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FORMALIZATION IN PHILOSOPHY

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Abstract. The advantages and disadvantages of formalization in philosophy are summarized. It is concluded that formalized philosophy is an endangered speciality that needs to be revitalized and to increase its interactions with non-formalized philosophy. The enigmatic style that is common in philosophical logic must give way to explicit discussions of the problematic relationship between formal models and the philosophical concepts and issues that motivated their development.

§1. Introduction. Few issues in philosophical style and methodology are so controversial among philosophers as formalization. Some philosophers consider texts that make use of logical or mathematical notation as non-philosophical and not worth reading, whereas others consider non-formal treatments as—at best—useful preparations for the real work to be done in a formal language. Such anti-formalist and pan-formalist sentiments are more often expressed at informal gatherings than in the scholarly literature. This is unfortunate, since the value—or disvalue—of formalized methods is an important metaphilosophical issue that is worth systematic treatment. In this essay, I will discuss the nature of philosophical formalization and highlight some of its advantages and disadvantages.

§2. Idealization in philosophy. A representation in formal language is always the outcome of a simplification for the sake of clarity, or in other words an idealization. Hence, the formal model is an ideal in the sense of "[s]omething existing only as a mental conception" (***OED***). To idealize in this sense means to perform a "deliberate simplifying of something complicated (a situation, a concept, etc.) with a view to achieving at least a partial understanding of that thing. It may involve a distortion of the original or it can simply mean a leaving aside of some components in a complex in order to focus the better on the remaining ones" (McMullin 1985, p. 248).

This sense of idealization must be distinguished from the more common sense of expressing a (too) high opinion of something. Formal models may or may not represent something that is "perfect or supremely excellent in its

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kind" (***OED***). Some branches of philosophy make use of formal representations that have been obtained through both types of idealizations. This applies, in particular, to formal models of rational behaviour and rational belief. Such models are both (1) idealizing—simplifying, i.e. they leave out many of the complexities of real life, and (2) idealizing—perfecting, i.e., they represent patterns that satisfy standards of rationality that are higher than what actual (doxastic) agents usually live up to. Much confusion can be created by a lack of distinction between these two forms of idealization. In this essay, the focus will be on idealization—simplification, that is found in all variants of formalized philosophy.

Idealization—simplification is not unique to formalization. To the contrary, it is omnipresent in both science and philosophy. Many, probably most, of the crucial concepts in philosophical discourse originate in idealizations of non-philosophical language.[1] As one example, it is common in moral philosophy to regard "John ought to ... ", "It is a duty for John to ... ", and "John has an obligation to ... " as synonymous, although there are occasions when common usage would accept one or two of these phrases but not the other(s) (Brandt 1965). In this and similar cases, philosophers (tacitly) assume that there is, or can be constructed, a more fundamental and more straight-lined concept behind the embellished meanings of words and phrases in non-regimented natural language.

True, idealization is only one part of the transformation of elements from non-philosophical language through which philosophical terminology is shaped. The construction of philosophical language also involves the creation of new distinctions and of terms that have no obvious counterparts in non-philosophical language. Hence, philosophical terminology differs from non-specialized language in two ways. First, it uses some words in different, idealized ways (e.g., 'knowledge', 'value', and 'truth'). Secondly, it uses some linguistic innovations of its own (e.g., 'consequentialism', 'modality', and 'induction'). Terms in the second category have, from the outset, the same streamlined character that the first category acquires through idealization.

Some philosophers have wished to philosophize in 'pre-philosophical' language. In my view, this is an illusory undertaking, since non-trivial philosophical pronouncements, with few exceptions, require more precision than what is immediately available in non-regimented language.[2] Hence, idealization is unavoidable. Unfortunately, it is also unavoidably problematic, and indeed more so in philosophy than in most other academic disciplines.

[1] I prefer 'non-philosophical' to the more common 'pre-philosophical', since there is no reason to believe that philosophy has in its more than two and half millennia of existence been devoid of impact on thinking and language outside of philosophy.

[2] By 'non-trivial' I mean non-trivial against the background of what has already been said by previous philosophers.

The specialized terminology of most other disciplines is supported by empirical correlations that are independent of the non-specialized concepts from which these concepts originated. Physicists who theorize about heat or gravitation do not have to refer back to the non-physicist's concepts of warm and cold, or light and heavy, in order to justify their theoretical constructions. These scientific concepts have their own justification, derived from experiments and other exact observations. Philosophers operating with concepts such as knowledge, truth, goodness, or permission are not in this fortunate situation. These philosophical concepts have no justification apart from their capability of clarifying the corresponding non-philosophical concepts. Hence, on one hand we have to deviate from the general-language meanings of our key terms in order to obtain the precision necessary for philosophical analysis, but on the other hand, if we deviate so far as to lose contact with general-language meanings, then the rationale for the whole undertaking will be lost. For this reason if no other it should be clear that there is no unique "true" formal analysis of non-philosophical or informal philosophical concepts. Different formalizations may capture different properties of the concepts. As an example, probabilistic and non-probabilistic theories of belief seem to capture different properties of human belief systems.

Philosophical or scientific model-making is always a trade-off between simplicity and faithfulness to the original. In philosophy, the subject-matter is typically so complex that an attempt to cover all aspects will entangle the model and make it useless. A reasonably simple model will have to leave out some philosophically relevant features. This makes it possible to devise a counter-argument—typically in the form of a counter-example—that seemingly invalidates the model. However, even if such a counter-argument convincingly discloses a deficiency in the model, this is not necessarily a sufficient reason to give up the model. If the counter-argument cannot be neutralized without substantial losses of simplicity, then an appropriate response may be to continue using the model, bearing in mind it weaknesses.

§3. Formalization as idealization in two steps. Formalization in philosophy typically results from an idealization in two steps, first from common language to a regimented philosophical language and then from regimented into mathematical or logical language. For an example, consider the derivation of the permission predicate (P) of deontic logic from the non-philosophical concept of a permission. We can use the following example from non-regimented language:

(1) 'Roberta is permitted to enter the building.'

Here, the permission refers to an action. In regimented philosophical language, it is common to represent each action by the state of affairs consisting in that action taking place. Hence:

(2) 'It is permitted$_{\text{phil}}$ that Roberta enters the building.'

where "permitted$_{\text{phil}}$" is the philosophical idealization of the "permitted" of ordinary language. "Permitted$_{\text{phil}}$" differs from "permitted" in referring exclusively to states of affairs, and also in other ways. In non-philosophical usage, "when saying that an action is permitted we mean that one is at liberty to perform it, that one may either perform the action or refrain from performing it" (Raz 1975, p. 161). Hence, "permitted" refers to what we may call bilateral permission.[3] In formal philosophy, however, "being permitted to perform an action is compatible with having to perform it" (Raz 1975, p. 161). Hence, one may be "permitted$_{\text{phil}}$" to perform an action but not to refrain from performing it. "Permitted$_{\text{phil}}$" refers to what we may call unilateral permission. The use of unilateral permission in regimented philosophical terminology is a convenient convention, since bilateral permission can be straightforwardly defined in terms of unilateral permission. No definition in the other direction is immediately available.

The second step of idealization takes us from "permitted$_{\text{phil}}$" to the deontic predicate "P"; hence we go from (2) to

(3) Pq,

where P is a predicate expressing permission and q the sentence (or the proposition represented by the sentence) "Roberta enters the building". There are major differences in meaning between "permitted" and "P". It should be noted, though, that in terms of most of the more philosophically significant differences, "permitted$_{\text{phil}}$" is closer to "P" than to "permitted". Hence, intuitively speaking, most of the idealization took place in the first of the two steps of idealization.

From this we may conclude that what makes treatments in formal language special is not their distance to ordinary discourse (that can be surpassed by treatments in regimented natural language). Rather, what makes them special is the mathematical skill that they require and the characteristic types of questions that they give rise to.

It is interesting to note in this connection that the additive model used in utilitarianism, although controversial in other respects, seems to have escaped the negative reaction against mathematical representation that other formal models have encountered in some philosophical quarters. I have not been able to find any other reason for this than the elementary nature of the mathematical skills required by the utilitarian model. However, there is no reason to believe that the usefulness of a formal model stands in inverse relationship to the efforts required to master it.

[3] It has also been called "facultative permission (Alchourrón 1993, p. 55) and "optional" permission (Castañeda 1981, p. 76).

§4. The virtues of formalization. In the natural sciences, formalized theories have the preponderant advantage of being correlated with empirical measurements, so that they can be tested in a more exact way than informal theories. No such mensural correlation is available for formal theories in philosophy. In this respect, formalized philosophy can be compared to pre-Galilean physics. Many medieval physicists employed formal models of physical phenomena, but they did not use these models to predict the outcomes of measurements.[4]

Due to the lack of measurements in philosophy, the claims that can be made for formalization are weaker in this discipline than in the natural sciences. In philosophy, the major virtue of formalization is the same as that of idealization in informal languages: By isolating important aspects it helps to bring them to light. Furthermore, as compared to informal idealization, formalized treatments tend to be helpful in at least four additional, more specific ways.

First, formalization incites definitional and deductive economy. It brings forth questions about the interdefinability of concepts and about minimizing the set of primitive principles of inference. In deontic logic, the interdefinablity of the various normative concepts ("must", "may", "forbidden") comes to the fore much more immediately than in informal discourse on norms and permissions (von Wright 1951). Furthermore, the definability of "good" and "bad" in terms of "better" can be investigated in more detail in preference logic than in informal value theory (Lenzen 1981 and 1983, Hansson 1990). In informal philosophy, two major attempts have been made to define "good" in terms of "better": as "better than its negation" (Brogan 1919) and as "better than some indifferent state of affairs" (Chisholm and Sosa 1966, van Dalen 1974). An obvious question, once these definitions have been proposed, is whether or not they are equivalent. It takes some formal work to find out that they are not equivalent in general, and to identify the rather special conditions under which they are equivalent (Hansson 1990 and 2000).

Secondly, formalization serves to make implicit assumptions visible. As an example of this, informal discourse on preferences often takes tacitly for granted that there is an alternative set, i.e., a set of objects to be compared. In formal models of preferences, this assumption has to be made explicitly, and important properties of the alternative set, such as mutual exclusivity of its elements, have to be specified with full precision. Much confusion has been caused even in rigorous but not fully formal treatments of preferences by equivocation between preferences with different alternative sets (Hansson 1993).

Thirdly, formal theories can support delicate structures that would be much more difficult to uphold and handle in the less unambiguous setting of

[4]See Livesey 1986 and the references given there.

an informal language. Symbolic treatment has made it possible to penetrate some philosophical issues more deeply than what would otherwise have been possible. One of the best examples of this is the relation between truth and language. The philosophical impact of Tarski's semantical analysis of the notion of truth can hardly be overestimated. It could only have been developed in a formalized setting.

Fourthly, formalization stimulates strivings for completeness. The rigorousness of a formal language is, for instance, necessary to make it meaningful to search for a complete list of valid principles of inference. Often enough, this search may uncover previously unnoticed philosophical problems. One example of this is the study of non-monotonic inference. The introduction of precise formal notation (in particular, a non-monotonic consequence relation) has led to much more thorough and extensive studies of patterns of non-monotonic inference and of the relationships between these patterns (Gabbay 1985, Makinson 1993). Among other things, interesting connections with the theory of rational choice have been discovered in this way (Lindström 1993, Rott 1993).

In several areas of philosophical logic, the use of semantical modelling and axiomatic characterizations has led to a deeper understanding of the relationships between the different properties of the structures that are represented in the formal language. One example of this can be found in recent work on belief revision. One of the major components of the AGM framework of belief revision (Alchourrón et al. 1985) is an operator of contraction that, given a (logically closed) belief set K and a sentence p turns out a logically closed subset $K \div p$ of K that does not contain p (unless p is a tautology and thus ineradicable from belief sets). A natural construction for this operator, called partial meet contraction, has been characterized in terms of six postulates, commonly called the Gärdenfors postulates. Five of these are fairly uncontroversial, but the sixth has been the subject of considerable controversy:

$$K \subseteq \mathrm{Cn}((K \div p) \cup \{p\}) \quad \text{whenever } K \text{ is a theory ('recovery').}$$

Cn is an operator that takes us from any set of sentences to the set consisting of all its logical consequences.

Due to the controversial nature of the recovery postulate, it would be interesting to see what can be done with contraction operators that do not satisfy this postulate. However, just giving up recovery does not seem to be a good idea. The reason for this is that the other five Gärdenfors postulates, taken in isolation, are compatible with severely mutilating operators, that may satisfy the following implausible property:

$$\text{If } q \in K \div p, \text{ then either } p \text{ or } q \text{ is a tautology.}$$

To avoid this problem, we would need a postulate, weaker than recovery, that ensures that sentences unrelated to the contraction input are not unnecessarily lost in contraction.

The following postulate seems to be the weakest possible candidate:

> If $q \in K$ and $q \notin K \div p$, then: there is a set A such that $A \subset K$ and $p \notin \mathrm{Cn}(A)$ and $p \in \mathrm{Cn}(A \cup \{q\})$ (*core-retainment*).

Core-retainment requires that if a sentence q is lost in contraction of p from K, then it contributes to the fact that K and some of its subsets imply p.

Surprisingly enough, core-retainment and recovery are equivalent in the presence of the other five postulates (Hansson 1991a). Hence, in this framework, the seemingly weak principle that nothing is unnecessarily lost turns out to be equivalent with the seemingly much stronger recovery postulate. In recent debates, some have argued that recovery is more plausible than it may seem at first, whereas others have maintained that recovery is an artefact of the formal framework (Glaister 1997, Makinson 1997, and Hansson 1999a). This discussion concerns principles of epistemic dynamics that can also be expressed in non-formal philosophical language, but it would hardly have come about without formal work with the axiomatic methodology that was introduced into belief revision theory by Alchourrón, Gärdenfors, and Makinson (1985).

§**5. The dangers of formalization.** In spite of all its advantages, formalization is not always useful. Examples are not difficult to find in which it has given rise to more confusion than clarity. There are several specific but partly overlapping ways in which formalization may be philosophically problematic.

First, formal models tend be *oversimplified*. In order to construct a workable formal model, the number of primitive notions has to be reduced to a very minimum. It is often cumbersome to introduce an additional factor into an already existing formal model. Therefore, the formal philosopher runs the risk of becoming mentally locked in the world of one or a few formal models, neglecting aspects of the real world not covered in these models. As an example of this, logical treatments of value theory tend to exclude many of the value concepts used in informal discourse, such as "acceptable", "fairly good", etc.

Formalization invites the *false unification* of concepts. Most treatments of deontic logic include only one monadic predicate, $O(\ )$. In this way, the distinction between prescriptive predicates with different strengths (should, must, ought, etc.) is lost. Similarly, the introduction of a notation for "dyadic ought", $O(\ /\ )$, has led to a tendency to unify all if-sentences with deontic consequents into one and the same formal predicate, although they differ widely in character and meaning (Hansson 2000). There is no obvious reason why counterfactual sentences with normative consequents should have the same properties as normative rules.

Formalization may also give rise to *false conceptual primitivity*. For reasons of mathematical convenience or elegance, certain concepts are selected to be used as primitives, although they are not, philosophically speaking, a good choice of primitives. In preference logic, "at least as good as" is the common choice of a primitive, from which "better than" and "equal in value to" are defined. From a conceptual point of view, it would have been more natural to use the latter two as primitives, from which "at least as good as" can be defined.

There are plausible ways to define "good" and "bad" in terms of "better", whereas no way to define "better" in terms of the two monadic predicates seems to be available. This has led to claims that "better" is "the fundamental value universal" (Brogan 1919), "the value-fundamental" (Timur 1955), or "the basic notion of normative logic" (von Kutschera 1975). This appears to be an overinterpretation of definability. From the viewpoint of conceptual genesis or fundamentality, "better" does not seem to have priority over the other two concepts.[5]

Formalization invites the introduction of *ad hoc constructions* with no sensible informal interpretation. One example is the use of tautologies and contradictions as value-neutral propositions in some variants of preference logic. According to this practice, a proposition is counted as good or bad according to whether it is better or worse than tautology (contradiction). Some of these constructions may be technically elegant, but from a philosophical point of view they are deeply problematic. It is far from clear how something contingent can be compared in terms of value to a tautology or a contradiction. Admittedly, it may emerge as a technical result in a formal system that "good" coincides with "better than tautology"[6], but this cannot be the formal definition through which "good" should be introduced. Its introduction must be based on intuitions relating to the comparisons that we actually make, and these are comparisons between contingent states of affairs.

Yet another danger connected with formalization is that of an *undue focus on problems that are mere artefacts of the formal model*, rather than on more general philosophical problems that the model can be helpful in elucidating. This can be exemplified by the two types of problems that the existence of moral dilemmas gives rise to in deontic logic. First, if both Op (p is obligatory) and $O\neg p$ (not-p is obligatory), then the dictates of the O

[5]Linguistic evidence points in the opposite direction. In a wide range of languages, the absolute form of adjectives ("tall") is the basic form, and the comparative form ("taller") is marked in relation to the absolute. In a survey of 123 languages, no instance of the opposite relationship between the two forms was found (Ultan, cit. in Klein 1980, p. 41).

[6]This is the case in (Goble 1989).

operator cannot be completely complied with. In the presence of conflicting obligations, no acceptable course of action seems to be available. This may be called the *compliance* problem. Secondly, in most deontic logics, deontic dilemmas also give rise to puzzles of a more logical nature. In standard deontic logic (SDL)[7], it is possible to conclude from Op and $O\neg p$ that Oq for any argument q of the O operator. Hence, in the presence of a moral dilemma, everything is obligatory. This may be called the problem of universal obligatoriness.

The formal inference from Op and $O\neg p$ to Oq runs counter to the way inferences are made in non-formalized normative discourse. It is clearly a logical artefact that has little or nothing to do with moral philosophy. Hence, rather than focusing on the problem of universal obligatoriness, deontic logicians should choose models in which this spurious inference does not arise, and use these models to study philosophically interesting issues such as the compliance problem.

Formalization sometimes involves *implicit ontological assumptions* that may be far from innocuous. The same applies, of course, to non-formal systems of terminology, but ontological presuppositions seem to be particularly entrenched in formal languages. In particular, predicate logic is committed to an ontology that attributes existence to particular things. Therefore, as was pointed out by Seeskin (1978), it is not in all respects well suited to express a metaphysics such as Plato's. Seeskin takes this as a reason to warn against the use of formalization in Platonic scholarship. Another possible response is to search for formalisms that suit Plato's metaphysics better. (Cf. Goodman 1951.)

Finally, formalization is often connected with an *enigmatic style*, in which important philosophical choices are made without explanation, and often without even being explicitly stated. It is common practice among philosophical logicians to introduce formal constructions without explaining them, presumably leaving the interpretation to the reader. This habit may be one of the major factors that alienate some philosophers from formalized work. In enigmatic style, and unwillingness to clarify, many philosophical logicians are the peers of some of the most abstruse postmodernists.

§6. Logic vs. other formalizations. Formalization in philosophy is in practice virtually synonymous with formalization in logical language. (The only major exception is decision theory, that uses decision matrices, rather than logic, as its paradigmatic formalization.) Some of the pioneers of formal philosophy allotted to logic a unique status in philosophy. In particular, Bertrand Russell maintained that "every philosophical problem, when it is subjected to the necessary analysis and purification, is found either to be not

[7]von Wright 1951, Føllesdal and Hilpinen 1970.

really philosophical at all, or else to be, in the sense in which we are using the word, logical" (Russell 1914, p. 14).

There is no clear demarcation between logic and mathematics. Arguably, much if not most of mathematics can reconstructed into some form of logic. Here, with logical languages I mean symbolic languages of the types that are taught in logic courses and in textbooks on logic. In my view, there are no *a priori* grounds why these languages should be better suited than other symbolic languages for modelling each and every subject-matter studied by philosophers. The relative usefulness of logic is an open question, and treatments of the same subject-matters in other types of formal languages should be welcomed.

This is a negative conclusion for logic, but it does in fact pave the way for a more positive conclusion. Once the claims that logic is the only "true" model have been renounced, it is no longer problematic to use truth-functional logic for modelling (subject-matter expressed by) sentences that are not true or false.[8] A normative sentence such as

(1) Jane ought to help her brother.

cannot be true or false (or at least, for the sake of argument, let us assume that it cannot). Therefore, a formal sentence in a truth-valued language (such as Op, where O stands for "ought" and p for "Jane helps her brother") cannot strictly speaking represent sentence (1). It can, however, represent the following sentence:

(2) There is a valid norm to the effect that Jane ought to help her brother,

where validity is relative to some moral code or standard. We can assume that there is a one-to-one correspondence between sentences of the type represented by (1) and those of the type represented by (2). Truth and falsity is, of course, fully applicable to sentences of the latter type. Therefore, to the extent that a logical system adequately mirrors the properties of sentences such as (2) it also mirrors, somewhat more indirectly, those of sentences such as (1).

The use of logic leads to a strong emphasis on sentences. As one example of this, sentences are used as inputs in belief revision theory. This is by no means unproblematic. Actual epistemic agents are moved to change their beliefs largely by non-linguistic inputs, such as sensory impressions. Sentential models of belief change (tacitly) assume that all inputs can, in terms of their effects on belief states, be adequately represented by sentences. When I see a hen on the roof (a sensory input), I am assumed to adjust my belief state as if I modified it to include the sentence 'There is a hen on the roof' (a linguistic input).

[8] See Makinson 1999 and the references given there.

It is a standard assumption in philosophical logic that logically equivalent expressions can be substituted for each other. Hence, again using the permission predicate "P" as an example, if p and q are logically equivalent, then Pp and Pq are also equivalent. Although this assumption is indispensable for many purposes, it sometimes leads to difficulties in terms of the intuitive interpretation (Hansson 1991b). Its problematic nature is particularly acute in attempts to formalize free-choice permissions, i.e., permissions to choose freely among a list of alternatives. In ordinary language, free-choice permission is usually expressed with "or": "You may have either coffee or tea." Some deontic logicians have attempted to formalize free-choice permission in terms of an extensional predicate P such that $P(p \vee q)$ expresses that the agent is free to choose between p and q. This predicate is then required to satisfy properties such as $P(p \vee q) \rightarrow Pp \,\&\, Pq$.[9] It follows from $P(p \vee q) \rightarrow Pp \,\&\, Pq$, by substitution of $p \,\&\, q$ for p and $p \,\&\, \neg q$ for q, that $Pp \rightarrow P(p \,\&\, q)$, which is an extremely implausible property.

In spite of its immediate appeal, this proposal is seriously defective. A free choice permission to perform either of the actions p and q cannot be adequately represented as an extensional property of the sentence $p \vee q$. If it could, then for any logically equivalent disjunctions $p_1 \vee q_1$ and $p_2 \vee q_2$, it should be (free-choice) permitted to perform p_1 or q_1 if and only if it is (free-choice) permitted to perform p_2 or q_2. To see that this is not the case, let p_1 denote that I take an afternoon walk and carry an umbrella, q_1 that I take an afternoon walk and do not carry an umbrella, p_2 that I take an afternoon walk and shoot a policeman, and q_2 that I take an afternoon walk and do not shoot a policeman. I hopefully have a free choice between p_1 or q_1 but not between p_2 or q_2.

This is not to say that free-choice permissions cannot be represented in a formal model, only that the traditional logical method cannot be used. A more promising approach is to represent free-choice permission to perform p or q as a property of the set $\{p, q\}$ rather than of the sentence $p \vee q$.

Despite its insufficiency in this and certain other cases, intersubstitutivity is for most purposes an extremely useful assumption. It would not be a wise policy to give it up in all cases because it causes problems in relatively few cases.

Another drawback of most logical models is that they do not easily accommodate continuous orderings. One of the most important uses of such orderings is the representation of time. It is interesting to note that dynamic models in logic often have no explicit representation of time. Instead, some such models are *input-assimilating* (Hansson 1999b, p. 8). By this is meant that the object of change (such as a state of belief) is exposed to an input (such as a new piece of information), and is changed as a result of this. No

[9] See von Wright 1968, pp. 21–22, Føllesdal and Hilpinen 1970, pp. 22–23, Kamp 1973, Wolénski 1980, Stenius 1982, and Jennings 1985.

explicit representation of time is included in models of this type. Instead, the characteristic mathematical constituent is a function that to each pair of a state and an input assigns a new state.

§7. Conclusion. Each of the major branches of formalized philosophy, such as decision theory, preference logic, belief revision has several of the advantages referred to in §4 but also several of the disadvantages referred to in §5. When summing up, it is useful to divide the philosophical and interpretational discussions to which a formal treatment gives rise into three categories:

(1) New aspects on issues already discussed in informal philosophy.
(2) Issues not previously discussed in informal philosophy, but with a clear philosophical interest.
(3) Issues that are peculiar to the chosen formalism and have no bearing on philosophical issues that can be expressed without the formalism.

The proportion between (1) + (2) and (3) can be used as measure of the usefulness of a philosophical formalization.

Formalized philosophy has an important mission. The need for good formal treatments of philosophical issues has become even more evident in recent years, due to developments in areas such as epistemology and the philosophy of economics. In spite of this, formalized philosophy is an endangered speciality. Much of the more technically involved work has been taken over by mathematical logicians, and recently much of the initiative for developing new formal systems has come from computer science. At the same time, formalization encounters an internal resistance in philosophy that is not present in these other disciplines.

It is urgently needed to revitalize formal philosophy and increase its interaction with non-formal philosophy. Technical developments should be focused on problems that have connections with philosophical issues. Close attention must be paid to the idealized nature of formal models, and the simplifications and exclusions through which they were obtained must be carefully analyzed. And above all, the enigmatic style in philosophical logic must give way to careful discussions of the relationships between the elements of the formal structure and the philosophical problems that motivated its development.

REFERENCES

Carlos Alchourrón 1993, *Philosophical foundations of deontic logic and the logic of defeasible conditionals*, ***Deontic logic in computer science*** (John-Jules Ch. Meyer and Roel J. Wieringa, editors), John Wiley & Sons, Chichester, pp. 43–84.

Carlos Alchourrón, Peter Gärdenfors, and David Makinson 1985, *On the logic of theory change: Partial meet functions for contraction and revision*, ***The Journal of Symbolic Logic***, vol. 50, pp. 510–530.

RICHARD B. BRANDT 1965, *The concepts of obligation and duty*, ***Mind***, vol. 73, pp. 374–393.

ALBERT P. BROGAN 1919, *The fundamental value universal*, ***Journal of Philosophy, Psychology and Scientific Methods***, vol. 16, pp. 96–104.

HECTOR NERI CASTAÑEDA 1981, *The paradoxes of deontic logic: The simplest solution to all of them in one fell swoop*, ***New studies in deontic logic*** (Risto Hilpinen, editor), Reidel, Dordrecht, pp. 37–95.

——— 1984, *Philosophical refutations*, ***Principles of philosophical reasoning*** (James H. Fetzer, editor), pp. 227–258.

RODERICK M. CHISHOLM AND ERNEST SOSA 1966, *On the logic of 'intrinsically better'*, ***American Philosophical Quarterly***, vol. 3, pp. 244–249.

JOHN W. DAVIS 1966, *Is there a logic for ethics?*, ***Southern Journal of Philosophy***, vol. 4, pp. 1–8.

DAGFINN FØLLESDAL AND RISTO HILPINEN 1970, *Deontic logic: An introduction*, ***Deontic logic: Introductory and systematic readings*** (Risto Hilpinen, editor), Reidel, Dordrecht, pp. 1–35.

DOV GABBAY 1985, *Theoretical foundations for nonmonotonic reasoning in expert systems*, ***Logics and models of concurrent systems***, Springer-Verlag, Berlin, pp. 439–457.

S. M. GLAISTER 1997, *Recovery recovered*, manuscript.

LOU GOBLE 1989, *A logic of better*, ***Logique et Analyse***, vol. 32, pp. 297–318.

NELSON GOODMAN 1951, ***The structure of appearance***.

SVEN OVE HANSSON 1990, *Defining 'good' and 'bad' in terms of 'better'*, ***Notre Dame Journal of Formal Logic***, vol. 31, pp. 136–149.

——— 1991a, *Belief contraction without recovery*, ***Studia Logica***, vol. 50, pp. 251–260.

——— 1991b, *The revenger's paradox*, ***Philosophical Studies***, vol. 61, pp. 301–305.

——— 1993, *Money-pumps, self-torturers and the demons of real life*, ***Australasian Journal of Philosophy***, vol. 71, pp. 476–485.

——— 1999a, *Recovery and epistemic residues*, ***Journal of Logic, Language and Information***, vol. 8, pp. 421–428.

——— 1999b, ***A textbook of belief dynamics***, Kluwer.

——— 2000, ***The structure of values and norms***, Cambridge University Press, in press.

R. E. JENNINGS 1985, *Can there be a natural deontic logic?*, ***Synthese***, vol. 65, pp. 257–273.

HANS KAMP 1973, *Free choice permission*, ***Proceedings of the Aristotelian Society***, vol. 74, pp. 57–74.

EWAN KLEIN 1980, *A semantics for positive and comparative adjectives*, ***Linguistics and Philosophy***, vol. 4, pp. 1–45.

WOLFGANG LENZEN 1981, *Ist Gut*, ***Ethik, Grundlagen, Probleme und Anwendungen, Akten des fünften internationalen Wittgenstein-Symposiums*** (Edgar Morscher and Rudolf Stranzinger, editors), Hölder-Pichler-Tempsky, Wien, pp. 165–171.

——— 1983, *On the representation of classificatory value strucures*, ***Theory and Decision***, vol. 15, pp. 349–369.

STEN LINDSTRÖM 1993, *A semantic approach to nonmonotonic reasoning: inference operations and choice*, manuscript.

STEVEN J. LIVESEY 1986, *The Oxford calculatores, quantification of qualities, and Aristotle's prohibition of metabasis*, ***Vivarium***, vol. 24, pp. 50–69.

DAVID MAKINSON 1993, *General patterns in nonmonotonic reasoning*, ***Handbook of logic in artificial intelligence and logic programming*** (Dov Gabbay et al., editors), vol. III, Oxford University Press, Oxford, pp. 35–110.

——— 1997, *On the force of some apparent counterexamples to recovery*, ***Normative systems in legal and moral theory***, Festschrift for Carlos E. Alchourrón and Eugenio Bulygin, (E. G. Valdès, editor), Duncker & Humblot, Berlin, pp. 475–481.

——— 1999, *On a fundamental problem of deontic logic*, ***Norms, logics and information systems. New studies in deontic logic and computer science*** (Paul McNamara and Henry Prakker, editors), *Frontiers in Artificial Intelligence and Applications*, vol. 49, pp. 29–53.

Ernan McMullin 1985, *Galilean idealization*, ***Studies in History and Philosophy of Science***, vol. 16, pp. 247–273.

G. H. Merrill 1978, *Formalization, possible worlds and the foundations of modal logic*, ***Erkenntnis***, vol. 12, pp. 305–327.

Joseph Raz 1975, *Permissions and supererogation*, ***American Philosophical Quarterly***, vol. 12, pp. 161–168.

Nicholas Rescher 1968, ***Topics in philosophical logic***.

Alf Ross 1941, *Imperatives and logic*, ***Theoria***, vol. 7, pp. 53–71.

Hans Rott 1993, *Belief contraction in the context of the general theory of rational choice*, ***The Journal of Symbolic Logic***, vol. 58, pp. 1426–1450.

Bertrand Russell [1914] 1969, *Our knowledge of the external world.*

Kenneth R. Seeskin 1978, *Formalization in Platonic scholarship*, ***Metaphilosophy***, vol. 9, pp. 242–251.

Erik Stenius 1982, *Ross' paradox and well-formed codices*, ***Theoria***, vol. 48, pp. 49–77.

M. Timur 1955, *Better as the value-fundamental*, ***Mind***, vol. 64, pp. 52–60.

Dirk von Dalen 1974, *Variants of Rescher's semantics for preference logic and some completeness theorems*, ***Studia Logica***, vol. 33, pp. 163–181.

Franz von Kutschera 1975, *Semantic analyses of normative concepts*, ***Erkenntnis***, vol. 9, pp. 195–218.

Georg Henrik von Wright 1951, *Deontic logic*, ***Mind***, vol. 60, pp. 1–15.

——— 1968, *An essay in deontic logic and the general theory of action*, ***Acta Philosophica Fennica***, vol. 21, pp. 1–110.

Jan Woleński 1980, *A note on free choice permissions*, ***Archiv für Rechts- und Sozialphilosophie***, vol. 66, pp. 507–510.

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