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MODAL CATAPULTS AND THE LIMITS OF MODAL LOGIC

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Abstract I explore modal "catapults," a variety of closure principles for modal operators. Consider a proposition *p* that logically implies, entails, strictly implies, modally implies, materially implies, …, a proposition *q*. According to the appropriate catapult for a modal operator *M*, if *Mp*, then also *Mq*. Modal catapults play a crucial role in the logical analysis of traditional philosophical arguments, such as fatalism and incompatibilism. Additionally, standard deontic paradoxes and moral dilemmas involve a deontic modal catapult in some form. In the realm of deontic logic, I advocate for a solution grounded in actualism and counterfactuals (Jackson, Goble). In considering whether it ought to be that *A* we should look particularly at what would be the case, were *A* the case. This approach explains the failures of closure while still acknowledging its central role in modal reasoning. Modal catapults are indispensable to the logic of modalities, but they also delineate the boundaries of this approach.

Keywords
normal modal logic, closure principles, the consequence argument, deontic logic, actualism, moral dilemmas

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MODALNI KATAPULTI IN MEJE MODALNE LOGIKE

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Izvleček Modalni »katapulti« so osnovne logične sheme sklepanj za modalne operatorje (»zaprtost« za logično posledico). Denimo, da propozicija *p* logično implicira, strogo implicira, modalno implicira ali materialno implicira …, propozicijo *q*. V skladu z ustreznim »katapultom« za modalni operator *M* velja prenos modalnosti: če *Mp*, potem tudi *Mq*. Modalni katapulti imajo pomembno vlogo pri logični analizi tradicionalnih filozofskih argumentov, kot sta fatalizem in inkompatibilizem. Tudi pri deontičnih paradoksih in v moralnih dilemah imajo katapulti osrednjo vlogo. Zagovarjam pristop, ki temelji na aktualizmu in protidejstvenem razmišljanju (Jackson, Goble): v razmišljanju o tem, ali bi *moralo* biti res, da *p*, upoštevamo, kaj *bi* bilo res, če *p*. Ta pristop dobro pojasni, kdaj prenos deontične nujnosti ne deluje in hkrati razloži njegovo uporabnost. Modalni katapulti so nepogrešljivi v logiki modalnosti, vendar tudi zarišejo meje tega pristopa.

Ključne besede
normalna modalna logika, načela »zaprtosti«, argument iz posledic, deontična logika, aktualizem, moralne dileme

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1 Modal logic and philosophy

Tradition has it that the phrase "Let no one ignorant of geometry enter" was engraved at the door of Plato's Academy. Humberstone (2005, 534) proposes that philosophy departments of a broadly analytical stripe would do well to post a similar inscription: "Let no one who is ignorant of modal logic enter here." Philosophical trends change in time, and so do their inscriptions. However, it is still true that the various branches of modern philosophical logic cannot be understood without some basic knowledge of modal logic. According to MacFarlane (2020, xv), "philosophical logic" today encompasses two main areas: (a) the philosophical investigation of the basic notions of logic and (b) the deployment of logic to help with philosophical problems. In the second sense, it consists mainly in the formal investigation of alternatives and extensions to classical logic. Modal logic is particularly significant, as many traditional philosophical problems—such as fatalism and free will, realism and knowledge, and moral dilemmas—entail modal notions and reasoning.

The book under discussion (Šuster, 2023) is divided into two parts. The initial "motivational" section comprises six essays addressing traditional philosophical problems, each centred around a specific modal argument or rule. The book's second part provides a formal "toolbox" for the first part: a standard introduction to normal (propositional) modal logic and possible world semantics. The final chapter presents a detailed account of non-monotonic logic and semantics of counterfactual conditionals – they are, after all, the pillars of hypothetical thinking and the royal road to the empire of modality in general.

Overall, the book fits the program of "hard-core" analytic philosophy perhaps best exemplified by Williamson in his methodological "sermon" (2007, 288):

> "Much even of analytic philosophy moves too fast in its haste to reach the sexy bits. Details are not given the care they deserve: crucial claims are vaguely stated, significantly different formulations are treated as though they were equivalent, examples are under-described, arguments are gestured at rather than properly made, their form is left unexplained, and so on. /…/ The fear of boring oneself or one's readers is a great enemy of truth. Pedantry is a fault on the right side. /…/ Precision is often regarded as a hyper-cautious characteristic. It is importantly the opposite. Vague statements are the hardest

> to convict of error. Obscurity is the oracle's self-defence. To be precise is to make it as easy as possible for others to prove one wrong."

Some might say that a hard-core analytic philosophy with its insistence on logic, clarity, and detail is slightly out of date, "recently old philosophy is like recently old fashion: old enough to be dowdy but not old enough to be romantic" (Saunders, 2022) Williamson and I would both disagree. The standards are not just recently old; they were set by the first grandmaster of logic and philosophy, Aristotle. Consider his famous discussion on necessity, time, logic and freedom in *De Interpretatione* (cf. the third chapter of Šuster, 2023). Moreover, they are likely to stay with us; I was always impressed by the precision, carefulness and attention to modal details in van Inwagen's formulation of *the consequence argument* for classical incompatibilism (if determinism is true, then no one is or ever was able to do otherwise). Much of my thinking about modal rules of inference, their interconnections, and implications in general has been shaped by the analysis of the reasoning that underpins this specific argument. However, in the book itself, I did not explain the actual *title*. In this article, I aim to address this omission and elucidate the connections between the various topics discussed in the book.

2 Modal catapults

Fischer and Ravizza coined the name "modal slingshot" (1996, 213):

> "The basic idea of the modal principle is that if some state of affairs S1 obtains and one does not have any choice about (or control over) S1's obtaining, and if S1 implies S2 and one does not have any choice about (or control over) the fact that if S1 obtains, then S2 obtains, then it follows that S2 obtains and one does not have any choice about (or control over) S2's obtaining. The modal principle works as a kind of modal slingshot: it projects the modal property of "powerlessness" from one state of affairs (S1) to another (S2)."

They were discussing van Inwagen's consequence argument (CA) and the role of the modal principle *Beta* (no choice about p, no choice about if p, then q, therefore no choice about q). Let us say that a particular principle corresponds to a "slingshot," as a smaller handheld device for launching "powerlessness" in the case of CA. "Catapults," on the other hand, are not supposed to indicate "siege weapons" (perhaps for attacking philosophical arguments), but should be associated with

larger, more complex devices used to launch a projectile over a distance. "Modal catapults" is a metaphorical designation of general logical weapons for projecting modal properties of propositions. My use of this term is closely related to the more familiar logical concept of *closure*. In standard metalogic, the logical closure of a set of propositions is the set of all propositions that logically follow from those propositions. Closure under *entailment* ensures that a given set of propositions includes all propositions that are logically entailed by it. When a set of propositions is closed under a *rule*, this means that applying the rule to any propositions within the set will produce propositions that are also within the set. One can specify a system of modal logic as a logically closed set of propositions (closure of characteristic modal axioms under the specific inference rules). The closure of a modal operator under a rule ensures that the modal properties of propositions are transferred.

Suppose that a proposition *p* logically implies, entails, strictly implies, modally or **M**-implies, materially implies, ..., a proposition *q*. Then, according to rule *R*, if *Mp*, then also *Mq*. Some catapults *seem* to be valid (if *p* is possibly true and *p* entails *q*, then *q* is also possibly true), and some are uncontroversially invalid (if *p* is necessarily true and *p* materially implies *q*, then *q* is necessarily true). But many are in-between, and this is where most of the philosophical action is (Ought we do something whenever our doing it logically follows from our doing something else that we ought to do?). The paradigm case of a modal catapult is the defining rule of normal modal logic. According to Chellas (1980, 114–115) normal systems of modal logic can be characterized in terms of the schema: »$\Diamond\phi =_{def} \sim\Box\sim\phi$« and the rule of inference:

RK. From $\vdash (\phi_1 \,\&\, \phi_2 \,\&\, \ldots, \phi_n) \supset \phi$ infer $\vdash (\Box\phi_1 \,\&\, \Box\phi_2 \,\&\, \ldots, \Box\phi_n) \supset \Box\phi$

Rules of inference, in this case, preserve the theoremhood: the conclusion of a rule is a theorem if each of its hypotheses is. **RK** expresses a general rule of modal consequence: a proposition is necessary if it is a consequence of a collection of propositions each of which is necessary. When $n = 1$ we get the core representative of modal catapults, the principle of closure under logical consequence:

RM. From $\vdash \phi \supset \psi$ infer $\vdash \Box\phi \supset \Box\psi$

Closure is also a fundamental principle in logics of counterfactual conditionals of the form "if it had been the case that ϕ, then it would have been the case, that ψ" or '$\phi > \psi$'. A conditional variant of **RK** is:

RCK. From $\vdash (\psi_1 \,\&\, \ldots \,\&\, \psi_n) \supset \chi$ infer $\vdash (\phi > \psi_1 \,\&\, \ldots\, \phi > \psi_n) \supset (\phi > \chi)$

Modal catapults, in my sense, encompass a family of modal principles (variously called "the principles of distribution," "closure principles," "the principles of inheritance," etc.). Some typical modal catapults are:

- If a subject S knows that *p*, and *p* entails *q*, then S also knows that *q*.
- If it is inevitably the case that *p* and it is also inevitably the case that, if *p*, then *q*, then it is inevitably the case that *q*.
- If something is obligatory and it necessarily entails something else, then that something else should also be considered obligatory.

Let me formally introduce some typical instances. Let 'Np' stand for: *p* is true and no one has or ever had any choice about *p*. There is an enormous discussion about the following rule ("slingshot"), which plays a central role in CA:

Beta $\quad N\phi, N(\phi \supset \psi) \vdash N\psi$

A variation, also much discussed in the literature on CA, is:

Beta 2 $\quad \Box(\phi \supset \psi) \vdash N\phi \supset N\psi$

Modal catapults have a venerable logical tradition. Diodorus Cronus offered the so-called "Master Argument" in the form of an inconsistent triad (Duncombe, 2024):

(MA1) Every past truth is necessary;
(MA2) The impossible does not follow from the possible;
(MA3) There is a possible truth which neither is true nor will be.

Diodorus denied (MA3) and affirmed, "All possible truths are either true or will be true." This was supposed to yield a form of *fatalism*, since only what is now true or will be true is possible, *unrealized* possibilities are excluded. A key premise is the

principle (MA2) that "Nothing impossible follows from the possible." In terms of modal logic, the principle expresses the closure of the possible over entailment (von Wright 1979, 302):

$$(\Diamond\phi \,\&\, \Box\,(\phi \supset \psi)) \supset \Diamond\psi$$

The variations of this principle are catapults in the form:

$$\Box\,(\phi \supset \psi) \supset (\Diamond\phi \supset \Diamond\psi)$$
$$\Box\,(\phi \supset \psi) \supset (\Box\phi \supset \Box\psi)$$

Kapitan (2002, 130) refers to the variations being discussed in the debate over CA as 'Diodoran Principles'. They are often used by incompatibilists to demonstrate the incompatibility of free will and determinism. Where *P* is any truth, *H* a proposition expressing the complete state of the world at a time in the distant past, *L* a conjunction of the laws of nature and '□' expresses broad logical necessity, it is a consequence of determinism that:

$$\Box[(H \,\&\, L) \supset P]$$

Consider now *the Simple argument* for *Incompatibilism*, an instance of **Beta 2**:

$$N(H \,\&\, L), \Box[(H \,\&\, L) \supset P] \vdash NP$$

Since a conjunction of laws and history is "out of anybody's control," it follows, given the truth of determinism, that, no one has a choice about any true proposition at all ('NP'). Should the compatibilists, therefore, deny the validity of Diodoran principles? Let me first notice that Chrysippus, the ancient compatibilist, really denied the closure principle (MA2): "Nothing impossible follows from the possible", and so do some modern compatibilists. Here is Perry's counterexample (2004, 247). Let *R* be the proposition that Joe raises his hand at *t*, where *t* is some future time. Let *Q* be a conjunction that Joe raises his hand at *t* and that Joe's mother ate a cookie in 1950. Since *Q* includes *R* as one of its conjuncts, *Q* entails *R* (so '□ (Q ⊃ R)'). Suppose also that Joe's mother did *not* eat a cookie in 1950. Joe can render *R* false by not raising his hand at *t* (so ~NR), but Joe cannot render *Q* false (therefore NQ), since *Q* was rendered false by his mother back in 1950.

The incompatibilists are ready to offer some "tweaks" to defend their argument. van Inwagen (1983, 68) defines "S can render *p* false" (a denial of 'Np') as "It is within S's power to arrange or modify the concrete objects that constitute his environment in some way such that it is not possible in the broadly logical sense that he arrange or modify those objects in that way and the past have been exactly as it in fact was and *p* be true." He is aware of the fact that, according to this definition, one *can* render false untrue propositions about the past: "I can render the proposition that Socrates died of old age false, since it is not possible that the past should have been exactly as it in fact was and Socrates have died of old age." According to van Inwagen, Joe can render it false that Joe's mother ate a cookie in 1950 after all, contrary to Perry's judgment!

Here, I am not interested in all the twists and turns of this particular philosophical discussion (see chapter 4 of Šuster, 2023), but it is clear that the modal slingshot (an instance of a modal catapult) is at the centre of the debate. The notion(s) of the ability to act otherwise in the free will debate (a denial of 'N' in the slingshot) are often explicated in terms of *counterfactual* conditionals. Thus Kapitan (2011, 135): S is able at *t* to see to it that ~P iff there is a course of action X such that at *t* (i) S is able at *t* to do X, and (ii) were S to do X, then ~P. According to the broadest possible understanding, all that is required from an agent S to have such an ability is that from S's doing X it may be inferred that *P* is false. Even contradictions and past falsities are such that one is able, at *t,* to see to it that they do not obtain in this sense: they are (now) false, and whatever S does, they (still) remain false.

But the compatibilists usually prefer an *active* reading of "If S were to do A, then *P*". The antecedent's being true in some sense "requires" *P* to be true ("makes it the case", "brings it about" that the consequent true). The *Simple argument* is invalid in this interpretation: nobody can make it the case that the thesis of determinism, '□[(H & L) ⊃ P]' is false and nobody can bring about a different combination of the past and the laws of nature, 'N(H & L).' The premises are true. But surely one can make it the case that one's hand, which was actually unraised, is raised (so '~NP')? This is quite clear from the early compatibilistic refutations of CA. Slote (1982, 19) interpreted 'N' as "selective" necessity – as being determined in a particular sort of way, which selects "some factor that brings about the unavoidable thing without making use of (an explanatory chain that includes) the desires, etc., the agent has around that time". The avoidability of *P* (or ability to render false the proposition

that *P*) then involves something like "the-agent-including-explanatory-chain" that *brings* about that not-P, or *active* ability. Let *P* be some "particular about-to-be-performed action" of an agent S (say raising her hand). Slote (1982, 20) argues *against* the inference:

$$N_s (H \& L), N_s[(H \& L) \supset P] \vdash N_s P$$

Premises are true (unavoidable for S, independent of her desires, etc.), but the conclusion is false – the relevant action is *brought about* and explained through S's desires, abilities, etc. Strictly speaking, this principle is closure of 'N' under implication, but Slote was right when he spoke about "closure under logical implication" or **Beta 2,** which really *fails* for active (in Slote's terminology, *selective*) ability.

Pruss tries to rehabilitate CA with the help of counterfactuals and claims that the following catapult principle is a plausible axiom (2013, 433):

WEAKEN. $p > q, \Box(q \rightarrow r) \vdash p > r$

Pruss reads 'Np' as the claim that there is nothing that anyone can (ever) do that would falsify *p*. He then derives **Beta 2** ('$\Box(\phi \supset \psi) \vdash N\phi \supset N\psi$') from **WEAKEN** and views this result as a decisive defence of CA.

According to Chellas (1980, 269), counterfactual conditionals can be conceived of as expressions of *relative* necessity: the proposition expressed by ψ is in some way necessary with respect to the condition expressed by ϕ, or '[ϕ]ψ,' where the antecedent forms a unary modal operator. So, we get:

RCK'. From $\vdash (\psi_1 \& \ldots \& \psi_n) \supset \chi$ infer $\vdash ([\phi]\psi_1 \& \ldots [\phi]\psi_n) \supset [\phi]\chi$

Conditionality assumes the aspect of a propositionally indexed modality. '[ϕ]ψ' holds at a possible world *w* just in case ψ holds at all possible worlds possible with respect to the given one, relative to the proposition expressed by ϕ. Expressed in terms of relative necessities, **WEAKEN** becomes a catapult-like principle:

$$[p]q, \Box(q \rightarrow r) \vdash [p]r$$

The compatibilist will likely remain unimpressed by this principle in the same way as they are by **Beta 2**, both will be declared invalid. They will draw attention to their *active* reading of conditionals, "If S were to do A, then *P*." Pollock (1984, 111) already made a distinction between *simple* subjunctive conditionals "If P had been true, then Q would have been true" ('P > Q') and the *necessitation* conditionals ('P >> Q'). A simple subjunctive conditional can be true because there is a connection between *P* and *Q,* such that *P*'s being true in some sense "requires" *Q* to be true but it can also be true because *Q* is already true and *P*'s being true would not interfere with this ("even if P, still Q"). Pollock notices that a *Catapult* principle fails for the necessitation: "If P >> Q is true and Q entails R, then P >> R is true." For instance: If I had pushed the button, it would have rung – pushing the button necessitates that the doorbell rings. That the doorbell rings entails that the doorbell exists. But pushing the button does *not* make it true that the doorbell exists. The compatibilists will point out that WEAKEN *fails* for Pollock's necessitation conditional, which is just the notion employed in their "active" analysis of ability (the ability to make it the case, to produce, to bring about, etc.). The catapult does not work.

I accept compatibilistic interpretations, but I think that logic *alone* will not settle the issue between the broad and the active understanding of the ability to act otherwise in CA. However, it will point out different properties of abilities and conditionals in question and make the disagreement much more precise, in line with the hard-core program of analytic philosophy (cf. Šuster, 2021).

3 Deontic catapults

Standard deontic logic (SDL) is a well-explored system of normal modal logic. Let 'O' stand for "it is obligatory that …" One of the central principles of SDL is the "Inheritance Principle":

ROM. From $\vdash \phi \supset \psi$ infer $\vdash O\phi \supset O\psi$

And a variant:

ROM.' From $O\varphi$ and $\Box(\varphi \supset \psi)$ infer $O\psi$

Brink (1996, 111) uses yet another variation, called *the obligation execution principle*:

$$(O\varphi \,\&\, \Box(\psi \supset \sim\varphi)) \supset O\sim\psi$$

One is obliged not to do anything that would interfere with the execution of our (original) obligations. This principle plays a crucial role in a debate on moral dilemmas (Šuster, 2023, chapter 6) – many have objected to its validity, but it is not easy to give it up. According to Goble (2009), it is the task of deontic logic to explain what follows from a statement that one ought to do something and to explain what other normative propositions follow. For example (Goble, 2009, 469):

"If the law of a nation states that every person aged 18 must register for national service, then Irwin, who has just turned 18, is surely entitled to infer that he must register for national service. The law does not explicitly say that he must; Irwin is not mentioned by name in any law of that nation. Nevertheless, that Irwin ought to register is surely implied by what the law does explicitly say."

Yet nearly all of the so-called paradoxes of deontic logic, in one way or another, involve **ROM** and its variants. Consider Ross's Paradox: "It is obligatory that the letter is mailed (M)," therefore, "It is obligatory that the letter is mailed (M) or the letter is burned (B)." A natural regimentation would be:

$$OM, \Box(M \supset (M \vee R)) \vdash O(M \vee R)$$

The conclusion is highly counterintuitive. Or take the Good Samaritan paradox:

(1) It is obligatory that Jones help (H) Smith who has been robbed (R).
(2) Necessarily, if Jones helps Smith who has been robbed, then Smith has been robbed.
(3) It is obligatory that Smith has been robbed.

In the form of a catapult, we get:

$$O(H \,\&\, R), \Box((H \,\&\, R) \supset R)) \vdash OR$$

The conclusion is unacceptable (McNamara & Putte, 2022). But does it really *follow*? In the first version of his *Logics*, Nolt (1997, 362) claims that the "Inheritance Principle" is not valid in modal deontic logic. He gives the example of the Bad Bart, who is bent on murdering me and can be stopped only by being killed. Then I may reason as follows:

> I should live (L).
>
> It is necessarily the case that if I live (L) Bad Bart dies (~B).
>
> Bad Bart should die (~B).
>
> Or: $OL, \Box(L \supset {\sim}B) \vdash O{\sim}B$

A simple possible worlds semantics model with two worlds is supposed to be enough to demonstrate the invalidity: in the actual world, I do not live, and Bart does not die, whereas in the one and *only deontic* alternative to the actual world, we are both alive. But there is a *caveat*: the deontic alternative is not relatively *possible* with respect to the actual world.[1] There are *two* accessibility relations in this model: one reflexive, defining the notion of (alethic) possibility, and another (S) serial, specifying the notion of (deontic) permissibility (for any two worlds i and j, iSj if and only if j is morally permissible relative to i). Both premises are true in the model: I am alive in all the deontic alternatives in the model, and the conditional premise is true in both worlds. The conclusion is false, since Bart is alive in the deontic alternative to the actual world. According to Nolt, this is the case of a *moral tragedy*: what *ought* to be the case *cannot* be the case. It ought to be the case that no life is lost, but given the circumstances, this cannot be the case (the world where we are both alive is not possible with respect to the actual world).

The idea that permissible worlds need not be a subset of possible worlds is sometimes offered as a solution for some of the so-called deontic paradoxes (Morscher, 2002). In the standard "Kripke-style" possible world semantics, p is obligatory in the actual world @ iff it holds in all the ideal worlds from the standpoint of @ (worlds w such that everything obligatory at @ holds in w). In this

[1] Borut Čerkovnik (University of Ljubljana) pointed out this explanation for the invalidity of **ROM** in a discussion note on Šuster, 2023.

semantics, only *two* types of worlds are distinguished in a model: actual and ideal ones. All ideal worlds are automatically possible. This is reflected in typical theses of SDL, which say that the (logically) impossible cannot be obligatory, and if the impossibility is interpreted broadly enough, we even get: "it is possible that all (relevant) normative demands are met" as a thesis of SDL (cf. McNamara & Putte, 2022). Nolt can only get his countermodel to the "Inheritance Principle" if there are *three* types of worlds in the model: the actual world, ideal (permissible) worlds, and worlds that may or may not be possible relative to the actual world. Kant's famous *dictum* that "ought" implies "can" is then violated but, according to Nolt, modal deontic logic allows for such moral tragedies.

Suppose that we ought to preserve the Earth's biosphere, yet we are nevertheless fated to destroy it. We should but we cannot, according to Nolt. Yet what does "fated to …" mean here? Consider a person tied to a tree on the shore of a lake, unable to move. Does she have an *obligation* to help a child drowning in the lake? I do not think so. Is the *ought* of ecology really different from the *ought* of saving the drowning child? And is the "*fated*" of ecology completely different from the *cannot* of saving the child? Difficult to say without ethical and metaphysical investigations. Even Nolt admits that, for consequentialists, all permissible worlds must also be possible, thus excluding the very possibility of moral tragedies. Given the intuitiveness of Kant's principle, I prefer to reserve the notion of a *moral tragedy* for standard moral *dilemmas*, situations where an agent's obligations conflict. The Bad Bart case can then be formulated as:

1. OL	a
2. OB	a
3. □ (L ⊃ ~B)	a
4. O~B	1, 3 ROM
5. O~B ⊃ ~O~~B	Dd'
6. ~O~~B	5, 6 MP

The derivation of a contradiction (lines 2 and 6) uses **ROM** and a fairly uncontroversial deontic principle, **Dd'**. In a moral dilemma, (i) the agent is required to do each of two actions; (ii) the agent can do each of the actions; yet (iii) the agent cannot do both actions. No matter what she does, she will do something wrong. The possibility of moral dilemmas is automatically excluded by the axioms of SDL (**Dd'**), but I think they are inevitable in our moral life and normative practice in general.

4 Paradoxes, dilemmas and actualism

Deontic paradoxes "… were the booster rocket that provided the escape velocity deontic logic needed from subsumption under normal modal logics, thus solidifying deontic logic's status as a distinct branch of logic" (McNamara & Putte, 2022). Many solutions have been proposed, I prefer the modifications of modal catapults based on the insights of the logic of counterfactual conditionals (analysed in chapter 9, Šuster, 2023).

A system of modal logic is monotonic if it is closed under **RM** (Chellas, 1980, 234). Counterfactuals do not obey the principle of monotonicity and witness the failure of the principle of *Antecedent Strengthening*. If I had scratched the match, it would have lighted; but it is not true that if I had scratched and drenched the match, then it would (still) have lighted. According to the Stalnaker-Lewis possible worlds semantics, we test whether the conditional "If it were the case that A, then it would be the case that B" (or 'A > B') is true in a possible world *w* by considering the closest possible worlds to *w* where *A* is true. The conditional is then true in *w* just in case *B* is true at all in the closest possible worlds to *w* where *A* is true. Closeness is standardly explicated in terms of similarity: *B* is true throughout some class of A-worlds that beat all competitors in respect of how like the actual world *w* they are. The closest "scratched match" world is the one where the match lights. The closest scratched and drenched match world, which is required for the evaluation of the conditional with the strengthened conditional, is a *different* world, further away from actuality and the consequent is false in *that* world.

How does this help with obligations? Well, there is a counterfactual element in deontic modality – in considering whether it ought to be that *p* we should look to what would be the case in the closest *p*-world to the actual world. Recall the Good Samaritan. It ought to be that Jones helps Smith, who has been robbed. But "Smith is helped by Jones" entails that Smith has been robbed. Yet it seems false that it ought to be that Smith has been robbed. Suppose that Smith has actually been robbed. Then what makes it true that it ought to be that he is helped by Jones is that the closest "robbed & helped" world is *better* than the closest "robbed & not-helped" world. And this is consistent with the fact that what would have been the case had he *not* been robbed in the first place is better than what is actually the case. The closest "robbed" world is worse than the closest "not-robbed" world, so the

conclusion "It ought to be that Smith is robbed" is false, and the initial catapult is "broken."

Jackson (1985, also Goble, 1990) argues for *contrastivism* and *actualism* about deontic claims. Contrastivism is the thesis that ought-sentences have their truth-conditions relative to a class of alternatives. It ought to be that *p* is true just when *p* is better than the relevant alternative propositions (mutually exclusive but not necessarily jointly exhaustive) alternatives. But the implicitly suggested reference class of alternatives is *changing*. As with counterfactual antecedents: in considering whether it ought to be that *A* we should look particularly to what would be the case were *A* the case, and what would be the case were *A* the case might be importantly different from would be the case were *A* & *C* the case. Obligations are *relative*, they concern what ought to be out of a range of exclusive alternatives. It ought to be that A *out* of {A, A^1, A^2. . .} iff what would be the case were A true (the closest A-world) is better than what would be the case were A^i true, for each *i* (Jackson 1985, 185). To simplify (Blumberg & Hawthorne, 2023, 86):

> OA is true in w iff the closest A-world to w is better than the closest ~A-world.

Actualist semantics that spells out the comparison of obligations in terms of similarity to the actual world explains the invalidity of ROM-like catapults. According to Jackson, the set of alternatives to which "ought" is relative can change at each stage in the conversation. The phenomenon is particularly clear in the so-called Sobel sequences of counterfactuals (Bennett, 2003, 160):

(1) If you had walked on the ice, it would have broken.
(2) If you had walked on the ice while leaning heavily on the extended arm of someone standing on the shore, the ice would have broken.
(3) If you had walked on the ice while leaning heavily on the extended arm of someone standing on the shore but slipped, the ice would have broken.

(1) and (3) are true and (2) is false, but we could easily continue the sequence of adding extra conditions to the counterfactual antecedent, leading to changes in the truth value. "A > B" is true since the closest A-world to the actual world *w* is a B-world. However, "(A & C) > B" is false because the closest "A & C" world differs

from the closest A-world. Jackson (1985) invokes this type of explanation in his account of the invalidity of ROM. Suppose Smith has actually been robbed and helped. Ought it be the case that he is robbed? The relevant alternatives are: {Smith is robbed, Smith is not robbed, Smith is robbed and helped, Smith is robbed and not helped}. The "not robbed" case is the best out of *this* set. Ought it be the case that he is robbed and helped? The relevant alternatives are now: {Smith is robbed and helped, Smith is robbed and not helped}. The "robbed and helped" case is the best in *this* set of alternatives. Once again, what would be the case were A true (the closest A-world) differs from what would be the case were both, A and C true.

Nevertheless, two tasks remain. How does this solution work in the case of moral dilemmas? Secondly, modal catapults are not so easy to dismiss. Utilising these principles, we may persuade moral agents that they are committed to the logical consequences of their moral principles. One should also be able to explain the reasonableness of this pattern! Let me start with the second task.

Many have noticed that the plausibility of strengthening the antecedent in the case of counterfactual conditionals can be restored after all. Consider the sequence above – when asserting the truth of (1), we *ignored* the possibility of leaning heavily on the extended arm of someone standing on the shore as irrelevant, but if this possibility is not ignored, both (1) and (2) will be false. We can generalise: relative to any given *fixed* set of alternative possibilities, (1), (2), and (3) have the same truth-value. A contextually variable *strict* conditionals analysis of counterfactuals was always an option (Lowe, 1990, 83):

$$A > B \text{ is true in a context } c \text{ in a world w iff } \Box_{cw} (A \supset B)$$

'$\Box_{Cw}$' is a necessity operator meaning: "In every possible world sufficiently similar to *w* as determined by the context *c*, it is true that ... ." Within a given context, relative to the same set of possibilities, any time 'A > B' is true, so is '(A & C) > B'. The moves in the Sobel sequence are marked by changes in the context *c*.

Stalnaker (1984, 125) was already aware that one could defend a strict conditional account of counterfactuals as an alternative to the variably strict account. The principal difference will then be in the demarcation between semantics and pragmatics, determining at what level of abstraction one's notion of validity is

defined. I address some of these issues (Šuster, 2023, chapter 2) in discussing Stalnaker's distinction between valid and reasonable inferences. I think we might also adopt the contextual approach as a solution of deontic paradoxes, which nevertheless respects the inferential potential of deontic closure principles. Consider a variation of Goble's example. According to laws in Slovenia, an identity card must be held by a citizen older than eighteen if he or she does not have another valid official identification document with a photograph issued by a public authority. Therefore, Ana, who is nineteen and does not have any other official identification document, is obliged to have an identity card. Given the general law, the particular is implied. Clearly, there are *no* contextual changes in this case. If *A* entails *B*, then if one ought to do *A,* then one ought to do *B*, provided we consider the *same* set of contextually relevant worlds. In the previous case of Smith, we first consider the case of his actually being robbed (he ought to be helped!), but in the conclusion, we do not envisage the *same* range of possibilities (he should not be robbed at all!).

However, a contextual move does not help in the case of moral dilemmas. It seems evident that there are situations where an agent's obligations conflict in the *same* context of relevant possibilities. There are situations in which some state of affairs both ought to be and ought not to be. For instance, I ought to help my friend even when this obligation is in conflict with the obligation to my community. Yet principles from deontic logic can be used to argue *against* the very existence of moral dilemmas. To simplify, take **Dd',** which immediately gives (via a plausible rule that logically equivalents are interchangeable): $\sim(O\varphi \,\&\, O\sim\varphi)$.

Does the analogy with the logic of counterfactuals help to solve this conundrum? Inconsistent "oughts" look like impossible antecedents. Recall the semantics of conditionals:

> A > B is true at *w* iff some (accessible) A and B-world is closer to w than any A and ~B-world, if there are any (accessible) A-worlds.

According to Lewis (1986, 18):

> If A is *impossible*, A > B is vacuously true regardless of the consequent B.

In deontic logic combined with actualism, we are now also supposing that among possible situations in which a particular proposition, that *A*, is true (false), some are closer to the actual case than others. In genuine dilemmas we seem to have both: the closest A-world to *w* is better than the closest ~A-world and the closest ~A-world to *w* is better than the closest A-world. Rather than accept all such obligations as vacuously true or introduce impossible worlds or lean on paraconsistent logic, I prefer to understand situations like these as lying *beyond* the scope of standard deontic logic. SDL is applicable only to domains in which it is presupposed that there are no such conflicts. Thus, I adopt an elegant solution proposed by Goble (2005, 2009) and restrict the scope of a catapult to *normal*, non-conflicted obligations (Šuster 2023, 117–121):

ROMu. From $\vdash \phi \supset \psi$ infer $\vdash P\phi \supset (O\phi \supset O\psi)$

ROMu'. From $P\phi$, $O\phi$ and $\Box(\phi \supset \psi)$ infer $O\psi$

If ϕ entails ψ, then if one ought to do ϕ, then one ought to do ψ, provided that ϕ is *permitted* by the normative system. In other words, if ϕ is an unconflicted obligation and it entails ψ, then ψ too is obligatory. The principles of deontic logic are modified to allow for the possibility of genuine normative conflicts, but we still keep the logical core of modal logic in "normal" situations (of course, we still have to be aware of contextual shifts and their impact on the validity of catapults). It seems to me that the inapplicability of normal modal logic and moral theory does not imply the end of rationality in some broader sense. Nagel (1979, 135) points us to Aristotle and practical wisdom, "which reveals itself over time in individual decisions rather than in the enunciation of general principles." However, I am aware that moral dilemmas might often be described as *deep disagreements* internalised within the agent. For example, I may feel torn between the loyalty I owe to a friend and my obligations towards the community. In such cases, I often suggest resorting to the more flexible tools of *informal* logic. The formal solutions I propose for addressing the failures of deontic closure – actualism, contextualism, and restrictionism – appear to be an inelegant patchwork. However, these issues are notoriously difficult, and nothing decisive has been proposed in the extensive discussion of the subject.

5 Conclusion

It may seem that I introduce and explore modal catapults solely to highlight their limitations as instruments for philosophical analysis. Why insist on normal modal logic and the general closure principles for modalities (necessity, ability, obligation, etc.)? Because modal catapults are, in one form or another, indispensable to the logic of modalities; discarding these principles is equivalent to relinquishing the entire framework of modal logic. Pollock, for instance, was well aware that the "active" necessitation conditional is of more interest to philosophers than the simple subjunctive. Nevertheless, he makes a crucial observation when he notes that the necessitation conditional satisfies virtually *no* logical laws (Pollock, 1984, 111). Generally, at least from the perspective of standard logical approaches, there is little to discuss regarding a modal operator that is not closed under entailment.

Does this observation warrant a pessimistic view towards the endeavours of "hard-core" analytic philosophy? On the contrary, much like in other scientific fields, we develop new tools and explore new formal approaches (beyond the scope of the book in discussion). Moreover, any form of logic, whether normal or otherwise, cannot replace philosophical reflection. Formal logic is a catapult that propels our initial beliefs with modal principles, shaping the trajectory of their journey. It neither dictates the starting point nor the philosophical interpretations of the landing points.

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