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ATTEMPT, SUCCESS AND ACTION GENERATION[1]

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Abstract: *Contemporary philosophers have overall 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 action where intentional actions are primary a s 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 ac tion contains a theory of attempts. 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. In classical philosophical logic, propositions with the same truth-conditions are identified. However it is clear that strictly equivalent propositions are not the contents of the same attitudes of human agents. For that reason I will first present a non-classical propositional logic capable of distinguishing the contents of intentional actions which are different. Next I will enrich earlier logics of action so as to characterize adequately intentional actions, attempts and purposes of agents and the different kinds of generation of action. I will state the basic laws of agentive commitment and action generation.*

Key-words: *Logic of Action; Philosophical Logic; Intentional Action; Time; Modality.*

I will only consider here *individual actions* that a single agent performs at one moment. Examples of such actions are intended body movements like raising the arm, some effects of these movements like touching something 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 collective actions like shaking hands performed jointly by several agents and of higher level actions like deliberating which last during several moments of time.

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 that A is a proposition representing 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: Do we always intend to perform the actions that we carry out? If not, 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 strongly commit the agent to performing other types of action. Any instance of an action of the first type contains an action of the second type. Thus it is not possible to shout without producing sounds. Moreover certain action tokens generate others in certain circumstances. A speaker who makes a promise that he or she does not intend to keep lies. 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? 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? What are the laws of identity for types and tokens of action? Which predications do we make in asserting propositions representing actions? What is the nature of their attributes? 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[2], philosophers are mainly concerned with intentional actions. *Intentional actions* are actions that agents *attempt* to perform in the world. However, our intentional actions have unintended effects in the world. Thus in walking intentionally in a certain direction an agent might unintentionally step on someone's foot. **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 the resources of a non-classical propositional logic. The predicative propositional logic that I advocate takes into consideration the acts of predication that we make in expressing propositions in order to explicate their nature. It analyzes both their structure of constituents and the way in which we understand their truth-conditions. My aim is to distinguish strictly equivalent propositions which do not have the same cognitive values.

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[2] See Goldman (1970), Davidson (1980), Searle (1983) and Bratman (1987).

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 it is preferable to work out a logic of action that is compatible with indeterminism. According to indeterminism, several incompatible moments of time might follow the same moment in the future of the world. In branching time any moment of time can 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's (1991-2) 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 PROPOSITIONS AND TRUTH

In classical philosophical logic (whether modal[3], temporal[4], intensional[5], agentive[6] or epistemic), propositions are usually reduced following Carnap (1956) to their truth-conditions. So strictly equivalent propositions (which are true in the same possible circumstances[7]) are identified. However it is clear that strictly equivalent propositions are not substitutable *salva veritate* within the scope of verbs of action and attitudes. Whenever we act so as to put a book on the table, we do not *eo*

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[3] See R. Barcan Marcus (1993) and S. Kripke (1963) .

[4] See Prior (1967), Thomason (1984), Belnap (1992).

[5] See R. Montague (1974).

[6] See the special issue 51 on action of *Studia Logica* in 1992.

[7] In the logic of branching time, possible circumstances are pairs of moments of time and histories.

ipso act so as to bring about that the book is on the table and identical with itself. In order to act intentionally an agent must have in mind the success conditions of his action. That 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. We never intend to perform actions of bringing about a fact that we know to be unpreventable. So we could not act so as to bring about that something be identical with itself. 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 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 he did not know then that Jocasta was his mother. So he did not intentionally marry 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.

As I have pointed out repeatedly (Vanderveken (1990-91), (1995), (1997), (2001)), we make acts of reference and of predication in expressing propositions. So all kinds of 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[8]. An atomic proposition is true in a circumstance when the objects which fall under its concepts have the attribute that it predicates of them in that very circumstance. 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 something is on the table is different from the proposition that it is on the table and identical with itself.

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 truth-conditions of their atomic propositions and incompatible with all 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. We can refer to an object under a concept without knowing which object falls under that concept. We often do not know which objects possess the properties that we predicate. From a cognitive point of view, atomic propositions have many *possible truth-conditions*: they could be true in all circumstances, they could be true in one circumstance and false in all others, they could be true in two circumstances and false in all others, and so on. From a logical point of view, **each possible truth-condition of an atomic proposition determine (and can be identified with) a unique particular set of possible circumstances** where that proposition could be true. So if n is the number of circumstances taken into consideration in an interpretation, there are 2^n different possible

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[8]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).

truth-conditions to consider in that interpretation. Most atomic propositions have a lot of possible truth-conditions. We can consider them to be true in a lot of sets of possible circumstances. Few are *tautological* or *contradictory*. *Tautological* atomic propositions attribute to an object of reference an property that we *a priori* know that it possesses e.g. that Paul's mother is a woman. 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.

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 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. In understanding an elementary proposition, we in general only know that its truth in a circumstance is compatible with all and only the possible truth-conditions of its atomic proposition which contains that very circumstance.

We know *a priori* the truth (or falsehood) of few propositions. For few elementary propositions contain a tautological or contradictory atomic proposition. 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. Consider the past proposition that the actual pope was

sick. In order that it be true in a given circumstance, it is sufficient that the actual pope be sick 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 which predicates of the pope the property of being sick (namely all those which contains at least one circumstance anterior to c).

In the theory of truth according to predication, *possible valuations* of atomic propositions are functions which assign to atomic propositions possible truth-conditions (or sets of possible circumstances) that they all could have together.[9] Among all possible valuations, there is of course one, called the *actual evaluation*, which assigns to each atomic proposition its actual truth-conditions. Most complex propositions contain several atomic propositions. So their truth in each circumstance is compatible with certain valuations of their atomic propositions and incompatible with all others.[10] As Wittgenstein pointed out in the *Tractatus*, they are two limit cases of propositions: tautologies that we know *a priori* to be necessarily true and contradictions that we know *a priori* 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 truth-conditions of their atomic propositions. And *contradictions* are propositions whose truth in any circumstance is not compatible with any possible truth-condition of their atomic propositions.** In other words, tautologies are

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[9] Possible valuations have to satisfy the meaning postulates of logical constants expressing concepts or attributes. Any valuation according to which the atomic proposition that Jocasta is Oedipus' mother is true in a circumstance must assign to the atomic proposition that Jocasta is a mother the truth in that circumstance.

[10] Possible truth-conditions of other atomic propositions do not matter. The truth of a proposition P is compatible with all possible truth-conditions of atomic propositions which are not in that proposition P.

true according to all valuations of atomic propositions and contra-
dictions according to none.

When the truth of two propositions is compatible with different
possible   truth-conditions   of   their   atomic   propositions,   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. This is why
we need in philosophical logic a finer explication of truth-conditions
than that of Carnap. In particular, **we have to distinguish in
philosophical logic 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 that whales are fishes and the contradictory
proposition that whales are and are not fishes. They are both composed
from the same atomic proposition which predicate of whales the
property of being fishes. And they are also strictly equivalent: they are
both false in all possible circumstances. For whales have the essential
property of being mammals. However it is clear that these two
propositions have different cognitive values. We all know *a priori* that the
contradictory proposition is false but we might believe that the
elementary proposition is true. That elementary proposition is not
contradictory. It was a historic discovery that whales are mammals.
Unlike traditional logic, my logic explains easily such a cognitive dif-
ference in terms of predication. The truth of these propositions is not
compatible with the same possible truth-conditions of their single atomic
proposition.[11] On my approach, propositions have then two distinct (but

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[11] On the one hand, the truth of the contradiction is not compatible with
any possible truth-condition of its atomic proposition. We know that *a priori*
by virtue of competence. So we cannot believe it. On the other hand, a lot of
possible truth-conditions of the same atomic proposition are compatible with
the truth of the elementary proposition that whales are fishes in any
circumstance. So we can believe that whales are fishes. And we can try to do

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 valuations assigning possible truth-conditions to their atomic propositions.

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 compatible with the actual truth-conditions of all its atomic propositions.** As I have shown, we can derive from that concise definition all the classical laws of the theory of truth.

A speaker *a* often rightly or wrongly believes at a moment *m* that certain atomic propositions could only be true in such and such sets of possible circumstances. So a particular set $Val(a,m)$ of possible valuations of atomic propositions is compatible with what that speaker *a* believes at that moment *m*. Such a speaker can then *believe* that certain propositions containing these atomic propositions are true in some circumstances. We can define exactly the notion of truth according to a speaker in our theory: 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 valuations $Val(a,m)$ assigned by that agent at that moment to its atomic propositions. 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. These are basic principles of my epistemic logic.

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impossible things on the basis of that false belief.

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 propositions have more atomic propositions than all their arguments. 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 agentive property of being a candidate for an election.

2.2. As regards truth-conditions

The truth-conditions 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, there is a single causal route to the past: each moment *m* is preceded by at most one past moment *m'*. Moreover all moments are historically connected: any two distinct moments have a common historical ancestor in their past. On the other hand, there are multiple future routes: several incompatible moments might follow upon a given moment. Consequently, the set of moments of time has the formal structure of a *tree-like frame* which can be represented as follows:

$\Diamond$A) is true at a moment m according a history h when the proposition that A is true at a moment m' coinstantaneous with m according to a history h'. $\Diamond$A means that it could have been the case that A.

Some moments of time are related by virtue of the actions of the agents at these moments. To each agent a and moment m there corresponds the set $Action_m^a$ of alternative moments m' which 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. 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. As Belnap and Perloff ((1990), (1992)) pointed out, the relation of compatibility with actions has to satisfy the *historical relevance condition*. 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. 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.

Thanks to the new compatibility relation, the logic of action can analyze the proposition that *A is true given what agent a does* (in symbols ΔaA): it is true at a moment m according to a history h[15] when the

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[15] 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.

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. In my view, the truth of the proposition ΔaA is then settled at each moment.[16] Chellas (1992) tends to identify the very notion of action with the normal modal operation corresponding to Δ. However any proposition of the form ΔaA 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, as Belnap pointed out, in order that the proposition that an agent a do that A, we have to require furthermore that it is not then necessary that A.

In their logic of agency Belnap and Perloff speak of prior possible choices of agents and refer to von Neumann (1944)'s theory of games. In their view, agents make 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) basically deal with actions that are guaranteed by a past choice of the agent. However most often we succeed to do things that we had no prior intention to do. We spontaneously attempt to do them. I want to study actions which are guaranteed by a present choice of the agent at the moment of the action. So I will consider *attempts* instead of prior choices in my logic of action.

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.

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[16] My conception of action at a moment is then incompatible with that of the deliberative *sees to it* of von Kutchera (1986), Horty (1989) and Belnap, Perloff and Ming Xu (2001).

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. So whenever an agent sees to it that A he or she also sees to it that *WasA* in case that past proposition is contingently true. This is not an action; it is a pure event.

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*.** For that reason, I have introduced a new logical constant of attempt *Tries* in the ideal object language of the logic of action. Formulas of the form *aTriesA* express the proposition that *agent a attempts to bring about that* A. 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. For example, 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. 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 **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. 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 move something could fail. (The thing is too heavy.) But he or she has at least mentally tried to make it. He or she has had in mind the corresponding *intention in action*. We often have an *experience of the attempt* when that attempt fails. [17] Such an experience gives us a presentation or representation of the success conditions of the attempted action. [18]

From a philosophical point of view, both intentions and attempts have the same world-to-mind direction of fit. 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*.[19] An agent can have various types of purposes. His or her purpose can be to do something at the very moment of the attempt. In that case he or she either succeeds or fails at that moment. This is settled at the very moment of the attempt no matter what happens later. However **often the achievement of an attempt depends on both the moment of the attempt and the historic continuation of that moment.** This happens when the agent has a future or collective objective. We often do something at a moment in order to bring about future things. We stand up with the intention of leaving the room. We often also act in order to do our part in a collective action that we want to carry out with others. We can make an offer with the intention of selling something to the hearer. In such cases, it is not settled at the moment of the attempt whether we will or not reach our objectives. We can succeed according

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[17] The notions of direction of fit, intention in action and experience of an action are explained in Searle (1983).

[18] Attempts of moving the body contain a *presentation* and attempts of making a act of conceptual thought a *representation* of their success conditions.

[19] The notions of success and failure here are relative to the achievement (and not the making) of attempts.

to one possible historic continuation of the world and fail according to another.

Given the fact that attempts have conditions of achievement, moments of time and histories are also logically related by virtue of the attempts of agents at these moments. Let us say that a moment m' is *compatible with the achievement of all attempts* that an agent a makes at a moment m whenever all these attempts are achieved at that moment m' or at a later moment according to at least one history h'. Attempts have the characteristic mind-to-world direction of fit. No attempt can be achieved according to a history unless that attempt is or has been made in that history. So each agent a makes all attempts that he or she makes at moment m at all moments m' which are compatible with the achievement of these attempts. Such moments m' are then coinstantaneous with the moment m.

Most of the time we try to do possible things. In that case, there are a lot coinstantaneous moments which are compatible with the achievement of our attempts. It happens that we try to do impossible things. In that last case there do not exist any such moment. For moments represent possible states of the world. So no impossible proposition can be true at any moment according to any history. However whenever we try to achieve a purpose we at least believe that we could achieve it. This is part of the sincerity conditions of any attempt and intention in the philosophy of mind. We sometimes have desires that we believe unsatisfiable, for example to be at Paris and Rome at the same moment. But we never could have similar intentions or make similar attempts.[20] So to each agent a and moment m there always corresponds a **non-empty set** $Attempt^a_m$ of 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 attempts to bring about that A at a moment m. In that case,

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[20] See Searle "Desire, Deliberation and Action" (2003).

the proposition that $\Diamond A$ is true according to that agent at that very moment. So the set $Attempt_m^a$ is not empty.

The relation of compatibility with the achievement of attempts that I have just defined is transitive. If $m' \in Attempt_m^a$ and $m'' \in Attempt_{m'}^a$ then $m'' \in Attempt_m^a$. For each attempt is intentional. Attempts are always attempted. Moreover, attempts are actions. So whenever $m' \in Action_m^a$, $m' \in Attempt_m^a$ and $Attempt_{m'}^a = Attempt_m^a$. An agent makes the same attempts at all moments which are compatible with what he or she does at a moment.

Because **attempts** are intentions in action, they **have strong propositional content conditions.** The set $Goals_m^a$ of propositions representing *possible goals* of an agent at a moment is a rather special set of propositions. Individual actions (personal body movements) are constitutive of all other kinds of action. So agents always attempt *to do something in the world at the moment of an attempt.* Consequently propositions of the form ΔaA representing actions of the agent a belong to the set $Goals_m^a$ when that set is not empty. As I said earlier, attempts are *personal.* No agent can attempt that someone else do something. So $\Delta bA \notin Goals_m^a$ when $b \neq a$. Moreover agents minimally rational. They never attempt to bring about something that they know *a priori* to be necessary or impossible. So $\Delta aA \notin Goals_m^a$ when the proposition that A is a tautology or contradiction. Finally attempts are directed at a present or future purpose. We never attempt to do something in the past. So propositions of the form $WasA \notin Goals_m^a$. On the basis of these considerations, 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 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 in

bringing about A, it is not enough that he or she try and that A be true. It is also necessary that A be true *because of* his or her attempt. The agent does not succeed to do that A in case someone else did it. The attempt of the agent must be the *cause* of what is done. Along these lines, I **propose to define as follows the logical form of intentional actions.** An agent *a succeeds to do that* A (in symbols: $\delta_i aA$) when firstly, that 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. So $\delta_i aA =_{\text{def}} ([aTriesA]) \wedge (\Delta aA) \wedge (\neg\Box A)$ in my logic of action. 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.[21]

All this leads to the following explication of the general notion of an individual action (whether intentional or not): an agent *a acts so as to bring about that* A (in symbols δaA) 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. For short, $\delta aA =_{\text{def}} (\Delta aA) \wedge (\neg\Box A) \wedge (\Diamond([aTriesA] \vee Was[aTriesA]) \wedge (\exists p[(aTries\ p \wedge (\Delta a(aTries\ p \Rightarrow A)))$.[22] In my conception of action, in order that that an

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[21] For a full account of intentional causation, we need, I think, the *counterfactual conditional* of sentences of the form If it were the case that A then it would be the case that B (in symbols: A $\Box\!\rightarrow$ B). Thanks to the counterfactual conditional one can state the additional clause in the explication 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. In symbols: $(\neg[aTriesA] \Box\!\rightarrow \neg\Delta aA)$. One can incorporate a logic of counterfactuals within the present logic of action by introducing a relation of comparative similarity between moments or histories in the sense of Lewis (1973).

[22] Thanks to the counterfactual conditional one can state more precisely that last condition: $\exists p(\delta_i ap \wedge (\neg\delta_i ap \Box\!\rightarrow \neg\Delta aA))$.

agent do something at a moment he or she must make an intentional action at that moment. There is no action without a simultaneous attempt of the agent. So dead agents do not act any more. What we do at each moment has to be the effect of our 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 without making an attempt. So it is wrong to say that unintentional actions are successful. 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. I will say that an agent *basically does* that A at a moment m when he or she performs at that moment all his or her intentional actions by way of doing that A. 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 his or her body. In particular, all public speech acts of an agent at a moment are generated by his or her 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 =, >, ∧, □, *Tries*, Δ, *Will*, *Was*, *Settled*, ¬ , ∃, [,], (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 $x = y$, *Tautological*(A_p) , $(A_p > B_p)$, $\neg A_p$, $\square A_p$, *Will*A_p , *Was*A_p , *Settled*A_p, $[x\textit{Tries}A_p]$, $\Delta x A_p$, $(A_p \wedge B_p)$ and $\exists p\ A_p$ are new complex formulas. Closed formulas have the following meaning:

Propositional constants express propositions. $(x = y)$ expresses the proposition that the agents named by x and y are identical. *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 . $\square A_p$ 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. $[x\textit{Tries}A_p]$ expresses the proposition that agent x attempts to do A_p. $\Delta x A_p$ expresses the proposition that A_p is true given what agent x does.[23] $(A_p \wedge B_p)$ expresses the conjunction of the two propositions expressed by A_p and B_p . $\exists p\ A_p$ means that at least one proposition satisfies A_p.

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[23] Δ is the logical constant of Chellas' (1992) logic of agency.

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

Later $A_p =_{df} SettledWill A_p$ and *Before* $A_p =_{df} SettledWas A_p$;

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

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

Strict implication: $A \multimap\!\!\in B =_{df} \Box (A \Rightarrow B)$;

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

Same structure of constituents: $A_p <> B_p =_{df} (A_p > B_p) \wedge (B_p > A_p)$;

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

Intentional action: $\delta_i a A_p =_{df} [x Tries A_p] \wedge (\Delta x A_p) \wedge (\neg \Box A_p)$

Failure: x *fails to do* $A_P =_{df} [x Tries A_p] \wedge ((\neg \Delta x A_p) \vee \Box A_p)$

Action (intentional or not): $\delta x A_p =_{df}$

$(\Delta x A_p) \wedge \neg \Box A_p \wedge (\Diamond([x Tries A_p] \vee Was[x Tries A_p]) \wedge \exists p(x Tries p \wedge \Delta x(x Tries p \Rightarrow A_p))$

Refraining: x *Refrains from doing* $A_P =_{df} \delta_i x \neg \delta x A_P$

The basic action of an agent:

x *basically does* $A_P =_{df} x Tries A_P \wedge$ "p $(\delta_i x p \Leftrightarrow (\Delta x (x Tries A_P \Rightarrow p))$

In my ideal object language, propositions representing an action of an agent are of the canonical form $\delta x A_p$. Any proposition of the form $\delta x A_p$ is *agentive for the agent* a [24] 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 Laïus" represents an action of Oedipus. For it can be paraphrased as " Oedipus acted so as to bring about that Laïus is dead". What agent x does is represented by A_p in $\delta x A_p$. From an

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[24] The terminology is due to Belnap & Perloff (1990).

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 [25]

Here are basic proper laws of my logic of action. $\models A$ means that A is logically true or valid in my logic.

First, there is a **normal logic for the Chellas connective** Δ

(C1) $\models (\Delta x A_p \Rightarrow A_p)$

(C2) $\models (\Delta x(A_p \wedge B_p) \Rightarrow (\Delta x A_p \wedge \Delta x B_p))$

(C3) $\models ((\Delta x A_p \wedge \Delta x B_p) \Rightarrow \Delta x(A_p \wedge B_p))$

(C4) $\models (\Box A_p \Rightarrow \Delta a A_p)$

(C5) $\models (\Delta x A_p \Rightarrow \Delta x \Delta x A_p)$

(C6) $\models (\neg \Delta x \neg A_p \Rightarrow \Delta x \neg \Delta x \neg A_p)$[26]

(C7) $\models (\Delta x A_p \Rightarrow Settled \Delta x A_p)$

The basic laws for attempts are the following

(A1) Any attempt of an agent contains an attempt to perform an individual action. $\models ([x\ Tries\ A_p] \Rightarrow \exists p[x Tries \Delta x\ p])$

(A2) Any attempt is an intentional action of the agent.

$\models Tautological ([x\ Tries\ A_p] \Rightarrow \delta_i x[x Tries\ A_p])$ So $\models ([x\ Tries\ A_p] \Rightarrow \Delta x[x Tries\ A_p])$,

$\models ([x Tries A_p] \Leftrightarrow [x Tries[x Tries A_p]])$ and $\models [x\ Tries\ A_p] \Rightarrow \neg \Box A_p$

(A3) Each attempt is personal. $\models [x Tries \Delta y[y Tries A_p]] \Rightarrow x = y$

Agents are minimally rational.

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[26] Axiom schema (C6) is not valid in Chellas logic for Δ.

(A4) They do not attempt to do something tautological or contradictory.

$$\models (Tautological\ A_p \lor Tautological\ \neg A_p) \Rightarrow \neg\Diamond[xTriesA_p]$$

(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.

$$\models ([xTriesA_p] \land [xTriesB_p]) \Rightarrow [xTries(A_p \land B_p)])$$

(A7) The converse is true when propositional content conditions are preserved. [27]

$$\models ([xTries(A_p \land B_p)] \Rightarrow (([xTriesA_p] \land \Diamond [xTriesB_p]) \Rightarrow [xTriesB_p]))$$

(A8) Any attempt is generated by the basic action of the agent.

$$\models [xTriesA_p] \Rightarrow \exists p\ (x\ basically\ does\ p)$$

One can derive the following important 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 when the agent believes the contrary. For the valuations $f \in Val(a,m)$ of an agent at a moment m need not assign to the atomic propositions of A their actual truth-conditions. Furthermore, when our attempt is directed towards the future, we can succeed according to a possible continuation of the moment of the attempt and fail according to another. $\not\models [aTriesWillA] \Rightarrow SettledWillA$.

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[27] Any proposition is identical with a conjunction of that proposition with a tautology. Thus $\models A_p = A_p \land (A_p \lor \neg A_p)$. However an attempt to make it true could not contain an attempt to make true a tautology.

to do. By way of marrying the queen of Thebes, Oedipus also married unintentionally his mother.

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