The operation of adding a new preparatory condition to a psychological mode

$$[B_{\Sigma}][A_{\boxtimes}, A_{\theta}, A_{\Sigma}, \mathcal{G}] =_{\text{def}} [A_{\boxtimes}, A_{\theta}, (B_{\Sigma} \cup A_{\Sigma}), \mathcal{G}]$$

The cognitive mode of knowledge: $\text{Knowledge} =_{\text{def}} [K_{\boxtimes}, 1_{\theta}, \text{Truth}_{\Sigma}, \text{Bel}]$

The volitive mode of will: $\text{Will} =_{\text{def}} [(\text{Want}_{\boxtimes}, \text{Present}_{\theta} \cup \text{Future}_{\theta}, \neg \Box_{\Sigma} \cup \Diamond_{\Sigma}, \text{Des})]$

The volitive mode of intention: $\text{Intention} =_{\text{def}} [\text{Int}_{\boxtimes}][\text{Int}_{\theta}] \text{Will}$

The volitive mode of prior intention: $\text{Prior intention} =_{\text{def}} [\text{Future}_{\theta}] \text{Intention}$

Components: $A_M(A_c) =_{\text{def}} [A_c] A_M = A_M$; $A_M(A_c)$ means that A_c is a component of mode A_M .

The property of having the null direction of fit

$$\emptyset(A_M) =_{\text{def}} A_M(\text{Des}) \wedge ((A_M(\text{ActualTruth}_{\Sigma}) \vee (A_M(\text{ActualFalsehood}_{\Sigma})))$$

$[\text{Bela}A_p] =_{\text{def}} [\text{Bela}1_{\boxtimes}A_p]$; $[\text{Bela}A_p]$ expresses the proposition that agent a believes that A_p .

Desire : $[\text{Desa}A_p] =_{\text{def}} [\text{Desa}1_{\boxtimes}A_p]$

Conditions of possession of propositional attitudes

$$[\text{aHas}([A_{\boxtimes}, A_{\theta}, A_{\Sigma}, \text{Bel}]A_p)] =_{\text{df}} ([\text{Bela}A_{\boxtimes}A_p] \wedge (A_{\theta}aA_p) \wedge [\text{Bela}A_{\Sigma}A_p] \wedge [\gg aA_{\Sigma}A_p])$$

$$[\text{aHas}([A_{\boxtimes}, A_{\theta}, A_{\Sigma}, \text{Des}]A_p)] =_{\text{df}} ([\text{Desa}A_{\boxtimes}A_p] \wedge (A_{\theta}aA_p) \wedge [\text{Desa}A_{\Sigma}A_p] \wedge [\gg aA_{\Sigma}A_p] \wedge$$

$$[\text{Bela}\neg\text{Tautological}A_p])$$

$[\text{aHas}(A_M A_p)]$ means that agent a has the attitude with the mode A_M and the content A_p .

Intention : $[\text{aIntends}A_p] =_{\text{def}} [\text{aHas}(\text{Intention}A_p)]$

Knowledge : $[\text{Ka}A_p] =_{\text{def}} [\text{aHas}(\text{Knowledge}A_p)]$

Strong psychological commitment for an agent:

$$(A_M A_p) \blacktriangleright a (B_M B_p) =_{\text{df}} \Box ([\text{aHas}(A_M A_p)] \Rightarrow [\text{aHas}(B_M B_p)])$$

$(A_M A_p) \blacktriangleright a (B_M B_p)$ means that agent a could not then have the first attitude without the second.

Strong psychological commitment for all agents:

$(A_M A_p) \blacktriangleright (B_M B_p) =_{df} \text{Tautological}((A_M A_p) \blacktriangleright_{a_1} (B_M B_p))$ where a_1 is the first individual constant.

$(A_M A_p) \blacktriangleright (B_M B_p)$ means that no agent can have the first attitude without having the second.

Psychological necessity $\blacksquare a A_p =_{df} \neg \blacklozenge a \neg A_p$ ²⁰

Weak psychological commitment for an agent: $a \triangleright (A_M A_p) =_{df} \blacksquare a \blacklozenge a [a \text{Has} (A_M A_p)]$

$(A_M A_p) \triangleright a (B_M B_p) =_{df} \square ((a \text{Has} A_M A_p) \Rightarrow a \triangleright (B_M B_p))$

Weak psychological commitment for all agents:

$(A_M A_p) \triangleright (B_M B_p) =_{df} \text{Tautological}((A_M A_p) \triangleright_{a_1} (B_M B_p))$

Propositional identity: $(A_p = B_p) =_{def} (A_p \mapsto B_p) \wedge B_p \mapsto A_p$

Same propositional attitudes: $A_M A_p = B_M B_p =_{def} (A_p = B_p) \wedge (A_M A_p \blacktriangleright B_M B_p) \wedge (B_M B_p \blacktriangleright A_M A_p)$

Conditions of satisfaction of propositional attitudes

Satisfied $(A_M a A_p) =_{df} [a \text{Has} A_M A_p] \wedge \neg \emptyset(A_M) \wedge \text{Actually} A_p \wedge (A_M (\text{Want}_{\overline{\omega}}) \Rightarrow [\rho(\text{Actually} A_p)[a \text{Has} A_M A_p]])$

Satisfied $(A_M a A_p)$ means that a propositional attitude of mode A_M and propositional content A_p of agent a is (or will be) satisfied.

All the instances in my ideography of classical axiom schemas of the first order predicate calculus, S5 modal logic for settled truth and historic necessity and of branching temporal logic are valid formulas. Here are new fundamental valid laws. Some are true by definition.²¹

Valid schemas for tautologies

(T1) $\models \text{Tautological} A_p \Rightarrow \blacksquare A_p$ Notice that $\not\models \blacksquare A_p \Rightarrow \text{Tautological} A_p$.

(T2) $\models \text{Tautological} A_p \Rightarrow \text{Tautological Tautological} A_p$

(T3) $\models \neg \text{Tautological} A_p \Rightarrow \text{Tautological} \neg \text{Tautological} A_p$

(T4) $\models \text{Tautological} A_p \Rightarrow (\text{Tautological} (A_p \Rightarrow B_p) \Rightarrow \text{Tautological} B_p)$

²⁰ $\blacksquare a A_p$ is true in a circumstance m/h when proposition A_p is true at all coinstantaneous moments where the agent a has all attitudes that he or she has at moment m .

²¹ See my forthcoming book *Propositions, Truth and Thought* for the axiomatic system and formal semantics of my logic.

$$(T5) \models \text{Tautological} B_p \Rightarrow (\text{Tautological} (A_p \Rightarrow B_p) \Rightarrow \text{Tautological} A_p)$$

Tautological implication is much stronger than strict implication.

$$(T6) \models (A_p \multimap B_p) \Rightarrow \text{Tautological}(A_p \multimap B_p)$$

$$(T7) \models \neg(A_p \multimap B_p) \Rightarrow \text{Tautological} \neg(A_p \multimap B_p)$$

Valid schemas for propositional identity

$$(I1) \models ((A_p \mapsto B_p) \wedge B_p \mapsto A_p) \Rightarrow (A_p = B_p)$$

(I2) $\models (A_p = B_p) \Rightarrow (C \Rightarrow C^*)$ where C^* and C are propositional formulas which differ at most by the fact that an occurrence of B_p in C^* replaces an occurrence of A_p in C .

$$(I3) \models (A_p = B_p) \Rightarrow \text{Tautological} (A_p = B_p)$$

$$(I4) \models \neg(A_p = B_p) \Rightarrow \text{Tautological} \neg(A_p = B_p)$$

Valid schemas for belief

$$(B1) \models ((\text{Bela} A_p) \wedge \text{Bela} B_p) \Rightarrow \text{Bela}(A_p \wedge B_p)$$

$$(B2) \models \text{Tautological} A_p \Rightarrow \neg \text{Bela} \neg A_p$$

$$(B3) \models \text{Tautological} A_p \Rightarrow (\text{Bela} A_p \Rightarrow \text{Bela} \text{Tautological} A_p)$$

$$(B4) \models \text{Bela} A_p \Rightarrow ((A_p \mapsto B_p) \Rightarrow (\text{Bela} B_p))$$

$$(B5) \models \text{Bela} A_p \Leftrightarrow (\text{Bela} \text{Bela} A_p)$$

$$(B6) \models \text{Bela} A_p \Rightarrow \text{Bela} \Diamond A_p$$

$$(B7) \models \text{Satisfied}_a[\text{Bela} A_p] \Leftrightarrow ([\text{Bela} A_p] \wedge \text{Actually} A_p)$$

Notice that the following laws are not valid for beliefs.

$\neq \blacksquare \neg A_p \Rightarrow \text{Bela} A_p$ and $\neq \blacklozenge A_p \Rightarrow \text{Bela} \neg A_p$. Agents are not perfectly rational.

$\neq \text{Tautological} A_p \Rightarrow \text{Bela} A_p$. Agents are not logically omniscient.

In particular, $\neq (\text{Tautological} (A_p \Rightarrow B_p)) \Rightarrow (\text{Bela} A_p \Rightarrow \text{Bela} B_p)$

For $\neq (\text{Tautological} (A_p \Rightarrow B_p)) \Rightarrow (A_p \multimap B_p)$.

However $\models \textit{Tautological} (A_p \Rightarrow B_p) \Rightarrow (BelA_p \text{---} \in \neg Bela\neg B_p)$

Valid schemas for desire

(D1) $\models (DesaA_p \wedge DesaB_p) \Rightarrow Desa(A_p \wedge B_p)$

(D2) $\models \textit{Tautological}A_p \Rightarrow \neg(DesaA_p \vee Desa\neg A_p)$

(D3) $\models DesaA_p \Rightarrow (((A_p \mapsto B_p) \wedge \neg \textit{Tautological}B_p)) \Rightarrow (DesaB_p))$

(D4) $\models DesaA_p \Rightarrow Bela\neg \textit{Tautological}A_p$

(D5) $\models DesaA_p \Rightarrow Desa\Diamond A_p$

(D6) $\models \textit{Satisfied}[DesaA_p] \Leftrightarrow ([DesaA_p] \wedge \textit{Actually}A_p)$

Notice that $\not\models (A_p \mapsto B_p) \Rightarrow (DesaA_p \Rightarrow DesaB_p)$. Moreover $\not\models Bela\blacksquare B_p \Rightarrow \neg DesaA_p$

However $\models \textit{Tautological} (A_p \Rightarrow B_p) \Rightarrow (DesaA_p \text{---} \in \neg Desa\neg B_p)$

Valid schemas for possession of attitudes

$\models [aHas(A_M A_p)] \Rightarrow \textit{Settled} [aHas(A_M A_p)]$

$\models ((A_p = B_p) \wedge (A_M A_p \blacktriangleright B_M B_p) \wedge (B_M B_p \blacktriangleright A_M A_p)) \Rightarrow (A_M A_p = B_M B_p)$

where \blacktriangleright is the sign for strong psychological commitment for all agents.

$\models ([A_c]A_M A_p) \blacktriangleright (A_M A_p)$

$\models \textit{Satisfied} (A_M A_p) \Rightarrow (\neg \emptyset(A_M) \wedge \textit{Actually}A_p)$

$\models (\neg \emptyset(A_M) \wedge \neg A_M(\textit{Want}_{\text{w}}) \wedge [aHas(A_M A_p)]) \Rightarrow (\textit{Satisfied}_a(A_M A_p) \Leftrightarrow \textit{Actually}A_p)$

$\models (\neg \emptyset(A_M) \wedge A_M(\textit{Want}_{\text{w}})) \Rightarrow (\textit{Satisfied}_a(A_M A_p) \Leftrightarrow [\rho(\textit{Actually}A_p)[aHas(A_M A_p)])$

Valid schemas for knowledge

(K1) $\models KaA_p \Rightarrow (A_p \wedge BelaA_p)$

(K2) $\models (KaA_p) \Rightarrow KaKaA_p$

(K3) $\models \textit{Tautological}A_p \Rightarrow ([aHas(A_M A_p)] \Rightarrow KaA_p)$ But $\not\models \textit{Tautological}A_p \Rightarrow KaA_p$

(K4) $\models KaA_p \Rightarrow ((A_p \mapsto B_p) \Rightarrow (KaB_p))$ But $\not\models (Tautological(A_p \Rightarrow B_p)) \Rightarrow (KaA_p \Rightarrow KaB_p)$

Valid schemas for intention

(I1) $\models (IntaA_p) \Rightarrow \neg(WasB_p = A_p)$

(I2) $\models IntaA_p \Rightarrow ((Bela\Diamond A_p \wedge Bela\neg\Box A_p) \wedge DesaA_p)$