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Actions and Normative Positions: A Modal-Logical Approach

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1 An Approach to the Logic of Action

Influenced by the earlier work of, in particular, Alan Ross Anderson (1967), Stig Kanger (1957; Kanger and Kanger 1966), and Georg Henrik von Wright (1963), Ingmar Pörn produced in 1970 a work entitled *The Logic of Power*.

The aim of the book was to develop some modal-logical tools and to apply them to the characterization of such concepts as *influence*, *control*, *right*, and *norm* – concepts which figure centrally in our understanding of social systems. Not surprisingly, a logic of action was one of the core components of Pörn's formal-logical framework.

Action sentences of the kind

(1) John opens the door

were assigned the logical form

(2) D_i A

to be read as '*i* brings it about that A,' where D_i is a relativized modal operator and A describes the state of affairs brought about. Pörn (1970: 4–5) recognized that the logical form he adopted for (1) was a simplification. Although (1) entails

(3) John brings it about that the door is open.

(3) certainly does not entail (1). If, for example, it is the case that

(4) John keeps the door open

then (3) is true whilst (1) may well be false. As Pörn pointed out, the difference in sense between (1) and (4) may be explained by reference to pairs of successive occasions. The truth of (1) requires that, on the earlier of two occasions, the door in question is not open, and then John does what he does and – as a result – the door is open on the later occasion. Whereas the truth of (4) requires the door to be open on the earlier occasion

and – as a result of John's action – *still* open on the later occasion. The 'brings it about that . . .' representation of action sentences is a simplification in (at least) the sense that (2) does not discriminate between (1) and (4). Marking an important point of contrast with the approach of von Wright (1963), Pörn noted that ". . . the notion of a pair of successive occasions is not fundamental to our logic of action" (1970: 4). We might say that Pörn's logic of action sentences is an abstraction, which ignores the change-of-state-over-time aspect of actions, and focuses instead on just two factors: who the agent is, and what state of affairs it is that results from the agent's action. For certain purposes – and in particular for the applications of the logic of action that interested Pörn – an abstraction of this kind is entirely appropriate. We may also note, in passing, that Pörn's approach ignored too the question of the *means by which* an agent secured, through his action, a particular result. (But in his later work, Pörn (1977: chapter 3) gave an analysis of sentences of the kind 'i brings it about that A by bringing it about that B' which drew on automata theory.)

The logic Pörn assigned to sentences of the form D_iA was that of a (relativized) normal modality of type KT in the Chellas (1980) classification. (We ignore here Pörn's treatment of quantification and modality, and restrict attention to the propositional modal logic). In barest outline, a semantical characterization of the D_i-logic may be given as follows: a standard model M is a triple $\langle W,R^D_i,V\rangle$, where W is a set of possible worlds, R^D_i is a binary relation on W (defined for each agent *i*), and V assigns to each atomic sentence a subset of W (the set of worlds at which that atomic sentence is true). R^D_i is required to be reflexive: that is, for each world $u \in W$, and for each agent *i*, $\langle u,u\rangle \in R^D_i$. Truth conditions for non-modal sentences are specified in the usual way for classical propositional logic, and for modal sentences as follows:

(C.D) $M,u \models D_iA$ iff $M,v \models A$ for all $v \in W$ such that $\langle u,v\rangle \in R^D_i$
(C.C) $M,u \models C_iA$ iff $M,v \models A$ for at least one $v \in W$ such that $\langle u,v\rangle \in R^D_i$

As usual, a sentence is said to be valid iff it is true at all worlds in all models, and where A is valid we write $\models A$.

Pörn read sentences of the form C_iA as "it is possible for all that *i* does that A." Given the structure of the truth condition (C.C), it is apparent that the intuitive understanding of the accessibility relation R^D_i is as follows: $\langle u,v\rangle \in R^D_i$ iff v is possible relative to u with respect to all that *i* does at u. It is readily shown that sentences of the following forms are valid:

DDC. $D_iA \leftrightarrow \neg C_i \neg A$
DM. $D_i(A \wedge B) \rightarrow (D_iA \wedge D_iB)$
DC. $(D_iA \wedge D_iB) \rightarrow D_i(A \wedge B)$
DK. $(D_iA \wedge D_i(A \rightarrow B)) \rightarrow D_iB$
DT. $D_iA \rightarrow A$

Furthermore, the following rule holds:

DRK. If $\models (A_1 \wedge A_2 \wedge \ldots \wedge A_n) \rightarrow A$ then
$\models (D_iA_1 \wedge D_iA_2 \wedge \ldots \wedge D_iA_n) \rightarrow D_iA$ for $n \geq 0$.

DT. expresses what is sometimes referred to as the 'success' condition, and captures the obvious truth that if an agent brings it about that A, then A is indeed the case. The validity of DT. turns essentially on the reflexivity of the accessibility relation.

For the cases n = 0 and n = 1, we have the following instances, respectively, of DRK.:

DRN. If $\models A$ then $\models D_iA$
DRM. If $\models (A_1 \rightarrow A)$ then $\models (D_iA_1 \rightarrow D_iA)$

As logical properties of the action operator, both of these two rules are intuitively problematic. The first says that each agent brings about all logical truths – but, surely, that which is logically true is unavoidably the case, and thus falls outside the scope of anyone's agency? The second says that any agent brings about all of the logical consequences of that which he brings about. So, for instance, if *i* brings it about that *j* brings it about that A, then – in virtue of DRM. and DT. – *i* brings it about that A. But there are certainly interpretations of 'bringing it about' for which we would not want a property of this kind to hold, as when we say that although *i* brought it about that *j* brought it about that A, *i* did not *himself* bring it about that A. A second problematic instance of DRM. arises if we consider expressions of the kind '*i* brings it about that *j* knows that A.' Since *j*'s knowing that A logically implies the truth of A, it will now follow from DRM. that *i* brings it about that A if he brings it about that *j* knows that A.

It is fair to say that problems of the kind raised by DRN. and DRM. led Pörn (and Kanger) to move away from using a normal modality (in the sense of Chellas (1980)) for the characterization of 'brings it about that . . .' (all normal modalities are closed under logical consequence in the sense expressed by the rule DRK.).

Pörn (1977) abandoned the idea that the logic of expressions of the kind '*i* brings it about that A' could be articulated in terms of D_iA alone. Following Kanger (1972), he adopted the hypothesis that sentences of the form D_iA should be read "it is necessary for something which *i* does that A," and that "*i* brings it about that A" entails D_iA. The question then, of course, is to decide what *else*, in addition to 'necessity for something which *i* does' is involved in '*i* brings it about that . . .'. The answer Pörn and Kanger provided can best be introduced by the following remark:

> The ascription of causality to an agent normally suggests either that but for his action it would not be the case that A or that but for his action it might not be the case that A. The notions of counteraction conditionality are not present in the concept of that which is necessary for something that an agent does. As evidence of this one may cite the fact . . . that if it is logically necessary and hence unavoidable that A, then A is also necessary for something that an agent does. (Pörn 1977: 5)

To capture the notion of counteraction conditionality, Pörn introduced modal expressions of the form D'_iA, read as 'but for *i*'s action it would not be the case that A.' In the semantics, a new accessibility relation $R_i^{D'}$ (relativized to each agent *i*) was incorporated; where $\langle u,v \rangle \in R_i^{D'}$, v is said to represent a situation in which *i* does not do any of the things that he does in u.[1] D′-expressions were assigned the following truth condition:

(C.D′) $M,u \models D'_i A$ iff $M,v \models \neg A$ for all $v \in W$ such that $\langle u,v \rangle \in R_i^{D'}$.

The new relation, $R_i^{D'}$, was required to be irreflexive and serial. (We note in passing, without entering into details, that Pörn also adopted conditions linking the two accessibility relations R_i^{D} and $R_i^{D'}$, and that in Pörn (1977) R_i^{D} was required to be both reflexive *and* transitive).

Expressions of the form $C'_i A$ were read 'but for *i*'s action it might not be the case that A' and assigned the following truth conditions:

(C.C′) $M,u \models C'_i A$ iff $M,v \models \neg A$ for at least one $v \in W$ such that $\langle u,v \rangle \in R_i^{D'}$.

It is now readily shown that sentences of the following forms are valid:

D′D′C′. $D'_i A \leftrightarrow \neg C'_i \neg A$
D′D. $D'_i A \rightarrow C'_i A$

Furthermore, D′ is a normal modality, and thus the counterparts to the schemas DM., DC., and DK., and to the rule DRK., also hold for the D′ modality.

So the action logic now contains two normal modalities and their respective duals, in terms of which a new analysis of sentences of the type '*i* brings it about that A,' now represented by $E_i A$, can be formulated. Pörn opted for the following definition:

$E_i A =_{df} D_i A \wedge C'_i A$

So *i* brings it about that A iff A is necessary for something that *i* does *and* but for i's action it might not be the case that A. The two conjuncts represent, respectively, a positive and a negative condition on agent causation. (Here there is a clear point of similarity with the STIT-analysis of agency later put forward by Nuel Belnap and his associates (e.g. 1990)). A comparative overview is way beyond the scope of the present paper, but valuable accounts of these and related approaches to the logic of action are to be found in Elgesem (1997) and Hilpinen (1997).

The E-modality is defined as a conjunction of two normal modalities, but it is not itself normal. For instance, the counterpart to DRN.:

ERN. If $\models A$ then $\models E_i A$

does not hold. On the contrary, the following rule is valid:

ER¬N. If $\models A$ then $\models \neg E_i A$

and this captures in an obvious way the claim that logical truths fall outside the scope of anyone's agency. Furthermore, neither the counterpart to DRM. nor the counterpart to DM. is valid for the E-modality. Since the E-modality is classical in the sense of being closed under logical equivalence (see Chellas 1980), the validity of the E-counterpart to DM. – call it EM. – would carry the disastrous consequence that there are no true

sentences of the form E_iA. The explanation is this: suppose E_iA; then, since A is logically equivalent to $(A \wedge T)$, where T is any tautology, it follows that $E_i (A \wedge T)$. But then if EM. were to be valid it would follow that E_iT, a result which is of course inconsistent with the valid rule ER¬N.

The E-counterparts to DC., DK. and DT. are each valid.

An alternative definition of the 'brings it about' operator was offered by Kanger (1972: 108):

$$E_i^*A = {}_{df} D_iA \wedge D_i'A$$

according to which an agent *i* brings it about that A iff A is necessary for something that *i* does and but for *i*'s action it *would* not be the case that A. Intuitively, this version of the negative condition on agency appears to demand too much; for it may be that *i* brings it about that A, but that in *some* of the situations which could have arisen if he had not acted in the way he did, A is still the case – perhaps as a result of some other agent's action. Considerations of this sort favor Pörn's weaker formulation of the negative condition. There is also a technical difficulty with Kanger's definition, as has been pointed out by Jones (reported in Pörn 1977: 5). Suppose that *i* brings it about that A and that he brings it about that if A then B. That is, on Kanger's definition:

$$(5) \quad D_iA \wedge D_i'A \wedge D_i (A \rightarrow B) \wedge D_i'(A \rightarrow B)$$

The second and fourth conjuncts require that, in all of the counteraction conditional alternatives to the given world, both ¬A and ¬(A→B) are true. But since the conditional here is the truth-functional conditional, a contradiction is implied. (In virtue of the seriality of $R_i^{D'}$ there will be at least one counteraction conditional alternative to each world.) Thus there can be no true act descriptions of the form $E_i^*A \wedge E_i^*(A \rightarrow B)$.[2]

It has often been observed that the Pörn–Kanger approach fails to provide an adequate analysis of the concept of action, since the accessibility relations used in the semantics are themselves articulated in terms of what is necessary for what an agent *does* and in terms of what might or would happen if the agent did not act as he does (see Hilpinen 1997: 5). Similar accusations of circularity have been leveled against the possible-worlds semantics of alethic, deontic, and epistemic modalities. If the aim of these semantical treatments of modality had been to *reduce* the concepts concerned to other concepts, then of course the criticism would be justified. But in the case of Pörn – and of many of those who have worked in applied modal logic over the last four decades – the criticism is misplaced. Pörn himself doubted whether a reduction of 'brings it about' to other notions was even possible:

> the principal construction employed, *viz.* "*i* brings it about that A", pertains to agent causality. It is not certain that this construction can be analysed in terms of anything simpler or more fundamental than itself. But it can be elaborated by means of concepts that make it possible to set out the principles of our reasoning with it. (Pörn 1977: 5)

Just the same point may be made in regard, for instance, to Hintikka's (1962) work in epistemic and doxastic logic, and in regard to much of what has been done in deontic

logic. The task has been to provide a formal framework within which our reasoning with the concepts concerned can be systematically investigated, not to effect a reduction of these concepts. Furthermore, a point which applies particularly to Pörn and Kanger, the aim has been to use action modalities and deontic modalities as basic building blocks in the construction of formal characterizations of norm-governed systems. An example of work of that kind will be described in Section 2.

However, other criticisms of Pörn's approach have addressed its adequacy as a basis for analyzing our reasoning about actions. For instance, Dag Elgesem has made some interesting observations about the negative condition in Pörn's definition of 'bringing it about,' suggesting that it collapses two distinct ideas into one:

> The first is that of avoidability in the sense that what is brought about is not logically true . . . The second idea, quite distinct, is that a necessary condition for agency is that the agent's activity is *instrumental* in the production of the result. (Elgesem 1997: 10)

Elgesem develops a new logic of action in which an attempt is made to characterize this distinction. He also notes that his criticism of Pörn's negative condition applies equally well to the version of the negative condition which appears in Belnap's STIT-theory (Elgesem 1997: 18).

2 Normative Act Positions

We now pose the following question: in regard to a particular state of affairs, and a particular agent, what is the class of possible relations between that state of affairs and the successful actions of the agent? We answer the question by generating the class of possible *act-positions* for a given agent *i* vis-à-vis a state of affairs A.

The state of affairs A either obtains or does not obtain; that is either A or $\neg$A holds. Now prefix each of A and $\neg$A with, first, the operator E_i and, second, its internal negation $E_i\neg$. Four formulas result:

E_iA, $E_i\neg A$, $E_i\neg A$, $E_i\neg\neg A$

Of these, the second and third are syntactically identical, and the first and fourth are logically equivalent, given that – as was observed in the previous section – the action operator is closed under logical equivalence. Now form the external negations of these two remaining act expressions (E_iA, $E_i\neg A$), and arrange the four resulting expressions in the form of two truth-functional tautologies:

(i) $E_iA \vee \neg E_iA$
(ii) $E_i\neg A \vee \neg E_i\neg A$

There are of course four distinct ways of choosing just one disjunct from each of (i) and (ii):

(E0) $E_iA \wedge E_i\neg A$
(E1) $E_iA \wedge \neg E_i\neg A$

(E2) $\neg E_i A \wedge E_i \neg A$
(E3) $\neg E_i A \wedge \neg E_i \neg A$

We now recall that the success condition (the counterpart to DT.) is valid for the E-operator:

ET. $E_i A \rightarrow A$

Thus (E0) is a logical contradiction, and does not represent a possible act-position. Furthermore, $E_i A$ logically implies $\neg E_i \neg A$ and $E_i \neg A$ logically implies $\neg E_i A$. So the class of possible act-positions (for one agent and one state of affairs) may be re-written as:

(E1) $E_i A$
(E2) $E_i \neg A$
(E3) $\neg E_i A \wedge \neg E_i \neg A$

The members of the set {(E1),(E2),(E3)} are mutually exclusive, and their disjunction is a tautology. That is to say, for any given agent *i*, and for any state of affairs A, precisely one of (E1), (E2), (E3) holds: either *i* brings it about that A, or *i* brings it about that ¬A, or *i* is passive (he does not bring it about that A and he does not bring it about that ¬A). We have now answered our first question by giving an exhaustive characterization of the class of one-agent act-positions vis-à-vis a given state of affairs.

Let us now introduce the normative/deontic modality O, and read expressions of the form OA as 'it is obligatory that A.' We define expressions of the form PA, 'it is permitted that A' as follows:

(Def.P) $PA =_{df} \neg O \neg A$

We may now use the set {(E1),(E2),(E3)} of one-agent act-positions as a basis on which to construct, or generate, the class of one-agent normative act-positions. First, prefix each of (E1)–(E3) with the operator O, and then prefix each of them with O¬. From these six expressions generate six more, by negating each one of them. Display the resulting twelve expressions as a set of six tautologous disjunctions:

(iii) $OE_i A \vee \neg OE_i A$
(iv) $OE_i \neg A \vee \neg OE_i \neg A$
(v) $O\neg E_i A \vee \neg O\neg E_i A$
(vi) $O\neg E_i \neg A \vee \neg O\neg E_i \neg A$
(vii) $O(\neg E_i A \vee \neg E_i \neg A) \vee \neg O(\neg E_i A \vee \neg E_i \neg A)$
(viii) $O\neg(\neg E_i A \wedge \neg E_i \neg A) \vee \neg O\neg(\neg E_i A \wedge \neg E_i \neg A)$

There are 64 ways of choosing just one disjunct from each of (iii)–(viii). That is, from (iii)–(viii) we may generate 64 distinct conjunctions, each of which contains 6 conjuncts. Suppose now that the logic of the O-modality is that of Standard Deontic Logic (SDL), which is a normal modal system of type KD. This means that SDL is based on classical propositional logic, and contains (Def.P), the axiom schema:

OD. $OA \rightarrow PA$

and the rule

ORK. $$\frac{(A_1 \wedge A_2 \wedge \ldots \wedge A_n) \rightarrow A}{(OA_1 \wedge OA_2 \wedge \ldots OA_n) \rightarrow OA} \quad n \geq 0$$

Given these logical properties, and those already assigned to the E-modality, it may be shown that 57 of the 64 conjunctions are logically inconsistent. In virtue of relations of logical implication between their conjuncts, each of the seven remaining conjunctions may be simplified by removing redundant conjuncts. The result is the following set of one-agent normative act-positions:

(N1) $PE_iA \wedge PE_i\neg A \wedge P(\neg E_iA \wedge \neg E_i\neg A)$
(N2) $PE_iA \wedge O\neg E_i\neg A \wedge P(\neg E_iA \wedge \neg E_i\neg A)$
(N3) $PE_iA \wedge PE_i\neg A \wedge O(E_iA \vee E_i\neg A)$
(N4) $O\neg E_iA \wedge PE_i\neg A \wedge P(\neg E_iA \wedge \neg E_i\neg A)$
(N5) OE_iA
(N6) $O(\neg E_iA \wedge \neg E_i\neg A)$
(N7) $OE_i\neg A$

The members of this set of positions are mutually exclusive, and their disjunction is a tautology. Thus, for any given agent *i*, and for any state of affairs A, precisely one of these normative act-positions holds. The seven positions correspond to Lars Lindahl's (1977: 92) basic types of one-agent legal positions. Lindahl's book develops in some detail the pioneering work of Kanger, who combined action and deontic modalities in an attempt to systematise further W. N. Hohfeld's (1923) theory of rights-relations. (The account of how to generate normative positions, given above, differs from that of Lindahl. It is taken from Jones and Sergot (1993), to which the reader is also referred for some comparisons of this approach with those of Kanger and Lindahl. Note, in particular, that the basic structure of the generation procedure itself does not turn on any particular choice of logics for the E- and O-modalities, although of course the content and size of the generated class of possibilities does depend on that choice.)

It is clear that once an exhaustive characterization of a class of positions has been specified, one can use it as a definitive guide in attempting to determine the appropriate logical form to be assigned to a particular norm. In Jones and Sergot (1993), the main example provided to illustrate this procedure was taken from a set of norms regulating access (by various categories of agents) to sensitive, confidential information. (The scenario was a psychiatric hospital, and the norms assigned/denied rights to patients, doctors, nurses, administrative staff, etc., with respect to accessing patients' medical files.) The example norm said that a patient did not have the right to access his/her own file. One interpretation of this norm would take it to be expressing a denial that a patient is empowered to insist on access to his/her file. A different interpretation views the norm as (in part) denying permission to a patient to access his/her own file.[3] Now consider this second mode of interpretation in relation to the set of seven one-agent normative act-positions, supposing *i* to be an agent in the category of patient, and letting A be the

sentence '*i* has access to *i*'s own file.' Which of (N1)–(N7) captures the appropriate logical form? Clearly (N1), (N2), (N3), and (N5) can all be ruled out immediately, since each requires that it is permitted that *i* brings it about that *i* has access to *i*'s own file. Each of the remaining three cases implies that E_iA is not permitted. Given the fact that *i* is in the category of psychiatric patient, it is perhaps unlikely that the authorities who formulated the norm intended to place *i* under an obligation to bring it about that *i* does not access *i*'s file: in which case (N7) is eliminated from the set of plausible candidates. (N6) makes it *obligatory* that *i*'s act-position (in regard to the state of affairs concerned) is one of passivity, which seems bizarre in the circumstances. Thus, from such considerations as these, (N4) emerges as the appropriate choice of logical form, making it obligatory that it is not the case that *i* accesses *i*'s own file, permitting *i* to bring it about that *i* does not access *i*'s own file, but also permitting *i* to remain passive.

The point behind the discussion of this example is this: the set of seven positions maps out, exhaustively, at a particular level of analytical detail (*one* agent, *one* state of affairs, *one* pair of interdefinable deontic operators) the class of available interpretations. Consideration of the meaning of the particular norm, and of the probable intentions of the norm-giver, then point to the most appropriate choice.

However, for an example of this kind, it would be unsatisfactory to end the search for the correct logical form at this stage. One of the fundamental insights from Hohfeld was that rights are *relational*, and cannot be completely specified in terms of an individual's permissions considered in isolation. Another example might help illustrate the point: in the eyes of the Norwegian state, a child of 12 years is permitted to place bets on sporting events at a state-owned betting shop. But the state does not thereby grant the child the *right* to place such bets, since it does not forbid some other agent (the child's parents, say) from preventing his betting activities. Returning to the access-control example, the relational aspect emerges when we address the issue of *who* it is that is likely to be assigned the *responsibility* for ensuring that *i* does not have access to *i*'s own file. Presumably *not i* himself, which is why it seemed implausible to suppose that the norm-giving authority intended (N7). Thus we see the need to bring into consideration the role of other agents: what will their normative position be vis-à-vis the state of affairs '*i* (the patient) has access to *i*'s own file'?

The generation procedure can readily be extended to facilitate a systematic investigation of this question. First rewrite (N1)–(N7), replacing each occurrence of E_i by one of E_j, but keeping the *same* interpretation as before of the scope-formula A ('*i* has access to *i*'s own file'). (We may consider, for example, that *j* is an agent in the category of doctor in the institution concerned.) There are of course 49 conjunctions obtainable by selecting one member of the set

$$\{(N1_i), (N2_i), \ldots (N7_i)\}$$

and conjoining it with one member of the set:

$$\{(N1_j), (N2_j), \ldots (N7_j)\}$$

Of these 49, 35 are internally consistent (see Lindahl 1977: 128). We may call these 35 conjunctions the set of two-agent normative act-positions. Just six of the 35 con-

junctions contain ($N4_i$) – the interpretation suggested above for the one-agent level of analysis. In these six cases, ($N4_i$) is conjoined with, respectively, ($N1_j$), ($N2_j$), ($N3_j$), ($N4_j$), ($N6_j$), and ($N7_j$). (The ($N5_j$) case is ruled out because the conjunction $OE_jA \wedge PE_i\neg A$ is inconsistent.) What then is the most likely intended interpretation at this two-agent level? Well, each of ($N1_j$), ($N2_j$), and ($N3_j$) contains PE_jA, which is clearly incompatible with the intended interpretation. ($N4_j$) allows doctor j to remain passive with respect to *i*'s having access to *i*'s own file, whilst ($N6_j$) makes passivity obligatory; so considerations of probable assignment of responsibility eliminate these two cases. In which case the appropriate choice appears to be ($N7_j$), giving, finally, the following two-agent normative act-position:

$$O\neg E_iA \wedge PE_i\neg A \wedge P(\neg E_iA \wedge \neg E_i\neg A) \vee OE_j\neg A$$

The first conjunct here can be eliminated as redundant, since it is logically implied by the fourth.

And then it would be possible to complicate matters further, by introducing more categories of agents. Or perhaps (for the analysis of some other types of norms) one might be interested in starting the generation of normative positions not from one-agent act-positions, but from two-or-more-agent act-control/influence positions, expressed in terms of sequences of two or more action operators relativized to different agents. Or perhaps one might add further operators, to express not only successful action, but attempted action.

These are just *some* of the dimensions along which the complexity of the analysis might be increased, and with it the number of conjunctions to be considered. Clearly, the task of *manually* formulating the class of consistent conjunctions will soon become unmanageable: there is a need for automation of the generation procedure. Considerable progress has been made in this direction in recent work by Marek Sergot (1999). The prospect is emerging of a rather sophisticated automated support tool, which can assist in the process of drafting clear specifications of norms pertaining to the rights of agents.

Despite the expressive power of a language combining deontic and action modalities, with respect to the characterization of rights-relations, there are also some rather significant shortcomings, as has been indicated by David Makinson (1986). For instance, Kanger's framework appears to be incapable of capturing the Hohfeldian notion of *power*, and of properly representing the *directionality* which is often characteristic of rights-relations, as when one agent (the bearer) has an obligation vis-à-vis another agent (the counterparty).

As regards the first of these shortcomings, it should be noted that there is good reason to believe that an agent's being assigned certain *legal* or *institutional powers* is not to be confused with his being *permitted* to perform certain acts. Nor should it be identified with his having the physical ability to act – see Makinson (1986) and Jones and Sergot (1996) for examples and discussion. The latter paper combines the E-operator with a modal conditional connective, in an attempt to capture the idea that, within a given institution, the actions of a designated agent may *count as* a means of establishing particular kinds of normative positions, as when a priest is empowered to

create a state of marriage, or a Head of Department is empowered to assign teaching duties.

As regards the question of how to represent the *directionality* of rights-relations, the reader is referred to the works of Henning Herrestad (1996) and Christen Krogh (1997).

Hopefully these remarks suffice to indicate the potential role of the modal logic of action, in combination with deontic and other modalities, in the characterization of norm-governed systems of agents.

Notes

1 See Segerberg (1985) for a discussion of some difficulties involved in Pörn's interpretation of this accessibility relation.
2 The underlying problem here concerns the use of the truth-functional conditional to represent counterfactual situations – a task for which it is well-known to be ill-suited.
3 We return below to the distinction between *empowered* and *permitted*.

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