

## Chapter 15

# ATTEMPT, SUCCESS AND ACTION GENERATION: A LOGICAL STUDY OF INTENTIONAL ACTION\*

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**Abstract** Contemporary philosophers have broadly studied intentional actions that agents attempt to perform in the world. However, logicians of action have tended to neglect the intentionality proper to human action. I will present here the basic principles and laws of a logic of individual action where intentional actions are primary as in contemporary philosophy of action. In my view, any action that an agent performs unintentionally could in principle have been attempted. Moreover any unintentional action of an agent is an effect of intentional actions of that agent. So my logic of action contains a theory of attempt and of action generation. As Belnap pointed out, action, branching time and historic modalities are logically related. There is the liberty of voluntary action. I will then work out a logic of action that is compatible with indeterminism.

Propositions with the same truth conditions are not the contents of the same attitudes of human agents. For that reason I will exploit the resources of a non classical modal and temporal predicative propositional logic capable of distinguishing the contents of intentional actions which are different. My primary purpose is enrich the logic of agency so as to adequately characterize attempts, intentional actions and the different kinds of action generation.

I will only consider here *individual actions* that a single agent performs at one moment. Examples of such actions are intended body movements

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like voluntarily raising the arm, some effects of these movements like touching something, mental actions like judgements and elementary illocutionary acts such as assertions and questions which are performed at one moment of utterance. Individual actions performed at a single moment are part of all other kinds of action: they are part of longer actions like deliberations which last during several moments of time and of collective actions like debates performed by several agents.

In my ideal language, formulas representing actions are of the canonical form: individual agent *a does that A* (or *acts so as to bring about that A*), where A represents what the agent does (the content of his or her action). In order to contribute to the foundations of the logic of action, I will attempt to answer general philosophical questions: What is the logical form of proper intentional actions? What are their success conditions? And what are the logical relations that exist between our intentional and unintentional actions? Some types of action contain other types of action. An agent cannot perform an action of the first type without performing an action of the second type. Thus it is not possible to shout without producing sounds. Moreover certain action tokens *generate* others in certain particular circumstances. An agent who expresses at a moment an attitude that he or she does not have lies. He or she could be sincere at another moment. What are the basic laws governing agentive commitment and action generation? In particular, how can an agent perform certain actions by way of performing other actions? Are all actions performed by an agent at a moment generated by a single *basic intentional action* of that agent at that moment? If yes, what is the nature of that basic action? What are the different kinds of agentive generation and how can we explicate them?

Furthermore, what kind of theory of truth do we need in the logic of action? By way of performing actions agents bring about facts in the world. They make true propositions representing these facts. How are success and truth related? Which predications do we make in attributing actions to agents? What is the nature of propositions representing actions? How do we determine in thought their truth conditions?

The structure of this paper is the following. I will first make philosophical remarks regarding the nature of propositions and actions. I will state basic criteria of adequacy for the theory of action and I will try to explicate the intrinsic intentionality of action. In contemporary philosophy of action<sup>1</sup>, philosophers are mainly concerned with intentional actions. By definition, *intentional actions* are actions that agents *at-*

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<sup>1</sup>See Goldman [1970], Davidson [1980], Searle [1983] and Bratman [1987].

*tempt* to perform in the world. However, our intentional actions have unintended effects in the world. Thus in walking intentionally on ice an agent might unintentionally slip and fall on the ground. **I will formulate a logic of action where intentional actions are primary** as in contemporary philosophy of action. In my view, any action that an agent performs unintentionally could in principle be intentional. Moreover any unintentional action of an agent is generated by intentional actions of that agent. However, not all unintended effects of intentional actions are the contents of unintentional actions. But only those that are historically contingent and that the agent could attempt to perform. So many events which happen to us in our life are not really actions.

In order to analyze adequately the contents of intentional actions I will use a non classical predicative modal and temporal propositional logic containing that the logic presented in chapter 10. That propositional logic takes into consideration the acts of predication that we make in expressing propositions. It analyzes both their structure of constituents and the effective way in which we understand their truth conditions. So my logic of agency is able to distinguish strictly equivalent propositions which do not have the same cognitive values.

As Belnap [1988,1991] pointed out, action, branching time and historic modalities are logically related. Our intentional actions are not fully determined. Whenever we do something, we could have done something else. Moreover, our present actions can have many different incompatible future effects. So I will use the logic of ramified time that is compatible with indeterminism. According to indeterminism, several incompatible moments of time might follow the same moment in the future of this world. Any moment of time can then belong to several histories representing possible courses of the world with the same past and present but different historic continuations of that moment.

On the basis of my philosophical considerations about truth and action I will further develop Chellas [1992]' and Belnap [1991-2]'s classical logics of agency. I will use a richer ideographic object language containing an additional logical constant of attempt. I will also state important valid laws governing purposes, actions and action generation.

## 1. Philosophical considerations on proposition and truth

In classical philosophical logic (whether modal<sup>2</sup>, temporal<sup>3</sup>, intensional<sup>4</sup>, agentive<sup>5</sup> or epistemic), propositions are reduced following Carnap [1956] to their truth conditions. So strictly equivalent propositions (which are true in the same possible circumstances<sup>6</sup>) are identified. However it is clear that such propositions are not substitutable *salva veritate* within the scope of verbs of action and attitudes. Whenever we act so as to put a stone on the table, we do not *eo ipso* act so as to bring about that the stone is on the table and a material object in space. In order to act intentionally an agent must know what he or she is trying to do and under which conditions he or she would succeed. We cannot do what we could not intend to do. So the propositional content conditions of intentions and attempts are success conditions of our actions. Any content of a successful action must satisfy these propositional content conditions. Human agents are minimally rational. They never intend to perform actions of bringing about a fact that they know to be unpreventable. So we could not act so as to bring about that an existing stone is a material object in space. For we know that this is necessarily the case no matter what we would do. Similarly we cannot act so as to bring about something in the past. For our intentions are essentially directed towards the present and the future.

From a philosophical point of view, then, we need a criterion of propositional identity stronger than strict equivalence in the logic of action. We cannot identify, as it is commonly done in classical logics of action, each proposition with the set of circumstances in which it is true. We need to consider the structure of constituents of propositions in order to analyze adequately intentional actions. Jocasta is Oedipus' mother. So by way of marrying Jocasta Oedipus *eo ipso* married his mother. However Oedipus did not know then that Jocasta was his mother. So he did not intentionally married his mother when he married Jocasta. In order to account for such facts, I will proceed here to a finer analysis in terms of predication of the logical type of propositions.

<sup>2</sup>See R. Barcan Marcus [1993] and S. Kripke [1963].

<sup>3</sup>See Prior [1967], Thomason [1984], Belnap [1992].

<sup>4</sup>See R. Montague [1974].

<sup>5</sup>See the special issue 51 on action of *Studia Logica* in 1992.

<sup>6</sup>In the logic of branching time, possible circumstances are pairs containing a moment of time and a history to which that moment belongs.

I have already presented my logic of propositions according to predication in chapter 10. I will now rapidly repeat its basic principles. Readers who already know them can skip the rest of this section.

We make acts of reference and of predication in expressing propositions. So propositions have a more complex logical structure than truth conditions. First, they have *propositional constituents: concepts* which serve to refer and *attributes* (properties or relations) which are predicated. They are composed from *atomic propositions* which attribute properties or relations to objects of reference under concepts<sup>7</sup>. Propositions composed from different atomic propositions are by nature different. We have to make different acts of predication in order to have them in mind. This is why the proposition that a stone is on the table is different from the proposition that it is on the table and in space.

Moreover, in understanding the truth conditions of propositions we do not determine their truth value in all different possible circumstances, as logicians influenced by Carnap wrongly believe. Rather, we only determine that their truth in each circumstance is compatible with certain possible denotation assignments to their constituents and incompatible with others. Thus in understanding an elementary proposition we know that it is true in a circumstance when its unique atomic proposition is true in that circumstance. But we do not *eo ipso* know whether it is true or false in that very circumstance. Simplest atomic propositions are true in a circumstance when the objects which fall under their concepts satisfy their attribute in that very circumstance. However we often refer to an object under a concept without knowing which object falls under that concept. We moreover often do not know which objects of reference possess the properties or entertain the relations that we predicate. So we can assign to expressed concepts and attributes other denotations that they actually have in reality. From a cognitive point of view, atomic propositions have therefore many *possible truth conditions* according to agents. They could be true in a lot of sets of possible circumstances given the different possible denotations that could correspond to their senses in reality. Suppose that in a given circumstance Smith's wife is a suspect (she could have killed Smith) according to the chief of police. Then the atomic proposition that attributes to her the property of being Smith's murderer could be true in that circumstance according to the chief of police. This is an epistemic possibility. From a logical point of view, **each possible truth condition of an atomic proposition**

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<sup>7</sup>In my propositional logic, two atomic propositions are identical when they have the same propositional constituents (the same attribute and objects under concepts) and the same truth conditions (they are true in the same circumstances).

corresponds to (and can be identified with) a unique particular set of possible circumstances where that proposition could be true given at least one possible denotation assignment to its attribute and concepts. So any interpretation taking into consideration a number  $n$  of possible circumstances has to consider  $2^n$  different possible truth conditions for atomic propositions.

Among all possible truth conditions of an atomic proposition there are of course its *actual truth conditions*, which correspond to the set of all possible circumstances where the objects which fall under its concepts satisfy its attribute. Objects of reference have properties and stand in relations in each circumstance. Atomic propositions have therefore a well determined truth value in any circumstance given the extension of their attribute and concepts and the order of their predication. But we are not omniscient. Our objects of reference could have according to us many other properties and stand in many other relations. **So in our use and comprehension of language we consider a lot of possible truth conditions of expressed atomic propositions** and not only their proper actual truth conditions, as Carnap advocated.

**We *a priori* know the truth (or falsehood) of few elementary propositions.** For few contain a tautological or contradictory atomic proposition. *Tautological* atomic propositions attribute to an object of reference an property that we *a priori* know that it possesses e.g. that an existing stone is a material object in space. Their only possible truth condition is the set of all possible circumstances. On the contrary, *contradictory* atomic propositions attribute to an object a property that we *a priori* know that it does not possess. Their only possible truth condition is the empty set of all possible circumstances. **Moreover, the truth of most complex propositions is compatible with various possible ways in which objects could be.** Think of disjunctions, past and future propositions, historic possibilities, etc.<sup>8</sup>

As Wittgenstein pointed out in the *Tractatus*, they are however two limit cases of propositions: tautologies that we *a priori* know to be necessarily true and contradictions that we *a priori* know to be necessarily false by virtue of linguistic competence. In my conception of truth, *tautologies* are propositions whose truth in any circumstance is compatible with all possible denotation assignments to their propositional

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<sup>8</sup>Consider the past proposition that the actual pope was attacked. In order that it be true in a given circumstance, it is sufficient that the actual pope be attacked in at least one previous circumstance. So the truth of that past proposition in any circumstance  $c$  is compatible with a lot of possible truth conditions of the atomic proposition attributing to the pope the property of being attacked (namely all those which contains at least one circumstance anterior to  $c$ ).

constituents. And *contradictions* are propositions whose truth in any circumstance is not compatible with any. Tautologies (and contradictions) are important kinds of necessarily true (and false) propositions for the purposes of the logic of action. For they represent facts that we *a priori* know to be respectively inevitable and impossible.

When the truth of two propositions is compatible with different possible denotation assignments to their constituents, these propositions do not have the same cognitive values. We do not understand in the same way their truth conditions even when they are strictly equivalent and have the same atomic propositions. In other words they represent according to us different facts. So we need in philosophical logic a finer explication of truth conditions than that of Carnap. In particular, **we have to distinguish universally true (and false) propositions** — which are true (and false) in all circumstances — **from tautologies (and contradictions)** composed of the same atomic propositions. Consider the elementary proposition (1) that Oedipus is the son of Jocasta and the tautological proposition (2) that Oedipus is or is not the son of Jocasta. Both are composed from the same atomic proposition which attributes to Oedipus the property of being the son of Jocasta. And they are strictly equivalent. Both are necessarily true. For it is an essential property of any living person to have at any moment a unique mother according to all possible histories. However it is clear that the two propositions in question have different cognitive values. We all *a priori* know by virtue of competence that the tautological proposition (2) is true but we might believe like Oedipus did that Oedipus is not Jocasta's son. The elementary proposition (1) could be false; it is not tautological.

Unlike traditional logic, my logic explains easily such a cognitive difference in terms of predication. The truth of these propositions is not compatible with the same possible truth conditions of their single atomic proposition. In my approach, propositions have then two distinct (but logically related) features. First, they are composed of a finite positive number of atomic propositions. Second, their truth in each circumstance is compatible with a unique set of possible denotation assignments to their propositional constituents.

In the philosophical tradition from Aristotle to Tarski, the truth of a proposition is based on its *correspondence* with reality. In order that a proposition be true in a circumstance, the things which fall under its concepts in that circumstance must be as that proposition represents them in that very circumstance. Otherwise, there would be no correspondence. Along these lines, **a proposition is by definition true in a circumstance when its truth in that circumstance is compat-**

ible with the special *denotation assignments* that associate with its propositional constituents their actual denotation in each possible circumstance. As one can expect such denotation assignments determine the actual truth conditions of all its atomic propositions. One can derive from my concise truth definition all the classical laws of the theory of truth.

Speakers often rightly or wrongly believe at a moment that certain objects could fall under concepts and could satisfy attributes in possible circumstances. According to them particular atomic propositions could then be true in certain sets of possible circumstances. Suppose a particular set  $Val(a,m)$  of possible denotation assignments to propositional constituents is compatible with what the speaker  $a$  believes at the moment  $m$ . We can determine which propositions that speaker then *believes to be true*. For we can define exactly the notion of truth according to a speaker in my approach: a proposition *is true in a circumstance according to a speaker  $a$  at a moment  $m$*  when the truth of that proposition in that circumstance is compatible with all possible denotation assignments  $Val(a,m)$  that the agent  $a$  at that moment considers for its propositional constituents. As one can expect, tautological propositions are true and contradictory propositions are false according to all agents who have them in mind. But impossible propositions which are not contradictory can be true and necessary propositions which are not tautological can be false according to some agents at some moments. Moreover whenever the modal proposition that it is then necessary that  $A$  is true in a circumstance according to a speaker at a moment that proposition is also true according to that speaker at that moment in all coinstantaneous circumstances. These are basic principles of my epistemic logic.

## 2. Action, time and modalities in philosophical logic

In order to analyze adequately the logical form of temporal, modal and agentive propositions, we must pay attention to the following facts:

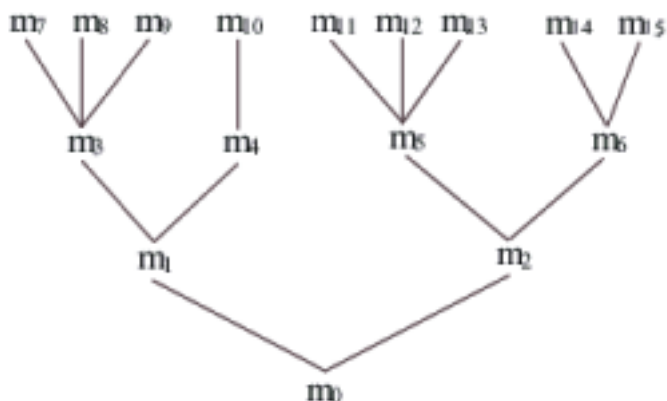
### 2.1 As regards their structure of constituents

Unlike truth functions, modal, temporal and agentive operations on propositions introduce more atomic propositions. We make new predications in expressing them. Thus in asserting that someone is making the hostages free we attribute to an agent the agentive property of freeing hostages. Prefixes like “en” serve to compose agentive predicates in English. To enable is to make able and to enrich is to make rich. Similarly in asserting that someone is making an attempt to be elected

we attribute to him or her the agitive property of being a candidate for an election.

## 2.2 As regards truth conditions

The truth values of many propositions depend on both moments of time and histories. In the logic of branching time, a *moment* is a possible complete state of the world at a certain instant and the *temporal relation* of *anteriority* / *posteriority* between moments is partial rather than linear because of indeterminism. On the one hand, the past is unique: each moment  $m$  is immediately preceded by at most one past moment  $m'$ . Moreover all moments are historically connected: any two distinct moments are preceded by a common past moment. On the other hand, there are multiple future routes: several incompatible moments might be immediately posterior to a given moment. Consequently, the set of moments of time has the formal structure of a *tree-like frame*:



A maximal chain  $h$  of moments of time is called a *history*. It represents a *possible course of history of our world*. The truth of certain propositions is *settled at each moment* no matter how that moment continues. So are past propositions because the past is unique. The past proposition that it was the case that  $A$  (in symbols: *WasA*) is true at a moment  $m$  when  $A$  is true at a moment  $m'$  anterior to  $m$ . Its truth value does not depend on histories. For all histories passing through a moment have the same past at that very moment. The proposition that it is settled that  $A$  (in symbols *SettledA*) is by definition true at a moment  $m$  according to a history  $h$  when the proposition that  $A$  is true at that moment  $m$  according to all histories to which it belongs. Unlike what is the case for past propositions, the truth of future propositions is

not settled at each moment; it depends on which historical continuation  $h$  of that moment is under consideration. Like Belnap [1994] let us say that the future proposition that it will be the case that A (in symbols  $WillA$ ) is true at a moment  $m$  according to a history  $h$  when the proposition that A is true at a moment  $m'$  posterior to  $m$  according to that very history  $h$ .<sup>9</sup>

Two moments of time are said to be *alternative* when they belong to histories which have the same past before these moments. For example, moments  $m_7$ ,  $m_8$  and  $m_9$  are alternative in the last figure. They represent how the world could be immediately after the moment  $m_3$ . The set of all *instants* is a partition *Instant* of the set *Time* of all moments containing exactly one moment of each history and respecting the temporal order of histories. For example, moments  $m_3$ ,  $m_4$ ,  $m_5$  and  $m_6$  of the last figure are *coinstantaneous*. They belong to the same instant.

Thanks to instants, the logic of agency can analyze the modal notions of *historic possibility* and *historic necessity* (in the sense now of *inevitability*)<sup>10</sup>. Consider the proposition that *it is then possible that* A (in symbols  $\diamond A$ ) in the sense that it could then be the case that A.  $\diamond A$  is true at a moment  $m$  according to a history  $h$  when the proposition that A is true at a moment  $m'$  coinstantaneous with  $m$  according to at least one history  $h'$  to which  $m'$  belong. Similarly, the proposition that *it is then necessary that* A (in symbols  $\square A$ ) — in the sense that it could not have been otherwise than A — is true at a moment  $m$  according to a history  $h$  when the proposition that A is true at all moments  $m'$  coinstantaneous with  $m$  according to all histories  $h'$ . In case a proposition of the form  $\square A$  is true at a moment  $m$ , its argument A represents a fact that is not only *settled* but also *inevitable* at that moment.

Agents can repeat actions of the same type at different successive moments in a possible course of the world. They can drink and eat again. Agents also perform actions of the same type at alternative moments. Suppose that a player is in a winning position at a moment in a chess game: that player wins the game if he or she plays. In that case the player is a winner at all alternative moments where he or she makes any move in playing that game. As one can expect, **moments of time are related by virtue of the actions of agents at these moments.** According to the logic of action, to each agent  $a$  and moment  $m$  there always corresponds the set  $Action_m^a$  of alternative moments  $m'$  which

<sup>9</sup>In the logic of branching time and action, circumstances are pairs of a moment of time  $m$  and history  $h$  where  $m \in h$ . So when I say that a proposition is true at a moment  $m$  according to a history  $h$ , I always assume that  $m$  belongs to  $h$ .

<sup>10</sup>As Prior [1967] says, now unpreventable propositions are “those outside our power to make true or false”

are *compatible with all the actions* that agent  $a$  performs at moment  $m$ . They are all, as Chellas [1992] would say, “under the control of - or responsive to the actions of” agent  $a$  at the moment  $m$ . Suppose that an agent  $a$  does not do anything at a moment  $m$  then all alternative moments to that moment are compatible with moment  $m$ . Suppose that he does something  $A$ . Then the proposition that  $A$  is true at all alternative moments  $m' \in Action_m^a$ .

In my view, in order that a moment be compatible with all the actions of an agent at another moment, **that agent must perform exactly the same actions at these moments**. So by definition, the *relation of compatibility with actions* that I consider is reflexive, symmetric and transitive. Of course the same actions of an agent can have different physical effects (that are not actions) in the world at different moments which are compatible with what that agent does at that moment. **Every agent persists in the world**. What an agent does at each moment depends on how the world has been up to that moment. The possible causes and effects so to speak of the actions of an agent at a moment are limited to those which are possible outcomes of the way the world has been up to that moment. This is why, the relation of compatibility with actions has to satisfy the so called *historical relevance condition*. As Belnap and Perloff [1990,1992] pointed out, in order that a moment  $m'$  be compatible with all the actions that agent  $a$  performs at another moment  $m$ , both must belong to histories with the same past.

Thanks to the new compatibility relation, the logic of action can start to analyze individual action. The proposition that  $A$  is true given what agent  $a$  does (in symbols  $\Delta aA$ ) is true at a moment  $m$  according to a history  $h$  when the proposition that  $A$  is true at all moments  $m'$  compatible with the actions of agent  $a$  at  $m$  according to all histories  $h'$ . By hypothesis, all histories  $h$  to which a moment  $m$  belongs, are responsive to all actions of each agent at that moment. Whenever an agent does something at a moment, he or she does it at that moment, no matter how that moment continues. So the truth of the proposition  $\Delta aA$  is settled at each moment in my logic of agency.<sup>11</sup> Chellas [1992] tends to identify the very notion of action with the normal modal operation corresponding to  $\Delta$ . However any proposition of the form  $\Delta aA$  is true whenever  $A$  is historically necessary. But it is quite clear that no agent could act so as to bring about an inevitable fact. Inevitable facts exist no matter what we do. So in order that the proposition that an agent  $a$  do something, we have to require furthermore that the thing in question

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<sup>11</sup>My conception of action at a moment is then incompatible with that of the deliberative *sees to it* of von Kutschera [1986], Horty [1989] and Belnap, Perloff and Ming Xu [2001].

be not then necessary. As Belnap pointed out, the proposition that an agent *sees to it that A* (in symbols [*a stit A*]) implies that it is false that  $\Box A$ .

In their logic of agency Belnap and Perloff use the logic of branching time and von Neumann [1944]'s theory of games. Agents make free choices in time. The notion of acting or choosing at a moment *m* is thought of as constraining the course of events to lie within some particular subset of the possible histories available at that moment. Belnap and Perloff [1992] first studied actions that are guaranteed by a past choice of the agent. (They made a theory of the so-called *achievement stit*.) However most often agents succeed to do things that they had no prior intention to do. They spontaneously attempt to do them. I never planned to use the words that I am typing right now. Many human actions are only due to a present choice of the agent at the moment of the action. So Belnap, Perloff and Xu [2001] came to study later actions directed at the future that are guaranteed by a present choice of the agent. (This is their theory of the *deliberative stit*.) In my logic of agency, I will study individual actions which are made at the very moment of the agent's choice. It does not matter to me whether they are oriented towards the present or the future. By definition *attempts* correspond to a present rather than to a prior choice. Every intentional action contains an attempt, few execute a prior intention. In my conception of time, most successful attempts by an agent to move one's body cause the movement at the very moment of the attempt. So speakers utter words at the very moment where they try to utter them in contexts of utterance.

Belnap's logical analysis of action in terms of ramified time and historic modalities has the merits of taking very seriously into consideration the temporal and causative order of the world. His logic is compatible with science. I will follow his approach under many aspects. Unfortunately Belnap tends to neglect the *intentionality* proper to action. For that reason agents carry out too many actions in his logic of agency. Suppose a proposition strictly implies another proposition which is not then necessary. According to Belnap an agent cannot make the first true without *eo ipso* making the second true even when the second proposition has nothing to do with what that agent could do or try to do at that moment. For example, an agent who repeats an action sees to it that he or she does and has done it in Belnap's logic.

I will try to work out a logic of action that takes into account the intrinsic intentionality of action so as to explicate adequately agentive commitment. On my account, there is no **action without attempt**. **So the logic of action must incorporate a logic of attempt**. We

need a new logical constant of attempt in the lexicon of the logic of action. Let formulas of the form  $aTriesA$  express the proposition that *agent a attempts to bring about that A*. Before stating truth conditions, let us make a philosophical analysis of the nature of attempts. Clearly attempts and actions are logically related in the philosophy of mind: **every attempt contains an intention**. However, unlike *prior intentions* which are *mental states* that agents *have*, attempts are *mental actions* that agents *make*. An attempt to do something contains an *intention in action*. For to make an attempt is to do something with the intention of achieving a purpose. By raising the arm an agent can make an attempt to greet someone and start a conversation.

**No attempt is determined.** There is the freedom of the will. So agents could attempt to do something else or make no attempt at all. Moreover **each attempt is personal and subjective**. Only an agent *a* can attempt that he or she does something. Someone else cannot. So when two different agents succeed to do the same thing (e.g. to drink), they do it by making different personal attempts. From a philosophical point of view, **attempts are a very special kind of action** that philosophers and logicians have tended to neglect until now. On the one hand, **all attempts are intentional actions**. An agent cannot make an attempt without intending to make that attempt. On the other hand, all individual **attempts are also successful actions** in the sense that no agent can fail to make the attempt that he or she is trying to make at a moment. For in trying to make an attempt the agent *eo ipso* makes that very attempt. This is tautological. An attempt is essentially a mental act. An agent who tries to raise the arm could fail. (He or she could be prevented by an external force or his or her arm could already be up.) But that agent has at least mentally tried to make that movement. He or she had in mind the corresponding *intention in action*. So direct attempts by an agent to move parts of one's body are *basic actions* in the sense of Goldman [1970]. If an agent really wanted to make a direct attempt to move such an attempt would result from his or her want no matter whether he or she is in *standard conditions* or not.<sup>12</sup> Notice that we often have an *experience of the attempt* when that attempt fails.<sup>13</sup> Such an experience presents or represents the success conditions of the attempted action.<sup>14</sup>

<sup>12</sup>See Goldman [1970] page 65.

<sup>13</sup>The notions of direction of fit, intention in action and experience of an action are explained in Searle [1983]. Searle like other philosophers of mind has not sufficiently taken into account the fact that attempts (or intentions in action) are themselves actions.

<sup>14</sup>Attempts of moving the body contain a *presentation* and attempts of making an act of conceptual thought a *representation* of their success conditions.

From a philosophical point of view, both intentions and attempts have the same world-to-mind direction of fit and related conditions of satisfaction. An intention is *satisfied* when it is *carried out*, an attempt when it is *achieved*. Each attempt is directed at an *objective* or *aim* and serves a certain *purpose*. It *succeeds* when that agent achieves his or her purpose. Otherwise it is a *failure*.<sup>15</sup> An agent can **have various types of purposes. So there are various kinds of attempt.** A first and basic kind of attempt is to do something at the moment of the attempt. (So are direct basic attempts to move one's body at a moment.) By hypothesis, any agent who has such a basic purpose either succeeds or fails to achieve it at the very moment of the attempt. As we have seen, the very performance of an individual action at a moment is settled at that moment no matter what happens later. An agent who attempts to make a movement at a moment could fail. So there are alternative moments where that agent does not make the attempted movement. However if he or she makes the movement then his or her present choice at the moment of the attempt corresponds to the set of whole histories passing through that moment. Human agents persist in the world and they live in society. For that reason they often also have future and collective objectives in addition to present ones. They do something at a moment in order to bring about future things. I am now typing on my computer with the intention of revising this chapter. Human agents also often act in order to do their part in a collective action that they want to carry out with others. I am now working in order to edit a collective book in a certain collection of Kluwer. In such cases, it is not settled at the moment of the attempt whether agents will or not reach their objectives. They can succeed according to one possible historic continuation of the world and fail according to another. All depends on how future things will be and how other agents will act. So **the achievement of many attempts depends on both the moment of the attempt and the historic continuation of that moment.** This always happens when the purpose is future or collective.

**Given the fact that attempts have purposes and conditions of achievement, moments of time and histories are also logically related by virtue of the attempts of agents at these moments.** To each agent *a* and moment *m* there also corresponds a (possibly empty) set of alternative moments *m'* where that agent succeeds to achieve according to at least one possible course of history *h'* the attempts that he or she makes at the moment *m*. Such alternative mo-

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<sup>15</sup>The notions of success and failure of an attempt are relative to satisfaction (and not success) conditions; they concern the achievement (and not the making). of attempts.

ments  $m'$  are said to be *compatible with the achievement of all attempts* of agent  $a$  at moment  $m$ .

Attempts have the characteristic world-to-mind direction of fit. In order that an attempt be achieved in a possible course of history that attempt must be made in that course of history. This is part of the satisfaction conditions of attempts. So all moments  $m'$  which are compatible with the achievement of the attempts of an agent  $a$  at a moment  $m$  are alternative and coinstantaneous with that moment. For that agent  $a$  has to make then all the attempts that he or she makes at the moment  $m$ . As one can expect, achievable attempts of agent  $a$  directed at the present are achieved at all such compatible moment  $m'$ , while achievable attempts directed towards the future are achieved at a later moment  $m''$  posterior to  $m'$ .

Most of the time we try to do possible things. In that case, there are a lot of alternative moments which are compatible with the achievement of our attempts. However we can wrongly believe that an objective can be reached. So we can try to do impossible things. In that last case, there does not exist by hypothesis any such compatible moment. In the logic of ramified time, moments represent *possible states* of the world (objective possibilities). Impossible objectives cannot be achieved just as necessarily false proposition cannot be true at any moment according to any history in the logic of ramified time. **How can we deal formally with unachievable attempts?** In philosophy of mind, human agents are minimally rational. They know that successful actions have to bring about facts in the world. And that impossible facts cannot happen. So whenever agents try to do something they at least believe that they could do it. This is part of the sincerity conditions of any attempt and intention. The logic of attempts and intentions is then much stronger than that of desires. Agents can have desires that they believe unsatisfiable, for example to be at Paris and Rome at the same moment for different reasons. But they could never have similar intentions or make similar attempts.<sup>16</sup> Any rational agent who makes an attempt believes that he or she could succeed. So to each agent  $a$  and moment  $m$  there always corresponds a non empty set  $Attempt_m^a$  of alternative moments  $m'$  coinstantaneous with  $m$  which are compatible according to the agent  $a$  with the achievement of his or her attempts at that very moment  $m$ . Suppose that an agent  $a$  tries something  $A$  at  $m$ . Then at all moments  $m' \in Attempt_m^a$  he or she also tries  $A$  and  $A$  is true

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<sup>16</sup>See Searle's chapter "Desire, Deliberation and Action" in the book.

according to him or her at these moments  $m' \in Attempt_m^a$  according to at least one history.

As we saw earlier, each attempt is intentional. Attempts are always attempted. So the relation of compatibility with the achievement of attempts that we consider is transitive. In each model of the logic of action: when  $m' \in Attempt_m^a$  and  $m'' \in Attempt_{m'}^a$ , it follows that  $m'' \in Attempt_m^a$ . Moreover, as attempts are actions, an agent makes the same attempts at all moments which are compatible with what he or she does at a moment. So whenever  $m' \in Action_m^a$ , both  $m' \in Attempt_m^a$  and  $Attempt_{m'}^a = Attempt_m^a$ .

By nature **attempts** are intentions in action. So they **have** like intentions **strong propositional content conditions** that the logic of action must determine. As one can expect, the set  $Goals_m^a$  of propositions representing *possible goals* of an agent  $a$  at a moment  $m$  is for that reason provided with the following logical structure in each standard model. **In order to make an attempt an agent must exist.** So the set  $Goals_m^a$  is empty when agent  $a$  does not exist at moment  $m$ . Because individual actions at a moment (in particular direct basic personal body movements) are constitutive of all other kinds of action, **agents always attempt to do something in the world at the moment of an attempt.** Consequently, propositions of the form  $\Delta aA$  representing actions of the agent  $a$  at moment  $m$  always belong to the set  $Goals_m^a$  of a model when that set is not empty. As **attempts are personal**,  $[b \text{ tries } A] \notin Goals_m^a$  when  $b \neq a$ . Furthermore, **as agents are minimally rational, they never attempt to bring about something that they know a priori to be necessary or impossible.** So  $A \notin Goals_m^a$  when the proposition that  $A$  is tautological or contradictory. Finally, **attempts are directed at a present or future purpose.** So propositions of the form  $WasA \notin Goals_m^a$ . We never attempt to do something in the past. On the basis of previous considerations on the nature of attempts, I will say that a proposition  $[aTriesA]$  is *true at a moment  $m$*  according to a history when, firstly, the proposition that  $A$  represents a possible goal of agent  $a$  at moment  $m$  (i.e. that  $A \in Goals_m^a$ ) and, secondly, the proposition that  $A$  is true according to agent  $a$  at all moments  $m' \in Attempt_m^a$  according to at least one history  $h'$ .

As Searle pointed out in the third chapter, the logic of desire and intention is very different from that of belief. Agents can both intend to do something and believe that their intended action will have a certain effect without *eo ipso* desiring and intending to produce that effect. Someone who rejects an offer can believe that he or she will irritate the hearer without desiring and intending to provoke such an attitude. In that case there is a conflict between the intentions and beliefs of an

agent at a moment. Certain moments compatible with the execution of the agent's intentions at a moment are not compatible with his or her beliefs at that very moment. For the unwanted effect of the intended action does not occur at these moments according to at least one history. Agents know that some of their beliefs could be false. This can even occur when the agent believes that it is settled or even inevitable that his or her action will have a certain unwanted consequence. Bratman and Searle have given a lot of convincing examples. A prior intention to do something (that A) and a belief that it is then necessary that if A then B do not commit the agent to a prior intention to do that B. We know that we can wrongly believe that certain facts are inevitable. We would then be happier if such facts would not occur. So there is something wrong with Kant's principle: "whoever intends to achieve an end thereby will the necessary means or effects that he or she knows to be part of the achievement of that end" This principle does not work for *prior intentions*.

However because agents are rational they have to minimally coordinate their cognitive and volitive states in trying to act in the world. So a restricted form of Kant's principle "Any agent who wills the end is committed to willing the necessary means" works for attempts which are intentions in action.<sup>17</sup> Suppose that an agent trying to do something knows that in order to succeed he or she has to do intentionally something else. Then that agent is going to try to do that other thing. In other words, an attempt to do something and a knowledge that one could not do it without intentionally doing something else *commit the agent to* an attempt to do that other thing.

Such a restricted Kantian principle is valid in my logic of action. For as I said earlier, whenever a modal proposition of the form  $\Box A$  is true according to an agent  $a$  at a moment  $m$  in a circumstance the same proposition  $\Box A$  is also true according to that agent at that moment  $m$  at all coinstantaneous circumstances containing all moments  $m' \in Attempt_m^a$ , which are compatible according to that agent with the achievement of his or her attempts at moment  $m$ . Let me give two examples. Any agent knows that in order to supplicate someone at a moment he or she has to make a request. So whoever tries to make a supplication *eo ipso* tries to make a request. His or her attempted request then *constitutes* his or her attempted supplication. Every agent also knows that in order to supplicate a person one has to tell him or her what one desires. So whoever tries to supplicate someone also tries to send him or her a message. His

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<sup>17</sup>See Searle [2001] page 266.

or her attempted emission of signs (or utterance act) then *generates* his or her attempted supplication.

Let us now come to the explication of *success*. As philosophers of action pointed out, the successful performance of an intentional action requires more than the existence of an attempt and the truth of its content. In order that an agent succeed to bring about a fact, it is not enough that he or she try and that the fact occur. It is also necessary that the fact occurs *because of* his or her attempt. The agent does not succeed in doing something in the case in which someone else did it. The attempt of the agent must be the *cause* of what is done. Along these lines, one can **define simply as follows the logical form of intentional actions**. An agent *a* *succeeds to do that* A (in symbols:  $\delta_i aA$ ) when firstly, the agent *a* attempts to do that A, secondly, A is true given what he or she does and thirdly, it is not then necessary that A. Notice that  $\delta_i aA$  entails  $\delta a([aTriesA] \Leftrightarrow A)$ . This is a step towards the explication of *intentional causation*. In case someone else does what an agent *a* attempts to do, that agent *a* does not do it. For there is then a moment compatible with what that agent does at the moment of his or her attempt where it is not the case. I have given this first explication of success in [2003]. However, for a full account of intentional causation, we need, I think, the *counterfactual conditional*.<sup>18</sup> That conditional enables us to state an important additional necessary condition of success: If agent *a* had not tried to do that A then it would not be true that A given what that agent does. For that purpose, I will add the counterfactual conditional  $\Box \rightarrow$  to the lexicon of my logic of action. Formulas of the form  $A \Box \rightarrow B$  mean that if it were the case that A then it would be the case that B. So  $\delta_i aA =_{def} ([aTriesA]) \wedge (\Delta aA) \wedge (\neg \Box A) \wedge (\neg [aTriesA]) \Box \rightarrow \neg \Delta aA$  in the present logic of action.

How could we now explicate the general notion of an individual action (whether intentional or not)? I propose the following definition: an agent *a* *acts so as to bring about that* A (in symbols  $\delta aA$ ) when firstly, A is true given what he or she does, secondly, it is evitable that A, thirdly, that agent *a* could attempt or have attempted to bring about that A, and fourthly, he or she brings about that A because of a present attempt. Thanks to the counterfactual conditional one can state precisely the condition of mental causation by saying that if the agent *a* had not made such a present attempt then he or she would not have done that A. For short, in symbols:  $\delta aA =_{def} (\Delta aA) \wedge (\neg \Box A) \wedge (\diamond([aTriesA]) \vee$

<sup>18</sup>One can incorporate a logic of counterfactuals within the logic of ramified time by introducing a relation of comparative similarity between moments or histories in the sense of Lewis [1973]. See Thomason & Gupta [1980].

$Was[aTriesA] \wedge (\exists p(\delta_i ap \wedge (\neg\delta_i ap \Box \rightarrow \neg\Delta aA)))$ . In my conception of action, there is no action without a simultaneous attempt of the agent. So dead agents do not act any more. What agents do at each moment has to be the effect of their intentional actions at that very moment.

By definition, **the notions of success and failure are relative to intentional actions**. No agent can succeed or fail to do something unless he or she makes an attempt. So we do not properly succeed to perform our unintentional actions. It just happens that we perform them. As philosophers of action pointed out, some of our actions, called *basic actions*, are by nature intentional. So are attempts, voluntary body movements, meaningful utterances and illocutionary acts. In order to perform a basic action an agent must make an attempt to perform it. Basic actions are then always successful when they are performed. Of course some intentional actions are *more basic than* others. For example, utterance acts are made by way of voluntarily emitting sounds or producing marks. Attempts of performance of illocutionary acts are made by way of making meaningful utterances. Such attempts cause the successful performance of illocutionary acts when they are made in appropriate contexts. Acts of communication occur when hearers understand illocutionary acts. They can provoke intended perlocutionary effects on such hearers. And so on. Following Goldman I will say that an agent *basically does* something at a moment  $m$  when he or she performs at that moment all his or her intentional actions by way of doing that thing. In my view, **all intentional actions that an agent performs at one moment are consequences of a unique action** that he or she basically performs at that moment. **That basic action is always an irreducibly personal attempt of moving parts of his or her body**. In particular, all public speech acts of an agent at a moment are generated by one's attempt to emit tokens of signs at that moment.

### 3. The ideal object-language

The **ideal object language L** of the present logic of action contains in its lexicon:

- (1) A series of **individual constants** naming *agents*
- (3) a series of **propositional variables and constants** and
- (4) the **syncategorematic expressions**:

*Tautological*,  $>$ ,  $\wedge$ ,  $\Box$ , *Tries*,  $\Delta$ , *Will*, *Was*, *Settled*,  $\neg$ ,  $\rightarrow$ ,  $\exists$ ,  $[ , ]$ ,  $($  and  $)$ .

#### **Rules of formation of formulas of L**

Propositional variables and constants are formulas. If  $A_p$  and  $B_p$  are formulas,  $x$  and  $y$  are individual constants and  $p$  is a propositional

variable, then *Tautological*( $A_p$ ),  $(A_p > B_p)$ ,  $\neg A_p$ ,  $\Box A_p$ , *Will* $A_p$ , *Was* $A_p$ , *Settled* $A_p$ ,  $[xTriesA_p]$ ,  $\Delta xA_p$ ,  $\exists p A_p$ ,  $(A_p \wedge B_p)$  and  $(A \Box \rightarrow B)$  are new complex formulas. Closed formulas have the following meaning:

Propositional constants express and propositional variables indicate propositions. *Tautological*( $A_p$ ) expresses the proposition that  $A_p$  is tautological.  $(A_p > B_p)$  expresses the proposition that all atomic propositions of  $B_p$  are atomic propositions of  $A_p$ .  $\neg A_p$  expresses the negation of the proposition expressed by  $A_p$ .  $\Box A_p$  expresses the modal proposition that  $A_p$  is then necessary (i.e. that it could not have been otherwise than  $A_p$ ). *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 proposition that the truth of  $A_p$  is settled.  $[xTriesA_p]$  expresses the proposition that agent  $x$  attempts to do  $A_p$ .  $\Delta xA_p$  expresses the proposition that  $A_p$  is true given what agent  $x$  does.<sup>19</sup>  $(A_p \wedge B_p)$  expresses the conjunction of the two propositions that  $A_p$  and that  $B_p$ .  $\exists p A_p$  means that at least one proposition  $p$  satisfies  $A_p$ . Finally,  $(A \Box \rightarrow B)$  means that if it were the case that  $A$  then it would be the case that  $B$ .

#### Rules of abbreviation

I will sometimes eliminate the subscript  $p$ . So  $A$  is short for  $A_p$ . I will eliminate exterior parentheses and introduce truth, modal and temporal connectives and the universal and unique existential quantifiers according to usual rules of abbreviation.

So  $(A_p \Rightarrow B_p) =_{df} \neg(A_p \wedge \neg B_p)$  and similarly for *material equivalence*  $\Leftrightarrow$ ;

*Was-always* $A_p =_{df} \neg Was \neg A_p$  and *Will-always* $A_p =_{df} \neg Will \neg A_p$ ;

*Always* $A_p =_{df} Was\text{-}alwaysA_p \wedge A_p \wedge Will\text{-}alwaysA_p$ ;

*Later* $A_p =_{df} SettledWillA_p$  and *Before* $A_p =_{df} SettledWasA_p$  ;

*Historical possibility*:  $\Diamond A =_{df} \neg \Box \neg A$  ;

*Universal necessity*:  $\blacksquare A =_{df} Always \Box A$  ;

*Universal possibility*:  $\blacklozenge A =_{df} \neg \blacksquare \neg A$  ;

*Strict implication*:  $A \text{---} \in B =_{df} \Box (A \Rightarrow B)$ ;

*Strong implication*:  $A_p \mapsto B_p =_{df} (A_p > B_p) \wedge Tautological (A_p \Rightarrow B_p)$ ;

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

*Intentional action*:

$\delta_i xA_p =_{df} [xTriesA_p] \wedge (\Delta xA_p) \wedge (\neg \Box A_p) \wedge (\neg [xTriesA] \Box \rightarrow \neg \Delta xA)$

$x$  fails to do  $A_p =_{df} [xTriesA_p] \wedge ((\neg \Delta xA_p) \vee \Box A_p) \vee \neg(\neg [xTriesA] \Box \rightarrow \neg \Delta xA)$

*Action* (intentional or not):  $\delta xA_p =_{df} (\Delta xA_p) \wedge \neg \Box A_p \wedge (\Diamond([xTriesA_p]$

<sup>19</sup> $\delta$  is the logical constant of Chellas' [1992] logic of agency.

$\vee \text{Was}[x\text{Tries } A_p]) \wedge \exists p(x\text{Tries } p \wedge (\neg[x\text{Tries } p] \Box \rightarrow \neg\Delta xA))$   
 $x \text{ basically does } A_P =_{df} x\text{Tries } A_p \wedge \forall p (\delta_i x p \Leftrightarrow (\neg x \text{ Tries } A_p \Box \rightarrow \neg\delta_i x p))$

*Identity of agents*  $(x = y) =_{df} \Delta xA_p = \Delta yA_p$

In my ideal object language, propositions representing an action of an agent are of the canonical form  $\delta xA_p$ . Any proposition of the form  $\delta xA_p$  is *agentive for the agent*  $a$ <sup>20</sup> in the sense that it represents an action of that agent, no matter whether  $A_p$  is itself agentive for  $x$  or not. So the sentence “Oedipus killed Laius” represents an action of Oedipus. For it can be paraphrased as “Oedipus acted so as to bring about that Laius is dead”. What agent  $x$  does is represented by  $A_p$  in  $\delta xA_p$ . From an ontological point of view, the content of an action can be a state of affairs, an event or even an action.

#### 4. Basic laws of the logic of action

Fundamental laws governing elementary propositions, truth functions, universal modalities, tautologies and propositional identity have been stated in chapter 10. Laws governing historic modalities and ramified time are stated in my work *Attempt and Action Generation Towards the Foundation of the Logic of Action* (2003). Here are basic proper laws of my logic of action.<sup>21</sup>

As usual,  $\vDash A$  means that  $A$  is logically true or valid in my logic.

First, there is a **normal logic for the Chellas connective  $\Delta$**

- (C1)  $\vDash (\Delta xA_p \Rightarrow A_p)$
- (C2)  $\vDash (\Delta x(A_p \wedge B_p) \Rightarrow (\Delta xA_p \wedge \Delta xB_p))$
- (C3)  $\vDash ((\Delta xA_p \wedge \Delta xB_p) \Rightarrow \Delta x(A_p \wedge B_p))$
- (C4)  $\vDash (\Box A_p \Rightarrow \Delta aA_p)$
- (C5)  $\vDash (\Delta xA_p \Rightarrow \Delta x\Delta xA_p)$
- (C6)  $\vDash (\neg\Delta x\neg A_p \Rightarrow \Delta x\neg\Delta x\neg A_p)$ <sup>22</sup>.
- (C7)  $\vDash (\Delta xA_p \Rightarrow \textit{Settled}\Delta xA_p)$

**The basic laws for attempts are the following**

- (A1) Any attempt of an agent contains an attempt to perform an individual action.  $\vDash ([x \text{ Tries } A_p] \Rightarrow \exists p[x\text{Tries}\Delta x p])$
- (A2) Any attempt is an intentional action of the agent.  
 $\vDash \textit{Tautological} ([x \text{ Tries } A_p] \Rightarrow \delta_i x[x\text{Tries } A_p])$  So  $\vDash ([x \text{ Tries } A_p] \Rightarrow \Delta x[x\text{Tries } A_p])$ ,

<sup>20</sup>The terminology is due to Belnap & Perloff [1990].

<sup>21</sup>For the model-theoretical semantics and a full axiomatization of my logic of action see *Attempt and Action Generation Towards the Foundations of the Logic of Action* in *Cahiers d'Épistémologie* Université du Québec à Montréal n°293, 2003.

<sup>22</sup>Axiom schema (C6) is not valid in Chellas logic for  $\Delta$

- $\models ([xTriesA_p] \Leftrightarrow [xTries[xTriesA_p]])$  and  $\models [x Tries A_p] \Rightarrow \neg \Box A_p$   
(A3) Each attempt is personal.  $\models [xTries\delta y[yTriesA_p]] \Rightarrow x = y$   
Agents are minimally rational.  
(A4) They do not attempt to do something tautological or contradictory.  
 $\models (Tautological A_p \vee Tautological \neg A_p) \Rightarrow \neg \Diamond [xTriesA_p]$   
(A5) They do not attempt to change the past.  $\models \neg \Diamond [xTriesWasA_p]$   
(A6) Whenever they attempt to do one thing and they attempt to do another thing they attempt to do both.  $\models ([xTriesA_p] \wedge [xTriesB_p]) \Rightarrow [xTries(A_p \wedge B_p)]$   
(A7) The converse is true when propositional content conditions are preserved.<sup>23</sup>  
 $\models ([xTries(A_p \wedge B_p)] \Rightarrow (([xTriesA_p] \wedge \Diamond [xTriesB_p]) \Rightarrow [xTriesB_p]))$   
(A8) Any attempt is generated by the basic action of the agent.  
 $\models [xTriesA_p] \Rightarrow \exists p (x \text{ basically does } p)$

One can derive the following laws in my logic of attempts. Firstly, agents really *make attempts*. So the making of an attempt is always settled at each moment. Secondly, *attempts can fail*. In order to achieve a purpose an agent must make the right attempt in the right circumstance. Suppose you want to threaten someone at a moment. You must speak to the right person and utter appropriate words. Otherwise your utterance is a wrong attempt. Moreover the context must be appropriate. If it is mutually known that you are unable to do what you say, your attempt is made in a wrong circumstance. So  $\not\models [aTries\delta aA] \Rightarrow \delta aA$ . Failure can happen even when the agent believes the contrary. An agent might have wrong beliefs about objects at which his or her action is directed. Furthermore, when an attempt is directed towards the future, the agent can succeed according to a possible continuation of the moment of the attempt and fail according to another.  $\not\models [aTriesWillA] \Rightarrow SettledWillA$ . All depends on what will happen later.

Agents can believe in the truth of impossible propositions for example that whales are fishes. So their objectives are sometimes impossible. In the past fishermen were trying to catch a big fish while trying to fish a whale. However they remain minimally rational. What they try to do is not contradictory. The truth of propositions representing their objective is compatible with some of their valuations at the moment of their attempt.

Notice finally that **the set of our purposes is not partially closed under strict but under strong implication**. In philosophical logic, a

<sup>23</sup>Any proposition is identical with a conjunction of that proposition with a tautology. Thus  $\models A_p = A_p \wedge (A_p \vee \neg A_p)$ . However an attempt to make it true could not contain an attempt to make true a tautology.

proposition *strictly implies* another proposition when it cannot be true unless that other proposition is also true. Agents ignore actual truth conditions of most propositions. So they also ignore how propositions are related by strict implication. For that reason, they can attempt to make true a proposition without *eo ipso* attempting to make true another proposition that the first strictly implies. Moreover attempts like intentions have strong propositional content conditions. Each proposition strongly implies many others which could not be the content of an attempt. So  $\not\models \Box(A \Rightarrow B) \Rightarrow ([aTries\delta aA] \Rightarrow [aTries\delta aB])$ . However, as I said earlier, because agents are minimally rational, whoever attempts to achieve an end attempts to use means that he or she knows to be necessary. In short, if we introduce in the logic of action the epistemic connective K of knowledge ( $[KaA]$  means that *a knows A*) we could assert the following law in my logic of action:  $\models [Ka\Box(\Delta aA \Rightarrow \Delta aB)] \Rightarrow ([aTries\Delta aA] \Rightarrow [aTries\Delta aB])$ .

Given my analysis of propositions, one can explain which propositions agents *a priori* know to be necessarily true and necessarily false. Any agent who has in mind a tautology or a contradiction *a priori* knows that the first represents an inevitable fact and the second an impossible fact. So agents *a priori* know that certain facts could not exist without others. As I have explained in Chapter 10, **there is a much finer logical propositional implication than strict implication called *strong implication* that agents *a priori* know by virtue of competence.** By definition, a proposition *strongly implies* another when firstly, it has all its atomic propositions and secondly, all possible denotation assignments to propositional constituents which are compatible with its truth in a circumstance are also compatible with the truth of that other proposition in that circumstance. In symbols:  $A_p \mapsto B_p =_{df} (A_p > B_p) \wedge Tautological(A_p \Rightarrow B_p)$ . **Strong implication is important for the purpose of the logic of knowledge and action.** Whenever a proposition strongly implies another proposition, an agent cannot have it in mind without having the other in mind and knowing that the first implies the second. For in case the proposition A strongly implies that B, it is identical with the conjunction  $(A \wedge B)$ . So according to any agent the fact represented by A contains the fact represented by B: the first could not exist without the second. Consequently any attempt by an agent to bring about the first fact A is also an attempt to bring about the second B in any circumstance where B is also a possible goal of the agent.

So  $\models (A_p \mapsto B_p) \Rightarrow (([xTriesA_p] \Rightarrow (\Diamond [xTriesB_p] \Rightarrow [xTriesB_p])))$  For  $\models (A_p \mapsto B_p) \Rightarrow (([Kx\Box(A_p \Rightarrow B_p)])$ .

## 5. Other important valid laws

First of all, there is a normal logic of action. As one can expect, some basic laws governing  $\Delta$  are also valid for the action connective  $\delta$ . In particular:

(D1) By acting agents bring about facts in the world.  $\models (\delta x A_p \Rightarrow A_p)$

(D2) To do something and to do something else is to do both.

$\models ((\delta x A_p \wedge \delta x B_p) \Rightarrow \delta x (A_p \wedge B_p))$

(D3) Actions are also facts that agents bring about in the world.

$\models (\delta x A_p \Rightarrow \delta x \delta x A_p)$

(D4) Any action that is done at a moment changes the world at that very moment.

$\models (\delta x A_p \Rightarrow \textit{Settled} \delta x A_p)$  Consequently,  $\models \delta x A_p \Rightarrow \textit{Settled} A_p$ .

So our individual **actions really change the world**. Whenever we do something at a moment, it is settled that it is done.  $\models \delta x A_p \Rightarrow \delta x \textit{Settled} A_p$ . We can even bring about now how things will be in the future. In that case, we act in such a way that they will be so later no matter how the world continues. By making a move in a chess game a player sometimes puts his or her adversary in an inevitable losing position. In that case it is settled that if the game is pursued the adversary will lose. So  $\models \delta x \textit{Will} A_p \Rightarrow \textit{Later} A_p$  where  $\textit{Later} A_p =_{df} \textit{Settled} \textit{Will} A_p$ . Otherwise, the fact that  $A_p$  will be the case is not the result of a present action. It depends on something else. As one can expect, an agent cannot change the past of the world.  $\models \neg \delta x \textit{Was} A_p$ . Secondly, **agents are free**.  $\models (\delta x A_p \Rightarrow \Diamond \neg \delta x A_p)$  and  $\models \neg \Box \delta x A_p$  We are not determined to do what we do.

Thirdly, **any action can be attempted** in at least one circumstance.  $\models (\delta x A_p \Rightarrow \Diamond ([x \textit{Tries} A_p] \vee \textit{Was} [x \textit{Tries} A_p]))$ . So  $\models \neg \Diamond ([x \textit{Tries} A_p]) \Rightarrow \neg \Diamond ([\delta x A_p])$ . Consequently, **our mistakes and failures are not really actions that we perform but rather events which happen to us**. For we cannot really attempt to make a mistake or fail.<sup>24</sup> Paradoxical sentences of the form “I am trying not to try anything”, “I am doing nothing”, “I am trying to fail” and “This very action is a failure” are logically false.  $\models \neg [x \textit{Tries} \forall p \neg [x \textit{Tries} p]]$ .  $\models \neg \delta x \forall p \neg \delta x p$ .  $\models \neg \exists p [x \textit{Tries} (p \wedge \neg [x \textit{Tries} p])]$  and  $\models \neg \exists p \delta x (p \wedge (\neg \delta x p))$ .

Fourthly, **any action is generated by a simultaneous intentional action**.  $\models (\delta x A_p \Rightarrow (\exists p [a \textit{Tries} p] \wedge \Delta a (a \textit{Tries} p \Rightarrow A_p)))$  Consequently, in order to act an agent must exist and be conscious at the

<sup>24</sup>According to Goldman [1970], there seems to be act properties like misspeaking, miscalculating, miscounting that preclude intentionality. In my view, such properties are not really act properties. We “suffer” mistakes and failures. We do not make them.

moment of his or her action. No agent can act after death. However past actions of a dead agent can still have effects now. Beautiful works of art of the past continue to provoke admiration.

There is a *law of foundation for intentional action*. An agent can only make a finite number of intentional actions at a moment. For he or she can only refer to a finite number of things and have in mind a finite number of attributes. In my logic, **an agent performs all his or her intentional actions at each moment by way of performing a unique basic intentional action**.  $\models \delta_i x A_p \Rightarrow \exists ! p \ x \text{ basically does } p$ . Two agents can perform individual actions of the same type at the same moment. But their individual intentional actions are always different. They contain different personal attempts. The very basic action of an agent at a moment is an individual attempt of moving parts of one's own body. If he or she had not made that attempt he or she would not have done anything.

By acting so as to bring about that A an agent does not act so as to bring about any effect B of A.  $\not\models \Box(A \Rightarrow B) \Rightarrow (\delta x A \Rightarrow \delta x B)$  for various reasons. First, as I have said repeatedly, an agent can only do things that he or she could attempt to do. Moreover, as medieval philosophers already pointed out, **no agent can do something which is inevitable**. By way of moving his or her body any agent inevitably moves invisible subatomic particles in the air. However, that event is not in and of itself an action. For he or she could not have done otherwise.  $\models \neg \Diamond \delta x \Box A$ . So agents cannot do necessary or impossible things.  $\models (\Box A \vee \Box \neg A) \Rightarrow \neg \delta x A$ . They only can attempt without success to do such things when they believe them to be possible. So  $\not\models (\Box A \vee \Box \neg A) \Rightarrow \neg [x \text{ Tries } A]$ .

#### *Laws of action generation*

By carrying out some actions in certain situations agents carry out other actions. My logic of action explains why certain action tokens *generate* others (causally, conventionally, simply and by extension) in the sense of Goldman [1970]. In order that an action by an agent at a moment generate another action of that agent at that moment, we have to require that the agent would not have made the second action if it were not the case that he had made the first. So I propose to explicate *generation* as follows:

$$(\delta x A \text{ generates } \delta x B) =_{def} \delta x A \wedge \exists p \delta x ((A \wedge p) \Rightarrow B) \wedge (\Delta x p) \wedge (\neg \Box p) \wedge (\neg \blacksquare (A \Rightarrow p)) \wedge (\neg \Box B) \wedge (\Diamond [x \text{ Tries } B] \vee Was[x \text{ Tries } B]) \wedge (\neg \delta x A \Box \rightarrow \neg \Delta x B)$$

*Physical causal generation*: Sometimes by doing something an agent also does something else for what he or she brings about physically causes that effect. For example, by flipping the switch an agent can turn on

the light. By making a fire he or she can get burned. In such cases, the first action *causally generates* the second. We can explain such instances of physical causal generation. The agent  $x$  acts then at a moment in a situation  $C$  (that philosophers of action call a *circumstance*) where the premise  $\Delta xC$  is true. For example, the electricity is on when the agent flips the switch. In making the fire he or she touches something very hot. These are circumstances  $C$ . In case what the agent brings about  $A$  is a cause of  $B$ , the other premises:  $\Box((A \wedge C) \Rightarrow B)$ ,  $\delta xA$ ,  $\neg\Box B$  and  $(\neg\delta xA \Box \rightarrow \neg\delta xB)$  are also true. The first represents *a law of nature*. So when agent  $x$  could attempt  $B$ , (in symbols:  $\Diamond x \text{ Tries}B$ ), one can conclude that agent  $x$  also does  $B$ .

*Conventional generation:* Sometimes by doing something at a moment in a certain situation an agent does something else at that moment because there is a convention according to which the first action in that situation counts as constituting the second. For example, by checkmating his opponent a player wins the game of chess. In such cases, the first action *conventionally generates* the second. In the case of conventional generation, what the agent  $x$  does ( $A$ ) *counts as* doing something else  $B$  in the situation  $C$  where he or she acts because of a *collective acceptance of a previous declaration*. We need illocutionary logic (that contains a logic of declarations and acceptances) in order to fully explicate conventional generation.

*Simple generation:* Sometimes by doing something at a moment in a certain situation an agent also does something else because any performance of the first action in such a situation would be the performance of the second action. For example, by expressing a mental state that he or she does not have, an agent *lies*. By asserting a proposition that is future with respect to the moment of utterance a speaker makes a prediction. In such cases, the first action *simply generates* the second in Goldman's terminology. In case an action token  $\delta xA$  simply generates another  $\delta xB$ , this is due to the law:  $\models(\Delta xC \wedge (\neg\Box C) \wedge (\blacksquare((A \wedge C) \Rightarrow B)) \wedge (\neg\Box B) \wedge ((\Diamond x \text{ Tries}B) \vee \text{Was}[x\text{Tries}B]) \wedge (\neg\delta xA \Box \rightarrow \neg\Delta x B)) \Rightarrow (\delta xA \Rightarrow \delta xB)$

In my view indirect performances of speech acts are simply generated by the performance of literal speech acts in certain contexts of utterance where additional non literal success conditions are obviously fulfilled in the conversational background.<sup>25</sup>

*Generation by augmentation:* A special case of simple generation occurs when the generated action *strongly commits the agent to* the gen-

<sup>25</sup>See Vanderveken [1997].

erating action. For example, by putting a part of one's own body on something one touches that thing. By begging very humbly from someone in power one makes a supplication. In such cases, the generating action is augmented by a certain way or means or fact which is part of the circumstance C in which the agent acts. And any token of the generated action is also a token of the generating action. So in the case of generation by augmentation the following law holds:  $\models (\Delta xC \wedge (\neg \Box C) \wedge (\blacksquare((A \wedge C) \Leftrightarrow B)) \wedge (\neg \Box B) \wedge ((\Diamond[xTriesB]) \vee Was[xTriesB]) \wedge (\neg \delta x A \Box \rightarrow \neg \Delta x B)) \Rightarrow (\delta x A \Leftrightarrow \delta x B)$  All performances of elementary illocutionary acts whose force F is stronger than a primitive force F\* are generated by augmentation from the very performance of an illocutionary act with that primitive force F\* and the same propositional content. In such cases of generation by augmentation, the generated illocutionary act of the form F(P) *strongly commits the speaker to* the generating illocutionary act F\*(P). Any successful performance of the first act is also a successful performance of the second.<sup>26</sup>

**Few intentional action are generated by our basic actions.** By succeeding to do something an agent also succeeds in doing something else only if he or she attempts to do it, that thing is evitable, he or she knows that the first action generates the second action. Intentional generation requires much. So the number of intentional actions is finite and very limited. **However our basic actions generate many more (an indefinite open number of) unintentional actions.** Many of them are unexpected. We are not aware of most contingent effects which follow from what we do. Whenever we do something to a woman we do it to the mother of her children whenever she has children no matter whether we know that or not. By way of marrying Jocaste, the queen of Thebes, Oedipus also married unintentionally his mother. So by doing something intentionally we can also do other things unintentionally that we might not at all want to do.

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<sup>26</sup>See Vanderveken [1990-91] for the notions of a stronger force and of strong illocutionary commitment.

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