

# The title

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## 1. Overview

Looking for possibilities (weak acceptance). Those propositions that are in the reflexive preferences in a large sense: there is no strong enough reason to reject those propositions, though their contrary may hold as well.

- All alternatives  $\mathcal{A}$ .
- Topic  $T^* = \{ t_a, a \in \mathcal{A} \} \cup \{ t_{\neg a}, a \in \mathcal{A} \}$ . Denoted simply  $a$  and  $\neg a$ . We define  $\neg t$ , with  $t = t_a$ , as equal to  $t_{\neg a}$  and  $\neg t$ , with  $t = t_{\neg a}$ , as equal to  $t_a$ .
- All possible arguments:  $S^*$ , the set of all strings. It can be chosen differently, but must be non empty as it contains at least  $\emptyset$ , the empty argument.
- $s' \not\vdash_V^t s$ : absence, all the time, of strong rejection attack;  $s'$  does not render  $s$  invalid; it is sure that  $s'$  has no impact on  $s$ , even assuming that  $s'$  would in turn resist all counter-arguments to it. This is an hypothesized relation, unobservable, used to define the deliberated preferences of  $i$  (it is clear we can't observe it, thus, as we can't observe the DP). With  $s$  supporting  $t$ ,  $s'$  claims that  $\neg t$  is a certainty, thus  $s'$  supports that  $t$  is not weakly accepted, thus  $s$ , if rebutted, can't be used even to say that  $t$  is a possibility. Thus we have only attacks between contradictory propositions. Suffices that the attack occurs at least once over the considered time frame and unstability factors (such as submitting  $i$  to other counter-arguments) to negate  $s' \not\vdash_V^t s$ . Here we do not condition on  $s'$  surviving:  $s'$  is declared incorrect, with no necessity of pursuing the debate and no hope of reinstatement. Example:  $s'$  has already been taken into account and countered in  $s$ ; or  $s'$  does not talk about  $s$  at all; or is not understood by  $i$ . Note that when  $s' \not\vdash_V^t s$ , further attacks to  $s'$

have no chance to change that fact (assuming some properties over the way  $i$  reason). The negation of this should read:  $s'$  may attack  $s$  in at least some cases. For example,  $\neg(s' \not\vdash_V^t s)$  ( $s'$  may attack  $s$ ) in case  $i$  suspects that  $s'$  is invalid (because of some counter-argument  $s_2$  to  $s'$  that  $i$  has in mind) but wants to leave the door open to reinstatement of  $s'$ .

- Define  $\neg(s' \not\vdash_V^t s)$  iff  $s' \triangleright_{\exists}^t s$ .
- Define  $S^t$  as the decisive arguments in favor of  $t$ :  $s \in S^t \Leftrightarrow \nexists s' \triangleright_{\exists}^t s \Leftrightarrow s' \not\vdash_V^t s$ .
- Define  $s \triangleright_{\exists}^{\neg t, \text{sure}} s'$  iff  $s$  may attack  $s'$ , where  $s$  has a weak claim ( $t$  is possible) and  $s'$  has a strong claim ( $\neg t$  is sure). Similarly,  $s \not\vdash_V^{\neg t, \text{sure}} s'$  is a constant absence of attack.
- Define  $S^{\neg t, \text{sure}}$  as the decisive arguments in favor of  $\neg t$ , sure:  $s' \in S^{\neg t, \text{sure}} \Leftrightarrow \nexists s \triangleright_{\exists}^{\neg t, \text{sure}} s' \Leftrightarrow s \not\vdash_V^{\neg t, \text{sure}} s'$ .
- Require (axiom A1) that  $s' \triangleright_{\exists}^t s \vee s \triangleright_{\exists}^{\neg t, \text{sure}} s'$ . Equivalently:  $\neg(s \not\vdash_V^{\neg t, \text{sure}} s' \wedge s' \not\vdash_V^t s)$ ;  $s \not\vdash_V^{\neg t, \text{sure}} s' \Rightarrow s' \triangleright_{\exists}^t s$ .
- Axiom A2:  $s \not\vdash_V^{\neg t, \text{sure}} s' \Rightarrow s \not\vdash_V^{\neg t} s'$ . Equivalently:  $s \triangleright_{\exists}^{\neg t} s' \Rightarrow s \triangleright_{\exists}^{\neg t, \text{sure}} s'$ .<sup>1 2</sup>

It seems that knowledge of the poss rels is insufficient to know the sure rel: assume  $\neg(s' \triangleright_{\exists}^t s)$  and  $s \triangleright_{\exists}^{\neg t} s'$ . Thus, 1.  $s$  is sufficient for  $t$  possible,  $s'$  not sufficient for  $\neg t$  sure; and 2.  $s$  may be sufficient for  $t$  sure,  $s'$  insuff for  $t$ . But is  $s$  sufficient for  $t$  sure? Thus,  $s' \triangleright_{\exists}^{\neg t, \text{sure}} s$ ? Equivalently:  $s \not\vdash_{\exists}^{\neg t} s'$ ? To know this we need to know whether  $\neg t \in T_i$ . Or can we use  $\neg(s' \triangleright_{\exists}^t s) \Rightarrow s' \not\vdash_{\exists}^t s$ ?

Previously:

- $\neg(s' \triangleright_{\exists}^t s) \Leftrightarrow s' \not\vdash_{\exists}^t s \Leftrightarrow s \triangleright_{\exists}^{\neg t, \text{sure}} s' \Leftrightarrow \neg(s \not\vdash_V^{\neg t, \text{sure}} s')$ .

Define  $T_i \subseteq T^*$  as the set of propositions that are weakly accepted.

**Definition 1** (Weak acceptance). Define a situation  $(\mathcal{A}, S^*, \{\triangleright_{\exists}^t\})$ . A proposition  $t \in T^*$  is weakly accepted,  $t \in T_i$ , iff  $\exists s \in S^* \mid \forall s' \in S^* : s' \not\vdash_V^t s$ .

It follows that  $\neg t \notin T_i$  iff  $\forall s : \exists s' \mid s' \triangleright_{\exists}^{\neg t} s$ . Equivalently,  $\neg t \notin T_i \Leftrightarrow \triangleright_{\exists}^{\neg t}(S^*) = S^*$ .

<sup>1</sup>A3:  $[\exists s \mid (s' \triangleright_{\exists}^t s \wedge s \triangleright_{\exists}^{\neg t, \text{sure}} s')] \Rightarrow \exists s_2 \mid s_2 \triangleright_{\exists}^{\neg t} s'$ . Equivalently:  $s_2 \not\vdash_V^{\neg t} s'$ ,  $\forall s_2$  implies that for all  $s$ ,  $(s' \not\vdash_V^t s \vee s \not\vdash_V^{\neg t, \text{sure}} s')$ . A1, A2 and A3 are equivalent to:  $s \not\vdash_V^{\neg t, \text{sure}} s' \Leftrightarrow s \not\vdash_V^{\neg t} s' \wedge s' \triangleright_{\exists}^t s$ .

<sup>2</sup>Having A1 and A2, can we have  $s \not\vdash_V^{\neg t} s' \wedge s' \triangleright_{\exists}^t s \wedge s \triangleright_{\exists}^{\neg t, \text{sure}} s'$ ? Consider  $(s', \neg t) \geq (s, t) \sim (s', \neg t, \text{sure}) \geq (s, t, \text{sure})$ .

**Definition 2** (Sure acceptance).  $\neg t \in T_i^{sure}$  iff  $\exists s' \in S^* \mid \forall s \in S^* : s \not\vdash_V^{\neg t, sure} s'$ .<sup>3</sup>

If  $\neg t \in T_i^{sure}$ , then  $t \notin T_i$ : with  $s' \in S^{\neg t, sure}$ , given any  $s$ ,  $s' \triangleright_{\exists}^t s$  (because  $s \not\vdash_V^{\neg t, sure} s'$ , see A1).

If  $\neg t \in T_i^{sure}$ , then  $\neg t \in T_i$ : from  $s \not\vdash_V^{\neg t, sure} s'$  we obtain  $s \not\vdash_V^{\neg t} s'$  using A2.

**Definition 3** (Clear-cut). A situation is clear-cut iff  $t \notin T_i \Rightarrow \neg t \in T_i^{sure}$ .

Here is an example of a non clear-cut situation.  $S^* = \{\emptyset\}$ ,  $T^* = \{t\}$ ,  $\emptyset \triangleright_{\exists}^t \emptyset$ ,  $\emptyset \triangleright_{\exists}^{\neg t, sure} \emptyset$ .

## 2. Models

$\triangleright_{\eta}$  an acyclic binary relation over  $S^*$  (by which we mean that its transitive closure is irreflexive).  $\leadsto_{\eta} \subseteq S^* \times T^*$ . Define  $S_{\eta} \subseteq S^*$  as the set of arguments used in  $\triangleright_{\eta} \cup \leadsto_{\eta}$ . Let  $+$  be defined over arguments used in the model:  $s_3 + s_1 = s'$  for some  $s' \in S_{\eta}$ , for any  $s_3, s_1 \in S_{\eta}$ .

Requirements. The maximum length of a path in  $\triangleright_{\eta}$  is finite.  $s_3 \triangleright_{\eta} s_2 \triangleright_{\eta} s_1 \Rightarrow s_2 \triangleright_{\eta} s_3 + s_1$ .<sup>4</sup>

Notation. Let  $\leadsto_{\eta}^{-1}(T^*) \subseteq S_{\eta}$  denote the subset of arguments supporting propositions.  $\triangleright_{\eta}(s_2)$ : arguments that  $s_2$  attacks,  $s_1 \in \triangleright_{\eta}(s_2) \Leftrightarrow s_2 \triangleright_{\eta} s_1$ . We write  $S \triangleright_{\eta} s$  to mean that  $\forall s' \in S : s' \triangleright_{\eta} s$ , and similarly for other binary relations.

Given a decision situation, define  $\succ_{\exists} \subseteq \triangleright_{\eta}$  as follows.

Given  $s_3 \triangleright_{\eta} s_2, t \in T^*$ :  $s_3 \succ_{\exists}^t s_2$  iff  $[\exists s_1 \in \triangleright_{\eta}(s_2) \mid (s_2 \succ_{\exists}^t s_1 \wedge s_2 \not\succ_{\exists}^t s_3 + s_1)] \vee [s_2 \leadsto_{\eta} t \wedge s_3 \triangleright_{\exists}^t s_2]$ .<sup>5</sup>

Given  $s_3 \triangleright_{\eta} s_2, t \in T^*$ :  $s_3 \not\succ_{\exists}^t s_2$  iff  $[\exists s_1 \in \triangleright_{\eta}(s_2) \mid (s_2 \succ_{\exists}^t s_1 \wedge s_2 \succ_{\exists}^t s_3 + s_1)] \vee [s_2 \leadsto_{\eta} t \wedge s_2 \triangleright_{\exists}^{\neg t, sure} s_3]$ .<sup>6</sup>

<sup>3</sup>Instead of accepting  $\neg t$  for sure, it is tempting to define strong rejection of  $t$  as follows. A proposition  $t \in T^*$  is strongly rejected iff  $\forall s_0 \in S^*, \exists s' \in S^* \mid s_0 \not\vdash_V^{\neg t, sure} s'$ . But this is too weak: we want  $s'$  to be also decisive, thus  $s \not\vdash_V^{\neg t, sure} s', \forall s$ . Hence the definition becomes  $\exists s' \in S^* \mid s \not\vdash_V^{\neg t, sure} s'$ .

<sup>4</sup>Necessary for definition of  $s_3 \succ_{\exists}^t s_2$ .

<sup>5</sup>Or  $s_2 \leadsto_{\eta} t \wedge \neg t \notin \leadsto_{\eta}(S^*) \wedge s_3 \triangleright_{\exists}^{\neg t, sure} s_2$ .

<sup>6</sup>Check: Given  $s_4 \triangleright_{\eta} s_3, s_3 \notin \leadsto_{\eta}^{-1}(T^*)$ , with  $s_2 \in \triangleright_{\eta}(s_3) \Rightarrow (s_2 \text{ and } s_4 + s_2 \triangleright_{\eta}\text{-attack only root nodes and do not support any proposition}): s_4 \succ_{\exists}^t s_3$  iff

- $\exists s_2 \in \triangleright_{\eta}(s_3) \mid [(s_3 \succ_{\exists}^t s_2) \wedge (s_3 \not\succ_{\exists}^t s_4 + s_2)]$  iff
- $\exists s_2 \in \triangleright_{\eta}(s_3) \mid [(\exists s_1 \in \triangleright_{\eta}(s_2) \mid s_2 \succ_{\exists}^t s_1 \wedge s_2 \not\succ_{\exists}^t s_3 + s_1) \wedge (\exists s_1 \in \triangleright_{\eta}(s_4 + s_2) \mid s_4 + s_2 \succ_{\exists}^t s_1 \wedge s_4 + s_2 \succ_{\exists}^t s_3 + s_1)]$  iff
- $\exists s_2 \in \triangleright_{\eta}(s_3) \mid [(\exists s_1 \in \triangleright_{\eta}(s_2) \mid s_1 \leadsto_{\eta} t \wedge s_2 \triangleright_{\exists}^t s_1 \wedge s_3 + s_1 \leadsto_{\eta} t \wedge s_3 + s_1 \triangleright_{\exists}^{\neg t, sure} s_2) \wedge (\exists s_1 \in \triangleright_{\eta}(s_4 + s_2) \mid s_1 \leadsto_{\eta} t \wedge s_4 + s_2 \triangleright_{\exists}^t s_1 \wedge s_3 + s_1 \leadsto_{\eta} t \wedge s_4 + s_2 \triangleright_{\exists}^t s_3 + s_1)]$ .

TODO this is well-defined because associate to each  $s \in S_\eta$   $d(s)$ , the distance to the farthest root (a root is an argument that  $\triangleright_\eta$ -attacks nobody). Then  $\succ_\exists$  is defined for all attacks from  $d(\cdot) = 1$  nodes (because those nodes attack only  $d(\cdot) = 0$  nodes), and thus is defined for all nodes 2, I suppose, ...

Given  $s_3 \in S_\eta, s_2 \in S_\eta$ , with  $\exists s_1 \in \triangleright_\eta(s_2) \mid s_2 \succ_\exists^t s_1$ , we have:  $s_3 \succ_\exists^t s_2 \vee s_3 \not\succ_\exists^t s_2$ .

Define  $s_2 \succ_\exists s_1 \Leftrightarrow \exists t \in T^* \mid s_2 \succ_\exists^t s_1$ .

Define  $\succ_\forall = \neg \not\succ_\exists$ . Define  $\not\succ_\forall = \neg \succ_\exists$ .

Hence, given  $s_3 \in S_\eta, s_2 \in S_\eta, s_2 \notin \sim_\eta^{-1}(T^*)$ :  $s_3 \succ_\forall s_2$  iff  $\forall s_1 \in \triangleright_\eta(s_2) \cap \triangleright_\exists(s_2) : s_2 \not\succ_\forall s_3 + s_1$ .

## 2.1. Certainties

Assume we define  $s_1 \succ_\exists^{\neg t, \text{sure}} s_2 \Leftrightarrow s_2 \not\succ_\exists^t s_1$ . Then, indeed, given  $s_1 \sim_\eta t, s_2 \succ_\exists^{\neg t, \text{sure}} s_1 \Leftrightarrow s_2 \triangleright_\exists^{\neg t, \text{sure}} s_1$ . But it gives the wrong conclusion. For  $s_3 \triangleright_\eta s_2 \triangleright_\eta s_1 \sim_\eta t : s_3 \succ_\exists^{t, \text{sure}} s_2$  iff  $s_2 \not\succ_\exists^t s_3$  iff  $\exists s_1 \in \triangleright_\eta(s_3) \mid s_3 \succ_\exists^t s_1 \wedge s_3 \succ_\exists^{\neg t} s_2 + s_1$ .

Given  $s_1 \sim_\eta t$ , define  $s_2 \succ_\exists^{t, \text{sure}} s_1$  iff  $s_2 \triangleright_\exists^{t, \text{sure}} s_1$ .

Given  $s_1 \sim_\eta t$ , define  $s_2 \not\succ_\exists^{t, \text{sure}} s_1$  iff  $s_1 \triangleright_\exists^{\neg t} s_2$ .

Given  $s_3 \in S_\eta, s_2 \in S_\eta, s_2 \notin \sim_\eta^{-1}(T^*), t \in T$ :  $s_3 \succ_\exists^{t, \text{sure}} s_2$  iff  $\exists s_1 \in \triangleright_\eta(s_2) \mid s_2 \triangleright_\exists^{t, \text{sure}} s_1 \wedge s_2 \not\succ_\exists^{t, \text{sure}} s_3 + s_1$ .

Given  $s_3 \in S_\eta, s_2 \in S_\eta, s_2 \notin \sim_\eta^{-1}(T^*), t \in T$ :  $s_3 \not\succ_\exists^{t, \text{sure}} s_2$  iff  $\exists s_1 \in \triangleright_\eta(s_2) \mid s_2 \triangleright_\exists^{t, \text{sure}} s_1 \wedge s_2 \succ_\exists^{t, \text{sure}} s_3 + s_1$ .

## 3. Conditions

All these conditions assume that a decision situation  $(\mathcal{A}, S^*, \{\triangleright_\exists^t\})$  and a model  $\eta = (\triangleright_\eta, \sim_\eta, +)$  are given.

Define  $S_{\text{decisive}} = S_\eta \setminus \text{im}(\succ_\exists)$  the decisive arguments according to  $\succ_\exists$ , or  $\succ_\exists^-$  decisive arguments for short:  $s \in S_{\text{decisive}} \Leftrightarrow \succ_\exists^{-1}(s) = \emptyset$ .

**Definition 4 (Reinstatement).** Given  $s_3 \succ_\exists s_2 \triangleright_\exists s_1, s_3 \in S_{\text{decisive}} : \triangleright_\eta(s_1) \subseteq \triangleright_\eta(s_3 + s_1) \wedge \triangleright_\eta^{-1}(s_3 + s_1) \subseteq \triangleright_\eta^{-1}(s_1) \setminus \triangleright_\eta(s_3)$ .<sup>7 8</sup>

<sup>7</sup>TODO the condition must be  $\succ_\exists^{-1}(s_3 + s_1) \subseteq \triangleright_\eta^{-1}(s_1) \setminus \triangleright_\eta(s_3)$  to allow  $s_5 \triangleright_\eta s_4 \triangleright_\eta s_3 \triangleright_\eta s_2 \triangleright_\eta s_1$  and  $s_5 \triangleright_\eta s_4 \triangleright_\eta s_3 + s_1$ , considering that possibly  $s_3$  is  $\succ_\exists^-$ -decisive. This should not invalidate the conditions, but it does currently. But it's not a problem: the model would actually not be built this way. In this scenario the argument  $s_3 + s_1$  is useful only in case  $s_3$  is decisive, thus  $s_4 \triangleright_\eta s_3 + s_1$  must not be planned. Rather  $s_5 + s_3$  decisive, then  $(s_5 + s_3) + s_1$ . Alternatively, also  $s_4 \triangleright_\eta s_1$  and then no problem as well.

<sup>8</sup>The stronger condition mandating  $\triangleright_\eta^{-1}(s_3 + s_1) \subseteq \succ_\exists^{-1}(s_1) \setminus \triangleright_\eta(s_3)$  would be more difficult to

**Definition 5** (Justifiable unstability).  $\forall s_2 \triangleright_\eta s_1 \mid s_2 \succ_\exists s_1, s_2 \not\succ_\exists s_1 : \exists s_3 \triangleright_\eta s_2 \mid s_3 \succ_\exists s_2$ .

**Definition 6** (Finite defense). *If  $\succ_\exists^{-1}(s) \subseteq \succ_\exists(S_{\text{decisive}})$ , then  $\exists S \subseteq S_{\text{decisive}}, |S| \leq j \mid \triangleright_\eta^{-1}(s) \subseteq \succ_\exists(S)$ .* <sup>9 10 11 12 13 14</sup>

Thus, if the attackers of  $s$  are attacked by decisive arguments, then  $j$  defenders are enough to defend  $s$ .

Define  $R$ , the reinstates relation, as follows:  $s_3 R s_1$  iff  $s_3 \succ_\exists s_2 \succ_\exists s_1$  (for some  $s_2$ ),  $s_3 \in S_{\text{decisive}}$ . Define  $S_\gamma$  as the transitive closure of  $\sim_\eta^{-1}(T^*)$  under  $R$ .

**Definition 7** (Covering).  $\forall s \in S_\gamma, s' \in S^* : s' \triangleright_\exists s \Rightarrow s' \triangleright_\eta s$ . <sup>15</sup>

**Definition 8** (Observable validity).  $\forall s_2 \triangleright_\eta s_1 \sim_\eta t : \neg(s_2 \succ_\exists^t s_1) \vee \exists s_3 \triangleright_\eta s_2 \mid s_3 \succ_\exists^t s_2$ . Furthermore, if  $\neg(S_\eta \sim_\eta t), \forall s_1 \sim_\eta \neg t, s \in S^* : s_1 \triangleright_\exists^t s$ . <sup>16</sup>

check: when some  $s_2 \succ_\exists s_3 + s_1$ , we'd need to check not only that  $s_2 \triangleright_\eta s_1$  but also  $s_2 \succ_\exists s_1$ .

<sup>9</sup>Define Finite defense- $\succ_\exists$ - $\triangleright_\eta$ -dec as:  $\succ_\exists^{-1}(s) \subseteq \succ_\exists(S_\eta \setminus \text{im}(\triangleright_\eta)) \Rightarrow \succ_\exists^{-1}(s) \subseteq \succ_\exists(S)$ . Finite defense- $\succ_\exists$ - $\triangleright_\eta$ -dec is insufficient to provide  $T_\eta = T_i$ . Define  $s' \triangleright_\eta^{\text{fail}} s$  iff  $s' \triangleright_\eta s \wedge \neg(s' \succ_\exists s)$ . Consider  $s_3 \succ_\exists s_2 \succ_\exists s_1, s'_3 \succ_\exists s'_2 \succ_\exists s_1$ , and so on, and  $s_4 \triangleright_\eta^{\text{fail}} \{s_3, s'_3, \dots\}$ . Then I really need infinitely many arguments to defend  $s_1$  but Finite defense- $\succ_\exists$ - $\triangleright_\eta$ -dec is artificially satisfied because the antecedent fails to trigger.

<sup>10</sup>Define Finite defense- $\succ_\exists$ - $\triangleright_\eta$ -subsets as:  $\succ_\exists^{-1}(s) \subseteq \succ_\exists(S) \Rightarrow \succ_\exists^{-1}(s) \subseteq \succ_\exists(S')$ . Finite defense- $\succ_\exists$ - $\triangleright_\eta$ -subsets is insufficient to provide  $T_\eta = T_i$ . This is because Reinstatement allows for new attacks in  $\succ_\exists$  (it only forbids new attacks in  $\triangleright_\eta$ ), thus we can forever transform previously failing attacks to new attacks, hence always satisfying Finite defense (always finite cover of  $\succ_\exists$ , but infinite cover of  $\triangleright_\eta$ ) but still not converging. Consider  $s_3 \succ_\exists s_2 \succ_\exists s_1, s'_3 \succ_\exists s'_2 \triangleright_\eta^{\text{fail}} s_1$ , and so on; and  $s'_3 \succ_\exists s'_2 \succ_\exists s_3 + s_1, s''_3 \succ_\exists s''_2 \triangleright_\eta^{\text{fail}} s_3 + s_1$ , and so on.

<sup>11</sup>Define Finite defense- $\triangleright_\eta$ - $\succ_\exists$ -startdec as:  $\triangleright_\eta^{-1}(s) \subseteq \succ_\exists(S_{\text{decisive}}) \Rightarrow \triangleright_\eta^{-1}(s) \subseteq \succ_\exists(S)$ . Finite defense- $\triangleright_\eta$ - $\succ_\exists$ -startdec is insufficient to provide  $T_\eta = T_i$ . Consider  $s_3 \succ_\exists s_2 \succ_\exists s_1, s'_3 \succ_\exists s'_2 \succ_\exists s_1$ , and so on, and  $s_5 \triangleright_\eta^{\text{fail}} s_4 \triangleright_\eta^{\text{fail}} s_1$ . Then I really need infinitely many arguments to defend  $s_1$  but Finite defense- $\triangleright_\eta$ - $\succ_\exists$ -startdec is satisfied as there is no cover of the  $\triangleright_\eta$  attacks to  $s_1$ .

<sup>12</sup>Define Finite defense- $\triangleright_\eta$ - $\triangleright_\eta$ -startdec as:  $\triangleright_\eta^{-1}(s) \subseteq \triangleright_\eta(S_{\text{decisive}}) \Rightarrow \triangleright_\eta^{-1}(s) \subseteq \triangleright_\eta(S)$ . Finite defense- $\triangleright_\eta$ - $\triangleright_\eta$ -startdec is insufficient to provide  $T_\eta = T_i$ . Consider  $s_3 \succ_\exists s_2 \succ_\exists s_1, s'_3 \succ_\exists s'_2 \succ_\exists s_1$ , and so on, and  $s \triangleright_\eta^{\text{fail}} \{s_2, s'_2, \dots\}$ . Then I really need infinitely many arguments to defend  $s_1$  but Finite defense- $\triangleright_\eta$ - $\triangleright_\eta$ -startdec is artificially satisfied because of  $s$ . Define Finite defense- $\triangleright_\eta$ - $\triangleright_\eta$ -subsets as:  $\triangleright_\eta^{-1}(s) \subseteq \triangleright_\eta(S) \Rightarrow \triangleright_\eta^{-1}(s) \subseteq \triangleright_\eta(S')$  (for any  $S \subseteq S_{\text{decisive}}$ ). Finite defense- $\triangleright_\eta$ - $\triangleright_\eta$ -subsets is (rightly) non satisfied in this example.

<sup>13</sup>To satisfy Finite defense, in presence of the other conditions, suffice to limit the width of the model (TODO check). But it may be interesting to not limit it and declare that the model has specific replies to any counter-argument, but promises to use only a few rebuttals and that afterwards, the dm will stop using those kind of arguments (but we don't know in advance which ones will be chosen).

<sup>14</sup>Define Finite defense- $\succ_\exists$ - $\triangleright_\eta$ -subsets as:  $\succ_\exists^{-1}(s) \subseteq \succ_\exists(S) \Rightarrow \succ_\exists^{-1}(s) \subseteq \succ_\exists(S')$ . Finite defense- $\triangleright_\eta$ - $\succ_\exists$ -subsets  $\not\Rightarrow$  Finite defense- $\succ_\exists$ - $\triangleright_\eta$ -subsets. Consider  $s_2 \triangleright_\eta^{\text{fail}} s_1$  (to be continued...)

<sup>15</sup>Specify  $\triangleright_\exists$ .

<sup>16</sup>If the model claims  $\neg t \in T_i^{\text{sure}}$ , this requires clear-cut (for that prop), so we must mandate it

## 4. Theorem

**Theorem 1** (Validity). *Given a decision situation and a model  $\eta$ , if all our conditions are satisfied,  $\sim_\eta(S_\eta) \subseteq T_i$ . Furthermore, if  $\neg t \in \sim_\eta(S_\eta) \wedge t \notin \sim_\eta^{-1}(S_\eta)$ ,  $\neg t \in T_i^{sure}$ .*

*Proof.* Define  $\succ_\exists^{\text{ext}} \subseteq S^* \times S^*$  as:  $s' \succ_\exists^{\text{ext}} s$  iff  $s' \succ_\exists s \vee (s \in \sim_\eta^{-1}(S_\eta) \wedge s' \triangleright_\exists s)$ .

$s$  is defended iff its  $\succ_\exists$ -attackers are  $\succ_\exists$ -attacked by  $\succ_\exists$ -decisive arguments.

Sketch:

1.  $s_1$  defended implies  $s_1$  replaceable by some  $\succ_\exists$ -decisive  $s$
2.  $s_1$  has its  $\succ_\exists$ -attackers  $\succ_\exists$ -attacked by defended arguments implies  $s_1$  defended
3. Hence,  $s_1$  has its  $\succ_\exists$ -attackers  $\succ_\exists$ -attacked by defended arguments implies  $s_1$  replaceable by  $\succ_\exists$ -decisive
4. If  $s_1$  is not defended, it is  $\succ_\exists$ -attacked by no  $s_2$  decisive [Obs valid], hence,  $s_1$  is attacked by no  $s_2$  defended (otherwise there would be a decisive attacker). TODO clarify how we take into account attacks from outside of  $\succ_\exists$  (simply  $\triangleright_\exists$ ) coming from arguments out of  $S_\eta$ .
5. If  $s_1$  is not defended, it is attacked by some  $s_2$  attacked by no  $s_3$  decisive (otherwise,  $s_1$  defended).
6. Hence, if  $s_1$  is not defended, it is attacked by some  $s_2$  not defended, itself attacked by no  $s_3$  decisive. And we can hopefully recurse.
7. In short:  $s_1$  not defended by dec, attacked by some  $s_2$  not defended by dec, implies  $s_2$  attacked by some  $s_3$  not defended by decisive.

First, we want to prove that  $s_1$  defended implies  $s_1$  replaceable by some  $\succ_\exists$ -decisive  $s$ , and if  $s_1 \in S_\gamma$ , then its replacer  $s$  is in  $S_\gamma$  as well.

By hypothesis,  $\succ_\exists^{-1}(s_1) \subseteq \succ_\exists(S_{\text{decisive}})$ . Thus,  $\exists S \subseteq S_{\text{decisive}} \mid \triangleright_\eta^{-1}(s_1) \subseteq \succ_\exists(S)$ ,  $S$  finite [Finite defense].

Pick any  $s_{3,1} \in S$  such that  $s_{3,1} \succ_\exists s_2 \succ_\exists s_1$  (if there's none,  $s_1 \in S_{\text{decisive}}$  and we're done).  $s_{3,1} + s_1$  replaces  $s_1$ , and  $\triangleright_\eta^{-1}(s_{3,1} + s_1) \subseteq \triangleright_\eta^{-1}(s_1) \setminus \triangleright_\eta(s_{3,1})$  [Reinstatement]. Hence,  $\triangleright_\eta^{-1}(s_{3,1} + s_1) \subseteq \succ_\exists(S) \setminus \triangleright_\eta(s_{3,1})$ . Iterate by picking any  $s_{3,2} \in S$  such that  $s_{3,2} \succ_\exists s_2 \succ_\exists s_{3,1} + s_1$  (if there's none,  $s_{3,1} + s_1 \in S_{\text{decisive}}$  and we're done) and obtaining  $s_{3,2} + (s_{3,1} + s_1)$  replacing  $s_{3,1} + s_1$  (hence, replacing  $s_1$ ) with  $\triangleright_\eta^{-1}(s_{3,2} +$

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(hopefully A3 or an equivalent such as Justifiable unstability fits). Thus we only need to prove  $t \notin T_i$ , for which  $s_1 \triangleright_\exists^t s$  suffices.

$(s_{3,1} + s_1)) \subseteq \triangleright_{\eta}^{-1}(s_{3,1} + s_1) \setminus \triangleright_{\eta}(s_{3,2})$ . Hence,  $\triangleright_{\eta}^{-1}(s_{3,2} + (s_{3,1} + s_1)) \subseteq \triangleright_{\exists}(S) \setminus \triangleright_{\eta}(s_{3,1}) \setminus \triangleright_{\eta}(s_{3,2})$ . Iterating in such a way over the finite set  $S$  will finally yield an element that is  $\triangleright_{\exists}$ -decisive. The last point,  $s_1 \in S_{\gamma} \Rightarrow s \in S_{\gamma}$ , follows from the definition of  $S_{\gamma}$ .

Second, we want to prove that if  $s_1$  not defended and has no decisive  $\triangleright_{\exists}$ -attackers (meaning that  $\triangleright_{\exists}^{-1}(s_1) \subseteq \overline{S_{\text{decisive}}}$ ), then  $s_1$  is  $\triangleright_{\exists}$ -attacked by some  $s_2$  that is not defended and has no decisive  $\triangleright_{\exists}$ -attacker.

Consider  $s_1$  not defended and having no decisive  $\triangleright_{\exists}$ -attackers. Because  $s_1$  is not defended, by definition, it is  $\triangleright_{\exists}$ -attacked by some  $s_2$  that has no decisive  $\triangleright_{\exists}$ -attacker. Because  $s_1$  has no decisive attacker,  $s_2$  is not decisive. If  $s_2$  was defended, by the first part of this proof, it would be replaceable by a decisive argument, and  $s_1$  would have a decisive attacker. Thus,  $s_2$  is not defended.

TODO do not mandate that  $s_3 + s_1 \leadsto t$ , so that the model can afford not resisting to the counter-attacks to  $s_3 + s_1$  (resistance to c-a to  $s_1$  suffice). We obtain that some argument exists that support  $t$ , but not necessarily one that the model claims supports it. We need: Obs applies to restricted supports (one per prop decided by model); Covering applies to extended supports (restricted supports plus those obtained by reinstatement). Replacement-1 applies to all and requires attack at least as large; Replacement-2 applies to restricted supports and requires no new  $\triangleright_{\exists}$ -attacks.

Third, consider an argument  $s_1 \in \leadsto_{\eta}^{-1}(T^*)$ . It has no decisive  $\triangleright_{\exists}$ -attacker: as  $s_1 \in S_{\gamma}$ , any  $\triangleright_{\exists}$ -attack is a  $\triangleright_{\exists}$ -attack [Covering], and  $s_1$  has no decisive  $\triangleright_{\exists}$ -attacker [Obs val]. Also,  $s_1$  is defended: assume it is not, then by our second point in this proof some  $s_2 \triangleright_{\exists} s_1$ , with  $s_2$  not defended and with no decisive  $\triangleright_{\exists}$ -attacker, and iterating and using finiteness of  $\triangleright_{\exists}$  leads to a contradiction. Hence, by our first point in this proof,  $s_1$  is replaceable by some  $\triangleright_{\exists}$ -decisive  $s \in S_{\gamma}$ . As  $s \in S_{\gamma}$ , any  $\triangleright_{\exists}$ -attack is a  $\triangleright_{\exists}$ -attack [Covering], thus  $s$  is  $\triangleright_{\exists}$ -decisive.  $\square$

## A. Todo

Road map.

- P1:  $p_a$  is w-a or  $p_{\neg a}$  is w-a
- Define  $p_a$  is strongly accepted;  $p_{\neg a}$  is strongly rejected, so that they are equivalent.
- P2:  $p_a$  is w-a or  $p_{\neg a}$  is strongly accepted.

Other todos.

- If  $i$  does not consider  $s$  as supporting  $t$ , it also works: if  $t$  is not weakly acceptable by default, then any  $s'$  is considered by  $i$  as a better argument than  $s$  in favor of certain  $\neg t$ , and so on. In fact, whether  $\emptyset \triangleright_{\exists}^t \emptyset$  determines whether  $t$  is weakly supported by default.
- I should define  $s'(\Box \triangleright_{\exists}^t)s$  as an observable: “Assuming  $s'$  would survive, do you consider  $s'$  as leading to certainty of  $\neg t$ , even when considering  $s$ ?”. It distinguishes our knowledge and the truth:  $s'(\Box \triangleright_{\exists}^t)s \Rightarrow s' \triangleright_{\exists}^t s$ , thus, implies  $\neg(s' \not\triangleright_{\forall}^t s)$ . But out of  $\neg(s'(\Box \triangleright_{\exists}^t)s)$ , nothing.
- Partition (objectively)  $S^*$  (or  $S^* \times T^*$ ) into arguments in favor of  $t$ , sure,  $\neg t$ , sure, and similarly for possible. Use only one rel  $\triangleright_{\exists}$ , defined on contradictory arguments only, instead of  $\triangleright_{\exists}^{t, \text{sure}}$  and others. Define  $s' \triangleright_{\exists}^t s$  equals no when  $\neg(s' \rightsquigarrow \neg t, \text{sure})$ , equals  $\triangleright_{\exists}$  for adequate arguments, and equals yes when  $\neg(s \rightsquigarrow t, \text{possible})$  and  $s' \rightsquigarrow \neg t, \text{sure}$ , with probably some complications needed for the argument  $\emptyset$  (and related default attitude towards  $t$ ).

Questions: Q1. Relationship with  $s \triangleright_{\exists}^t s$ ?

We want to exclude:  $s$  supports  $p$  perhaps, attacked by  $s_2$  (supporting  $\neg p$  sure), but then  $s_2$  is attacked by  $s$ . Exclude  $s' \triangleright_{\exists}^t s$  and  $s \triangleright_{\exists}^{\neg t, \text{sure}} s'$ . Require to assume that this situation implies another argument  $s_3$  “attacking”  $s'$ , thus, such that  $s_3 + s$  is no more attacked by  $s_2$ .

## B. To think

Propositions weakly self-supported  $T \subseteq T^*$ : weakly accepted if no arg is given. Examples:  $m$  = “eat miam”;  $\neg b$  = “beurk is to exclude”; or, in a problem where there’s no particularly good aliments, both  $a$  = “eat this” and  $\neg a$ .

When given  $(s, t)$ ,  $i$  may say:  $s$  does not survive; or: assuming  $s$  survives, then  $s$  supports  $t$ , or, assuming  $s$  survives, then  $s$  does not support  $t$  anyway.

When given  $s'$  against  $s$ ,  $i$  may say:  $s'$  does not survive, or: assuming  $s'$  survives, then  $s'$  supports  $\neg t$ , ...

Given  $(s_2, t), (s_1, \neg t) \in D$ , define  $\neg(s_2 \triangleright_{\exists \neg t}^{\text{neg}} s_1)$  iff for some  $(s, t) \in D$ , where  $s_1 \triangleright_{\exists}^t s$ :  $s_1 \triangleright_{\exists}^t s + s_2$ . Equivalently:  $s_2 \triangleright_{\exists \neg t}^{\text{neg}} s_1$  iff for all  $s$ , where  $s_1 \triangleright_{\exists}^t s$ :  $\neg(s_1 \triangleright_{\exists}^t s + s_2)$ . (This does not seem right: if given  $s_3$  attacking  $s_2$ , and not given  $s_4$  which would convincingly rebut  $s_3$ , then temporarily it may hold again that  $s_1 \triangleright_{\exists}^t s + s_2$  (in the sense that  $s_1 + s_3 \triangleright_{\exists}^t s + s_2$ ).)

$s_2 \triangleright_{\exists \neg t} s_1$  can perhaps be queried directly by asking (in the context of some  $s_1 \triangleright_{\exists}^t s$ ): “assume  $s_2$  survives, then does  $s_2$  counter  $s_1$ ?” (In the sense that  $s_2$  is sufficiently



convincing that  $t$  holds perhaps, to cancel the argument  $s_1$  according to which  $\neg t$  surely holds.)

## C. Certainties

Looking for certainties. Those propositions that are in the reflexive preferences in a demanding sense: there is a strong enough reason to prefer it than its contrary.

- $s' \succ_{\exists} s$ : weak attack;  $s'$  renders  $s$  invalid (can't be used to say that  $t$  holds for sure) (assuming  $s'$  survives)
- Propositions strongly self-supported: strongly accepted if no arg is given. Examples:  $m$  = “eat miam”;  $\neg b$  = “beurk is to exclude”. We might have neither  $c$  nor  $\neg c$  in that set.

**Definition 9** (Sure acceptance). *Define a situation  $(\mathcal{A}, S^*, \{\triangleright_{\exists}^t\})$ . A proposition  $t \in T^*$  is accepted as sure iff  $\exists s' \in S^* \mid \forall s \in S^* : s \not\triangleright_{\forall}^{t, \text{sure}} s'$ .*

Assume we use rather: if  $p$  is not sure, then  $\neg p$  is weakly accepted (by def). Then we have never problems of inconsistency! But we could be in a situation where  $p$  is not accepted as sure but nobody can tell why because it is fundamentally unstable (sometimes  $p$  being accepted, sometimes not).

## D. Example about model instantiation

The general conditions are Reinstatement, Justifiable unstability, Finite defense and Covering. A general model is a model that claims it satisfies the general conditions.

TODO give up general models. In this example,  $s_1$  would need to be planned as attacking sometimes  $s_2$ . Better consider an instantiation mechanism. An instantiated model is particular, and can be tested (especially against another one).

*Example 1.*  $s_3 \triangleright_{\eta} s_2 \triangleright_{\eta} s_1 \rightsquigarrow_{\eta} t, s_2 \rightsquigarrow_{\eta} \neg t; s_3 + s_1 \rightsquigarrow_{\eta} t$ .  $\triangle$

This model is compatible (meaning that it satisfies the general conditions) with the following decision situations. We describe  $\triangleright_{\exists}$  fully (no attack iff not mentioned).

- Sure of  $t$ :  $s_1 \rightsquigarrow_{\eta} t; s_3 \triangleright_{\exists} s_2$  (the rest is implied, for example  $\forall s_4 \in S^* : s_1 \triangleright_{\exists}^{\neg t} s_4$  because of covering).
- Sure of  $t$  with reinstatement:  $s_3 \triangleright_{\exists}^t s_2 \triangleright_{\exists}^t s_1 \rightsquigarrow_{\eta} t; s_1 + s_3 \rightsquigarrow_{\eta} t; s_3 \triangleright_{\exists}^{\neg t} s_2$
- Sure of  $\neg t$ :  $s_2 \rightsquigarrow_{\eta} \neg t; s_2 \triangleright_{\exists} s_1$

- Both:  $\neg(s_2 \triangleright_{\exists} s_1), s_1 \leadsto_{\eta} t, \neg(s_3 \triangleright_{\exists} s_2), s_2 \leadsto_{\eta} \neg t$

This situation falsifies the model.  $s_4 \triangleright_{\exists} s_1$ ,  $s_4$  not attacked.

## E. Example about default arguments

$s_2$  argues in favor of  $p$  against  $s_1$ :  $s$  "le monde n'est pas fiable".  $s_1$  "le monde est fiable, bhl l'a dit".  $s_2$  "bhl est un clown, il s'est planté sur l'Irak".  $s_3$  "il avait raison sur l'Irak : l'Irak a des ADM".  $s_4$  "l'Irak n'a pas d'ADM, Bush l'a reconnu". Does  $s_4$  attack  $s_3$ ? "bhl est un clown, il s'est planté sur l'irak" + "l'irak n'a pas d'ADM, Bush l'a reconnu" VS "il avait raison sur l'Irak : l'Irak a des ADM" !

Measure problem?