

Obligations and Permissions*

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Abstract

Utterances and statements that are concerned with obligations and permissions are known as *deontic* expressions. They can present something of a challenge when it comes to formalising their meaning and behaviour. The content of these expressions can appear to support entailment relations similar to those of classical propositions, but such behaviour can sometimes lead to counter-intuitive outcomes. Historically, much of the descriptive work in this area has been philosophical in outlook, concentrating on questions of morality and jurisprudence. Some additional contributions have come from computer science, in part due to the need to specify normative behaviour. There are a number of formal proposals that seek to account for obligations and permissions, such as *Standard Deontic Logic*. In the literature, there has also been discussion of various conundrums and dilemmas that need to be resolved, such as *the Good Samaritan*, *the Knower*, *the Gentle Murderer*, *Contrary to Duty Obligations*, *Ross's Paradox*, *Jørgensen's Dilemma*, *Sartre's Dilemma*, and *Plato's Dilemma*. Despite all this work, there still appears to be no definite consensus about how these kinds of expressions should be analysed, or how all the deontic dilemmas should be resolved. It is possible that obligations themselves, as opposed to their satisfaction criteria, do not directly support a conventional logical analysis. It is also possible that a linguistically informed analysis of obligations and permissions may help to resolve some of the deontic dilemmas, and clarify intuitions about how best to formulate a logic of deontic expressions.

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1 Introduction

Work on the formal semantics of natural language has often focused on the propositional interpretation of indicative sentences. Such sentences can be analysed in terms of their truth conditions. This is achieved by translating sentences into propositions expressed in some form of classical logic. The logic may be enriched to make it easier to deal with phenomena such as anaphora and propositional attitudes, like *belief* and *knowledge*, and the modalities of *necessity* and *possibility*.

This article is concerned with aspects of the interpretation of *obligations* and *permissions*. Statements pertaining to obligations and permissions are called *deontic* expressions.¹ Logical systems that set out to capture the inferential behaviour of such expressions are referred to as *deontic logic*.

1.1 Deontic Expressions

Basic examples of deontic expressions include those given in (1). Some more complex cases will be considered later (for example, in §4).

- (1) (a) “*Peter must close the door.*”
- (b) “*Mary is obliged to find a job.*”
- (c) “*You must pay your taxes.*”
- (d) “*You can walk on the grass.*”
- (e) “*You are permitted to delay payment for up to three months.*”
- (f) “*Evan may go to the beach.*”

Deontic expressions do not necessarily include words directly related to “*obligation*” or “*permission*”, but instead can employ a modal verb, such as “*must*”, “*should*”, “*can*”, “*may*”, among others. These modal verbs modify the intended interpretation of the underlying propositional content so that it is no longer a simple factual claim. There can be some ambiguity in the precise nature of the meaning of such modal expressions. For example, “*can*” may be used to express a physical ability (2) rather than permission.

- (2) “*John can run very fast.*”

55 And “*should*” and “*ought*” may be used to express *epistemic* claims (3), claims that
56 make predictions based on our knowledge and belief.

57 (3) (a) “*The coin should fall when released.*”

58 (b) “*John ought to be in a lot of pain,*”

59 in the context where John has just suffered an injury.

60 The focus of this article is on the formal semantic analysis of deontic expres-
61 sions. We are not so concerned with analysing the ways in which obligations and
62 permissions can be formulated in natural language.

63 Some uses of deontic expressions may be intended to describe which obligations
64 and permissions are currently in operation. Other uses of deontic expression may
65 actually bring such obligations and permissions into being, as with a *proclamation*,
66 *edict*, *degree*, and other essentially *performative* utterances and declarations (see
67 Kamp, 1973, 1979; Kempson, 1977; Lemmon, 1962b, for example). We will not
68 consider the performative interpretation of these kinds of speech acts here.

69 1.2 Formal semantics of natural language

70 In the paradigm of formal semantics, the aim is to provide a rigorous interpretation
71 of language, and to avoid *ad hoc* and inconsistent analyses. Usually this is achieved
72 using a systematic translation of natural language into a formal language that has a
73 well defined syntax and behaviour. The translation process and formalisation are
74 often targeted at particular aspects of meaning, and usually do not attempt to deal
75 with the full complexity of meaning in all its richness. This can be seen as a form of
76 *abstraction*.

77 In this paradigm, we have to have a clear understanding of our intuitions con-
78 cerning how a given expression of the language should be interpreted. We need to
79 consider how the behaviour of interest should be captured by the translation process
80 and the formal language, and whether there may be confounding influences from
81 some other aspect of meaning and interpretation.

82 1.3 Truth conditions and inference

83 Theories that seek to interpret the propositional content of indicative sentences are
84 concerned primarily with truth. This can involve determining the *truth conditions*

85 of indicative “assertoric” sentences, or the legitimate patterns of *reasoning* from
86 truth to truth.

87 A logic for deontic expressions needs to concern itself with the validity of claims
88 of the kind given in (4).

- 89 (4) (a) The assertion of a deontic statement follows from the assertion of another
90 deontic statement, for example from “*You are obliged to mow the lawn*
91 *and prune the tree*” we may infer “*You are obliged to mow the lawn*”.
- 92 (b) Two deontic expressions are incompatible with each other, for example
93 “*You must eat all the food*” is incompatible with “*You must leave some cake*
94 *for Mary*”.
- 95 (c) The satisfaction of an obligation is possible. Consider “*You must ensure*
96 *that $1 + 1 = 3$* ”.
- 97 (d) The satisfaction of an obligation implies the satisfaction, or absence of
98 satisfaction, of some other obligation: for example satisfying “*You must*
99 *eat bread and cheese*” also satisfies “*You must eat bread*”.
- 100 (e) A particular state of affairs, or action, satisfies an obligation.
- 101 (f) A particular state of affairs, or action, is consistent with what is permit-
102 ted.

103 For deontic expressions, although we may consider the truth of whether there
104 is an obligation in force, or whether some permission has been granted, it does
105 not automatically follow that the notions of equivalence and entailment for such
106 expressions should *necessarily* follow the same pattern of inferences that the sentences
107 would have without the deontic modality.

108 There are, however, many cases where deontic expressions do appear to support
109 patterns of entailment and equivalence akin to those of the corresponding non-
110 deontic propositions. For example, many would agree that from (5a) we should be
111 able to infer (5b), even though the “underlying” propositional content of (5a) “*You*
112 *sit down and eat the cheese*” is not being asserted as a straight-forward fact.

- 113 (5) (a) “*You should sit down and eat the cheese.*”
114 (b) “*You should sit down.*”

115 Some deontic systems, such as *Standard Deontic Logic* (SDL, §2), encapsulate
116 the view that deontic expressions should support the same patterns of entailment
117 as non-deontic expressions. But as we shall see in §4, this is not uncontroversial or
118 unproblematic, as such behaviour appears to lead to a number of dilemmas.

119 1.4 Obligation to and Obligation that

120 When it comes to the kind of things that may satisfy an obligation, obvious can-
121 didates are actions—where an obligation is *an obligation to do something*—and out-
122 comes, or states—where an obligation is *an obligation that something be the case*
123 (Jackson, 1985).

124 In some analyses, the intended interpretation is not made explicit. Furthermore,
125 the boundary between the two characterisations may be somewhat artificial. An
126 action in itself could be characterised by the state of affairs that results from its
127 successful completion (the *post-condition* of the action).

128 One approach to this question is simply to ignore it; provided we assume that
129 there is some way of expressing the satisfaction conditions of an obligation, we can
130 go on to consider facets of their analysis without making specific commitments as to
131 their basic nature. Such agnosticism may not always be appropriate: consider (6).

132 (6) “... *surviving being shot is not something that Kennedy ought to have done, though*
133 *it is something that ought to have been.*” (Jackson, 1985, p179)

134 1.5 Scope of this article

135 Here we consider some existing semantic analyses of deontic expressions, and the
136 problems they face. We follow the practice of many working in the field of assuming
137 plausible representations for natural language examples, rather than attempting a
138 rigorous and highly systematic interpretation. While allowing us to focus on the
139 logical and formal details, there is admittedly some danger in this approach: there
140 may be other aspects of interpretation that confound the proposed analysis, or
141 which, if properly analysed, cast light on apparently problematic examples. As we
142 shall see, it is not unusual for formal accounts of deontic expressions to ignore issues
143 such as quantification, predicates and relations, effectively stripping things down to
144 a propositional logic for obligations and permissions.

2 Standard Deontic Logic

Standard Deontic Logic (SDL) represents a classic approach to formalising deontic statements. SDL extends classical propositional logic (see Chapter 5 of Allwood *et al.*, 1977, for example) by adding *modal operators* (Lemmon and Scott, 1977) for “obligation” and “permission”, together with rules and axioms that govern the behaviour of these new entities (von Wright, 1953). In brief, if a is a proposition, then $\text{OB}(a)$ means that a is obligatory, and $\text{PE}(a)$ that a is permitted.

In the literature, the precise syntax for the deontic operators may vary. Another common notation is to use O for obligation and P for permission.

2.1 Axioms and Rules for SDL

SDL is conventionally presented using rules and axioms as given in (7), where “ a ” and “ b ” are propositions, “ \wedge ” represents logical conjunction (*and*), “ \vee ” is disjunction (*or*), “ \rightarrow ” is material implication (*if... then...*) and “ \neg ” is negation (*not*). The expression “ $\vdash a$ ” means that a is a tautology: the truth of a follows from the rules and axioms of the logic.²

- (7) (a) All the axioms and rules of classical logic.
- (b) $\text{OB}(a \rightarrow b) \rightarrow (\text{OB}(a) \rightarrow \text{OB}(b))$ (OB-K)
- (c) $\text{OB}(a) \rightarrow \neg \text{OB}(\neg a)$ (OB-D)
- (d) If $\vdash a$ then $\vdash \text{OB}(a)$ (OB-NEC)

Rule (7b) says that obligation distributes across implication. Rule (7c) says that if something is obligatory, then its negation cannot also be obligatory. An alternative formulation is $\neg(\text{OB}(a) \wedge \text{OB}(\neg a))$. Finally, (7d) says that that all tautologies of the logic are obligatory, for example $\text{OB}(a \vee \neg a)$ for any a .

When taken together, it can be shown that if b follows from a , then $\text{OB}(b)$ follows from $\text{OB}(a)$ —that is, if a is obligatory, then so is b . This captures the intuition that (5b) follows from (5a), for example. This allows the theorems given in (8) to be derived, among other things.

- (8) (a) If $\vdash a \rightarrow b$ then $\vdash \text{OB}(a) \rightarrow \text{OB}(b)$ (OB-RM)
- (b) $\text{OB}(a \wedge b) \rightarrow (\text{OB}(a) \wedge \text{OB}(b))$ (OB-M)

174 (c) $OB(a) \rightarrow OB(a \vee b)$

175 It is conventional to define *permission* as the ‘dual’ of *obligation*, as in (9).

176 (9) $PE(a) =_{def} \neg OB(\neg a)$

177 SDL is not uncontentious. It does not impose syntactic or categorial constraints
178 on what kinds of proposition-like entities can appear within the scope of OB and
179 PE (see Castañeda, 1981, for example). To allow the possibility that they might
180 form a distinct class, here a, b, \dots are used to denote expressions that can appear as
181 arguments to OB and PE, and p, q, \dots will be used to denote regular propositions.

182 Concerns have also been expressed that SDL is too strong, and that it leads to
183 counterintuitive conclusions, and dilemmas (see §4, and McNamara, 2006a,b, for
184 example). Many authors have expressed concern about (8a) and also (7c), for their
185 role in creating deontic paradoxes and ruling out deontic conflicts, respectively (see
186 Goble, 1990a,b, 1991, 1993; Hansson, 1988, 1990, 2001; Jackson, 1985; Schotch and
187 Jennings, 1980, for example. Some of these issues surrounding (8a) are also discussed
188 by van der Torre, 1997).

189 2.2 A Possible Worlds Model for SDL

190 In addition to a system of rules and axioms, it is useful to consider whether there
191 is a *model* that can provide a *consistent* interpretation of the rules. This can help
192 demonstrate that the proposed rules and axioms are formally coherent.³ Like many
193 modal logics, SDL can be given a possible worlds interpretation. (Kripke, 1959, 1963;
194 von Wright, 1951, 1953). In the standard account, a is obligatory in the current
195 world, $OB(a)$, if and only if a is true in all accessible *ideal* worlds, where an ideal
196 world is one in which all obligations have been satisfied. And a is permitted, $PE(a)$,
197 if and only if a is true in some such worlds.

198 3 Other Approaches

199 SDL is not the only approach. Here we sketch a small selection of alternative
200 proposals. Additional proposals are discussed in §5.

201 3.1 The Andersonian-Kangorian reduction

202 One alternative approach is to say that a proposition is obligatory if some bad thing,
203 a *sanction*, arises whenever that proposition is false, or that this sanction is avoided
204 if the proposition is true. This sanction can be represented by a distinguished
205 proposition S .

206 This approach is proposed by Prior (1958) and developed by Anderson (1958).
207 Kanger (1971) gives an equivalent alternative in which the distinguished proposition
208 represents the absence of a sanction. The sanction is fixed, and does not indicate
209 which obligations are unsatisfied.

210 A variant of this approach, combined with *dynamic deontic logic* (§3.3) is pro-
211 posed by Wyner (2008), but where there are propositions that indicate both compli-
212 ance and non-compliance, and the obligation involved.

213 3.2 Input-Output Logic

214 Another alternative to SDL that is founded on different conceptual assumptions is
215 *input-output logic* (Makinson and van der Torre, 2000, 2001, 2003a,b). Essentially
216 this takes the perspective of an agent that determines what obligations hold on
217 the basis of facts about the state of the world. On this view, a deontic system is
218 an input-output *transducer* from states to obligations. Natural language deontic
219 statements could be interpreted as *specifications* of this transducer.

220 3.3 Dynamic Deontic Logic

221 The final alternative that we will mention here is where obligations, and their
222 satisfaction, are expressed terms of actions within the framework of *dynamic logic*
223 (Harel, 1984). We can model actions as things that bring about a state of affairs.
224 Assuming that an action α can be carried out (i.e. its *preconditions* are satisfied), then
225 we can write $[\alpha]p$ to indicate that proposition p is true following the execution of
226 action α . Propositions and actions can be combined in various ways.

227 Using this paradigm, we can follow Meyer (1988), and use $OB(\alpha)$ to mean that
228 action α is obligatory.⁴ It is claimed that this approach can account for problematic
229 examples, such as *Contrary-to-Duty* obligations (§4.3.4), although there may be other
230 problems with this approach (see Anglberger, 2008, for example).

4 Common Issues and Difficulties

There are many problematic examples which present difficulties for formalisations such as SDL. These may be due to: (i) foundational issues concerning whether obligations must be coherent and fulfillable (§4.1); (ii) the use of representations for natural language which have inappropriate consequences (§4.2); and (iii) inappropriate inferential behaviour in the representation language (§4.3). The precise nature of these categories may be subjective and open to dispute. They are not entirely independent, and some examples may have aspects that fall into more than one category. Nevertheless, this categorisation helps to provide some structure to the exposition.

4.1 Foundational Issues

Any account of obligations and permissions has to address the possibility of conflict, either between obligations, and permissions, or between obligations and our understanding of how the world is.

4.1.1 Conflicting obligations

Examples (10) and (11) indicate two cases where there may be conflicting obligations (Lemmon, 1962a).⁵

(10) (a) “*You are obliged to have dinner with your friend.*”

(b) “*You are obliged to rush your choking child to hospital.*”

(11) (a) “*You are obliged to return the knife.*”

(b) “*You are obliged to avoid giving a knife to someone who will commit murder.*”

Resolving such conflicts may require some way of prioritising or ordering the obligations. It could be argued this is *moral* rather than a logical question (Bonevac, 1998, p43). Either way, any formal theory of obligations should be able to accommodate conflicts without resulting in inconsistency of the logic itself. This is one motivation for considering alternatives to SDL (§5).

258 **4.1.2 Unfulfillable obligations**

259 We may also question whether all felicitous obligations should be individually
260 fulfillable. Some obligations, such as (12) under a literal interpretation, are clearly
261 unreasonable.

262 (12) “*You are obliged to fly me to the moon.*”

263 Others, such as (13), are not possible.

264 (13) “*Mary must ensure that 2 + 2 is 5.*”

265 The view that such obligations are infelicitous is characterised by “*Kant’s Law*”,
266 namely that “*ought*” implies “*can*”. This view is not universally accepted (see Martin,
267 2009, for example). Some argue that Kant’s Law is a conversational implicature
268 rather than a logical rule (Sinnott-Armstrong, 1984).

269 In general we must account for obligations that conflict with each other, or with
270 the world as we understand it to be, and we should be able to do so without giving
271 rise to a formal inconsistency in the semantic theory itself. This problem of conflict
272 is not confined to deontic expressions.

273 **4.2 Representational Issues**

274 Some seemingly straightforward representations of deontic expressions can have
275 unfortunate consequences. This issue can arise when there is some propositional
276 content—perhaps a relative clause or some propositional condition—that intuitively
277 should lie outside the scope of any obligation.

278 Some problems might be avoided if the given representations behaved differently,
279 for example if obligations did not distribute to constituent parts (unlike SDL, §2).
280 Even so, there is still an underlying question about how such examples should be
281 represented.

282 **4.2.1 The Good Samaritan**

283 Given one of the obligations in (14), we do not wish to infer that there is an obligation
284 to rob a man in order to then help him, and thus satisfy the obligation to help a
285 robbed man (Prior, 1958).

- 286 (14) (a) “*You are obliged to help a man who has been robbed.*”
287 (b) “*You are obliged to help a robbed man.*”

288 Such examples are similar to conditional obligations (15). Indeed, some argue that
289 all forms of *the Good Samaritan* are essentially disguised conditionals (Castañeda,
290 1981; Tomberlin, 1981).

- 291 (15) (a) “*If a man has been robbed, then you should help him.*”
292 (b) “*There is an obligation such that if a man is robbed, you help him.*”

293 Generally, (15a) and (15b) can be formulated in SDL-like languages by an expression
294 of the form (16a) and (16b), respectively, where p corresponds to “*a man has been*
295 *robbed*” and a is “*you help him*”.⁶

- 296 (16) (a) $p \rightarrow \text{OB}(a)$
297 (b) $\text{OB}(p \rightarrow a)$

298 It is not clear whether (16b) really expresses what is desired. From this, SDL would
299 allow us to infer (17).

- 300 (17) $\text{OB}(p) \rightarrow \text{OB}(a)$

301 This seems odd; (17) states that we are obliged to help not when a robbery has taken
302 place, but in the event that there is an *obligation* to rob. In the case of (16a), the
303 original conditional obligation (15a) will then be judged “true” in the event that a
304 man has not been robbed.

305 Various questions can be raised about these representations, such as: the desir-
306 ability of using material implication to represent conditional obligations (cf. §4.3.4
307 & §5.2)⁷; whether obligations should distribute to constituent parts (§5.4); and
308 whether such inferences should be defeasible (§5.5). The difficulty of analysing
309 complex expressions involving conditionals and other constructs also arises in other
310 non-deontic contexts.

311 4.2.2 The Knower

312 Most moral people would argue that from (18) we should not infer (19), given a
313 deontic interpretation of “*ought*”.

314 (18) “*It ought to be the case that A knows his wife is committing adultery.*”

315 (19) “*It ought to be the case that A’s wife is committing adultery.*”

316 There appears to be a risk of such entailments in some formulations that combine
317 obligation with knowledge (Åqvist, 1967; Jones and Pörn, 1985). This is sometimes
318 called *the Paradox of Epistemic Obligation*.

319 4.2.3 The Gentle Murderer

320 Following Forrester (1984), if we were to utter (20) we probably mean that in the
321 unfortunate event that John murder’s his wife, he ought to do so gently. From this
322 we should not be able to infer (21).

323 (20) “*John ought to murder his wife gently.*”

324 (21) “*John ought to murder his wife.*”

325 Other modalities also appear not to distribute into adverbial expressions (Jack-
326 son, 1985). It is unlikely that anyone would claim 23 follows from (22).

327 (22) “*I want to die a painless death.*”

328 (23) “*I want to die.*”

329 Jackson (1985) argues that interpretation must be relative to a set of alternatives
330 (see §5.1) as in (24).

331 (24) Given *A* (“*you murder your wife*”) it ought to be the case that *B* (“*you do so*
332 *gently*”).

333 4.2.4 The Hygienic Cook

334 Some of the previous conundrums might be avoided if distributive inferences did
335 not apply when faced with contrary obligations (§5.5). But there are examples
336 where such a proposal does not seem entirely appropriate, as in the morally neutral
337 example (25) (Fox, 2010).

338 (25) “*You are obliged to use a clean knife.*”

339 This may give rise to an obligation for the knife to be clean, in contrast to the
340 behaviour of (14). Furthermore, it could be claimed there is no obligation to use
341 a knife (clean or not), only that in the event we use a knife, it ought to be clean,
342 echoing (24).

343 The different readings available for (25) lend weight to the view that obligations
344 be interpreted with respect to relevant alternatives, as has been proposed for the
345 analysis of the pragmatic notions of *topic* and *focus* (Rooth, 1993). This approach
346 has been considered explicitly by Wyner (2008, Section 2.7, pp69–74), in his analysis
347 of *the Gentle Murderer* (§4.2.3). It appears to correspond to the idea of ‘relativised’
348 interpretation, as discussed in §5.1.

349 4.3 Behavioural Issues

350 Finally in this section, we consider examples that raise questions about the basic
351 behaviour of representations of deontic expressions.

352 4.3.1 Free choice permission

353 The issue of *free choice* interpretations arises with deontic expressions involving
354 disjunction (Kamp, 1973; Ross, 1941), such as (26).

355 (26) “*You may go to the beach or watch television.*”

356 Under the free-choice interpretation (27) the subject can choose which permission
357 to take advantage of.

358 (27) “*You may go to the beach or watch television (or neither), the choice is yours.*”

359 Such free-choice permission may be *exclusive* (28); if you go to the beach, you may
360 no longer have permission to watch television.

361 (28) “*You may either go to the beach or watch television (or do neither), the choice is*
362 *yours.*”

363 Free-choice permission appears to indicate a space of possibilities—the “paths”
364 that a subject can take without fear of retribution (Dignum *et al.*, 1996). This
365 interpretation could be captured by considering the consistency (or coherence) of a
366 system of obligations. In particular, (26) would be inconsistent with (29) and perhaps
367 even with (30). This is problematic for SDL, where $PE(a \vee b)$ follows from $PE(a)$.

368 (29) (a) “*You are obliged not to go to the beach.*”

369 (b) “*You are obliged not to watch television.*”

370 (30) “*You may go to the beach and you may watch television.*”

371 The problem of free-choice disjunction arises in many other contexts, not just
372 those relating to permission (and obligation). Barker (2010) seeks to analyse free
373 choice using the machinery of linear logic, using the insight that linear logic’s
374 resource sensitivity can be used to constrain the extent to which permission has
375 been granted. Others have taken the constraints on entailments to be a matter of
376 *implicature* rather than logical *inference* (see Fox, 2007; Franke, 2009; Shulz, 2005,
377 for example), or that free choice should be presented as a choice among epistemic
378 alternatives (see Zimmermann, 2000, for example)

379 4.3.2 Conjunctive commitments

380 In some cases it may seem that the force of an obligation should distribute across
381 conjunction, as with (5). Given (31) it seems reasonable to conclude both (32a) and
382 (32b).

383 (31) “*You ought to have a shower and go to bed.*”

384 (32) (a) “*You ought to have a shower.*”

385 (b) “*You ought to go to bed.*”

386 But consider (33).

387 (33) “*You are obliged to jump off the bridge and land on the train.*”

388 It might be unfortunate if a subject were then to infer (34).

389 (34) “*You are obliged to jump off the bridge.*”

390 Indeed, (33) is presumably consistent with (35).

391 (35) “*It is not permitted for you to jump off the bridge and not land on the train.*”

392 Distributive behaviour is enforced by SDL (8b), but is not supported by other
393 accounts (see Goble, 1990a; Jackson, 1985; Jones and Pörn, 1985; Lewis, 1973, for
394 example). This may just be an example of the “*and then*” sequential interpretation
395 of conjunction, which also arises with indicatives, as in (36).

396 (36) “*John entered the room and turned on the light.*”

397 But a case might still be made that conjunction with obligations can have an “all or
398 nothing” interpretation that is distinct from the sequential interpretation.

399 Questions about distributive inferences arise with other logical connectives.
400 What will count as an appropriate representation for natural language constructs
401 will depend on which inferences are supported by the chosen logical connectives
402 (§4.2).

403 4.3.3 Disjunctive Obligations and Ross’s Paradox

404 Theories that import all *valid* inferences of classical logic into deontic contexts, like
405 SDL (§2), allow (38) to be inferred from (37).

406 (37) “*You are obliged to post the letter.*”

407 (38) “*You are obliged to post the letter or burn the letter.*”

408 One way to *satisfy* (38) is to satisfy (39).

409 (39) “*You are obliged to burn the letter.*”

410 In general, inferences relating to *validity* are concerned with deducing what other
411 obligations may also be deemed to be in force, starting from a given system of
412 obligations. This can be contrasted with inferences concerning *satisfaction*, which
413 seek to deduce what other obligations may be deemed to be satisfied following the
414 satisfaction of one or more obligations.

415 If judgements concerning validity and satisfaction were conflated, in effect giving
416 a single notion of entailment, then (39) would follow from (37) (Ross, 1945). This
417 counter-intuitive outcome is referred to as *Ross’s Paradox*.⁸

418 The conclusion we can draw from this ‘paradox’ is that the notion of validity
419 (that is, which obligations follow from existing obligations) should not be conflated
420 with the notion of satisfaction (that is, which other putative obligations may be
421 satisfied when satisfying a given obligation).

422 Even given this distinction, we may wonder whether it is appropriate to be able
423 to infer the obligation (38) from the obligation (37), just as we may question whether
424 the existence of an *utterance* (or *belief*) that “*p* or *q* is the case” can be inferred

425 from an utterance (belief) that “ p is the case”. One argument against unrestricted
426 *disjunction introduction*—exemplified by the move from (37) to (38)—is that there are
427 free-choice connotations associated with the disjunction which may not be intended.

428 4.3.4 Contrary to Duty Obligations

429 Difficulties can arise in analysing obligations that specify how we should make
430 amends, or compensate, for a failure to satisfy other obligations. A classic example
431 (40) is due to Chisholm (1963).

- 432 (40) (a) “*It ought to be that a certain man go to the assistance of his neighbours.*”
433 (b) “*It ought to be that if he does go, he tell them he is coming.*”
434 (c) “*If he does not go then he ought not to tell them he is coming.*”
435 (d) “*He does not go.*”

436 From these we should be able to conclude (41).

- 437 (41) “*He ought not to tell them he is coming.*”

438 It turns out that regardless of whether conditional expressions (40b) and (40c) are
439 represented in the form $OB(a \rightarrow b)$, or $a \rightarrow OB(b)$ (cf. §4.2.1), apparently faithful
440 representations of (40a–40d) in SDL are either mutually inconsistent, or one of the
441 obligations follows from the others.⁹ Both of these outcomes run counter to the
442 intuition that the sentences are mutually consistent and logically independent. Some
443 proposed solutions are mentioned in §3.3 and §5.1.

444 Tomberlin (1981) gives a detailed account of the problem of *Contrary-to-Duty*
445 obligations, and some possible solutions.

446 5 Alternative Formalisations

447 Some of the issues mentioned in §4 have motivated alternative proposals for repre-
448 senting and reasoning with deontic expressions.

449 In general, given a straightforward interpretation of deontic statements, SDL ap-
450 pears to allow conclusions to be drawn which are counter-intuitive or contradictory.
451 To avoid this, we may reconsider the nature of the interpretation of natural language
452 examples (§5.1 and §5.2), prioritise obligations (§5.3) or weaken the logic in some
453 way (§5.4 and §5.5).

5.1 Relativisation of interpretation

It may be possible to avoid inappropriate patterns of entailment for *the Good Samaritan* (§4.2.1), *the Knower* (§4.2.2) and *the Gentle Murderer* (§4.2.3) by evaluating the meaning of deontic expressions with respect to a *context*. The obligations to “*help*” (14), “*know*” (18), or “*murder gently*” (20) arise in those contexts in which it is given that there has been (or will be) robbery, adultery, and murder, respectively.

Such ‘relativised’ interpretations have been proposed by Jackson (1985); Kratzer (1981); Prakken and Sergot (1996), for example.¹⁰ Carmo and Jones (2002) disagree with the need to relativise interpretation of deontic expressions in this way, and Zvolenszky (2002) shows there are problems with the relativised account of Kratzer (1981).

5.2 Dyadic modality

The use of *dyadic* modal operators has been proposed to deal with the conditional forms or interpretations of *the Good Samaritan* (§4.2.1) (see van Fraassen, 1972, for example), and the *Contrary-to-Duty* obligations (§4.3.4) (see Prakken and Sergot, 1997, for example). Dyadic modals avoid the use of material implication—as in $OB(p \rightarrow a)$ and $p \rightarrow OB(a)$ —and instead borrow the notation of conditional probability, expressing the obligation “to *a* given that *p*” by writing $OB(a|p)$ (van Fraassen, 1972; Hansson, 1969; Spohn, 1975; von Wright, 1957).

Dyadic operators can be thought of as relativising obligations (and permissions) to deontic contexts. In these case of *the Good Samaritan* and *Contrary-to-Duty* obligations, these may be context in which a man has been robbed, or an obligation is not met.

Appropriate inferential patterns of behaviour can be attributed to dyadic conditionals (Anderson, 1959; Chellas, 1980; van Fraassen, 1972, 1973; von Wright, 1961, 1962), such as (42).

- (42) (a) If $OB(a|p)$ and $PE(b|p)$ then $OB(a|p \wedge b)$.
(b) If $OB(a|p)$ and $OB(a|q)$ then $OB(a|(p \vee q))$.

The claim formalised by (42a), for example, is intended to capture the idea that bringing about something permitted does not change one’s obligations.

484 We may model dyadic obligation by saying that $OB(a|p)$ holds if a is true in the
485 “best” worlds in which p is true. The *monadic* expression $OB(a)$ is then equivalent to
486 $OB(a|T)$, where T is a tautology. Other model-theoretic interpretations of dyadic
487 obligation are possible (Hansen, 2008; Hansen *et al.*, 2007). See also Lewis (1974).

488 5.3 Prioritised obligation

489 Some dilemmas could be avoided if obligations had different *priorities*, where higher-
490 level priorities over-rule lower-level priorities (Åqvist, 1967). This could resolve
491 *conflicting* obligations (§4.1.1), and *Contrary-to-Duty* obligations (§4.3.4). The issue
492 then becomes how to determine priorities, and indeed whether there should be fixed
493 priorities within the logic. As discussed below in §5.5, there are alternatives for
494 resolving conflicts that may not need to appeal directly to a fixed priority assignment.

495 In general we may question whether it is the responsibility of a *linguistic* theory
496 of meaning to account for such behaviour, or whether this falls within the realms of
497 general, non-linguistic reasoning. The problem of conflicts is a general one that also
498 arises with non-deontic utterances.

499 5.4 Weaker logic

500 Many deontic dilemmas and conflicts could be resolved by weakening the logic
501 in various ways (see Goble, 1999, 2001, 2004; Routley and Plumwood, 1989, for
502 example). For instance, difficulties with some apparently problematic inferences—
503 like *the Good Samaritan* (§4.2.1) and conjunction (§4.3.2)—might be resolved if
504 obligations did not distribute across logical connectives such as conjunction (Jackson,
505 1985; Jones and Pörn, 1985)

506 If a logic has OB-RM (8a) as a theorem, as is the case with SDL, then obligations
507 will distribute across conjunction; and disjunction introduction within deontic
508 contexts will also follow (§4.3.3). Given that such inferences are sometimes thought
509 to be problematic, some propose weakening the logic so that OB-RM does not
510 follow (Goble, 1990a,b, 1991, 1993; Hansson, 1988, 2001; Jackson, 1985).

511 Others defend OB-RM on the grounds that it captures the idea of an agent taking
512 moral responsibility for the logical consequences of her commitments (Nute and
513 Yu, 1997; Schotch and Jennings, 1989). But to argue that agents need to understand

514 the consequences of their obligations does not mean that OB-RM must necessarily
515 be supported (Jackson, 1985).

516 There are proposals for weaker logics that capture salient inferences between
517 obligations, such as the “weakened” OB-RM of Goble (2004), where if A implies B ,
518 then $OB(A)$ implies $OB(B)$ provided A is permitted.

519 **5.5 Weaker inference**

520 An alternative to weakening the rules and axioms of a theory is to adopt a different
521 kind of logic, with a weaker notion of inference. With such an approach, we
522 can still allow obligations to distribute, for example, but take any problematic
523 entailments to be *defeasible* (Bonevac, 1998; Makinson and van der Torre, 2003b;
524 Nute, 1997). For *the Good Samaritan* (§4.2.1) a prior obligation not to rob overrides
525 the default inference to rob, and for *the Gentle Murderer* (§4.2.3), a prior obligation
526 not to murder overrides the default inference to murder. This may be appropriate
527 if distributive inferences are thought appropriate in “normal” circumstances, and
528 the main issue with *the Good Samaritan*, and similar examples, is viewed as residing
529 in a conflict between primary obligations and derived obligations. Arguably this is
530 related to proposals to stratify deontic statements into different levels of priority
531 (§5.3). There may be both logical and moral issues to resolve in determining the
532 relative priority of obligations.

533 The idea of withdrawing conflicting conclusions does not seem to help determine
534 the precise nature of the obligation imposed by *the Clean Knife* example (§4.2.4),
535 where there are no prior prohibitions on cleaning, or using, a knife.

536 In the case of deontic conflicts, it is also possible to consider *paraconsistency*,
537 where reasoning is performed with respect to maximal consistent collections of
538 obligations (da Costa, 1988; da Costa and Carnielli, 1986; Loparic and Puga, 1986).

539 **5.6 Logic-free obligations**

540 An alternative approach sketched by Fox (2009) is to allow entailments between
541 the satisfaction conditions of obligations, but not directly between obligations
542 themselves. If an obligation is unsatisfied, than a *transgression* has occurred. For
543 those obligations that have been satisfied, we may wish to record the subject’s

544 *compliance*. Transgressions, and compliance, can be specific to the obligation in
545 question (cf. Wyner, 2008), unlike the notion of a single, universal sanction (§3.1).

546 This allows for partial fulfilment, including partial fulfilment of contradictory
547 and unfulfillable systems of obligations, as well as *Contrary-to-Duty* obligations
548 (§4.3.4). In such cases, if an agent fails to comply with any compensating obligations
549 then there are simply more unfulfilled obligations (or transgressions). The choice
550 of which obligations to satisfy, and which transgressions to avoid, can then be
551 considered a question of moral judgement, rather than one of logical inference (cf.
552 Bonevac, 1998, p43).

553 A notion of *coherence* (cf. Makinson and van der Torre, 2003b) can be used
554 in place of logical entailment. Instead of $OB(a)$ following from $OB(a \wedge b)$, we
555 can say that a *coherent* system of obligations will not combine $OB(a \wedge b)$ with
556 $OB(\neg a)$, or indeed with any obligation whose satisfaction is at odds with the
557 satisfaction of $OB(a \wedge b)$. If needed, *equivalence* and *subsumption* relationships
558 between deontic systems can be formulated in terms of satisfaction conditions and
559 coherence properties.

560 Coherence can be used to analyse permission. If a is permitted, $PE(a)$, then it
561 would be incoherent for there to be obligations whose satisfaction is at odds with a .
562 For free-choice permission (§4.3.1), if “ a or b ” is permitted, $PE(a \vee b)$, then it would
563 be incoherent to have obligations that are at odds with a , or with b . In the case of
564 *exclusive* free choice, it would be incoherent to combine $PE(a \vee b)$ with $PE(a)$ and
565 $PE(b)$.

566 By itself, this approach does not resolve how to identify the specific obligations
567 imposed by *the Good Samaritan* (§4.2.1), *the Gentle Murderer* (§4.2.3) and *the Clean*
568 *Knife* (§4.2.4) examples. They may merit more analysis of the linguistic data, and
569 the use contextualised interpretations (§5.1).

570 6 Further Reading

571 McNamara (2006a,b) describes SDL and other approaches, together with discussion
572 of various paradoxes and conundrums and proposals for their resolution. McConnell
573 (2002) discusses some moral dilemmas that any treatment of obligations and per-
574 missions should consider. Hansen *et al.* (2007) presents key philosophical questions

575 about deontic logic from the perspective of input/output logic. Other survey pa-
576 pers include Åqvist (2002); Carmo and Jones (2002); Føllesdal and Hilpinen (1971);
577 Hilpinen (1981a); Meyer and Wieringa (1993a).

Notes

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1. The terms *sentence*, *statements*, *utterance* and linguistic *expression* refer to different notions. Not all sentences are statements. Not all utterances or expressions are sentences. And an expression exists independently of any particular physical utterance. In this article we are not especially concerned about such distinctions. One case where the precise terminology is relevant is when the act of making a particular utterance itself imposes an obligation or grants a permission.
2. Here the names of the various rules and axioms (OB-K, OB-D, OB-NEC, etc.) are derived from the conventional names for rules and axioms of these forms in modal logic (K, D, NEC, etc.). The provenance of these names is varied (K for *Kripke*, D for *deontic*, NEC for *necessitation*, etc.). Essentially they are given here as they are part of the vernacular of modern logical theories.
3. Some semanticists might even view the model as not just allowing a demonstration of consistency, but of providing, in some sense, the “real” semantics of the formal account.
4. This kind of approach has been considered for the analysis of imperatives (Lascarides and Asher, 2004; Segerberg, 1990). We will not attempt to consider the relationship between deontic statements and imperatives in this article.
5. Examples of the form (10) and (11) are sometimes referred to, respectively, as *Satre’s Dilemma*, from Sartre (1957/1946), and *Plato’s Dilemma*, from Plato’s *Republic*, Book I “...if a man borrows weapons from a sane friend, and if he goes mad and asks for them back, the friend should not return them, and would not be just if he did. Nor should anyone be willing to tell the whole truth to someone who is in such a state.” (*Republic*, I, 331c). This example is used to counter the argument that “Justice is speaking the truth and repaying debts.” (*Republic*, I, 331b–c).
6. Here we use p to stand for a regular proposition. This is in contrast to a , which may be constrained to be some form of “practive” proposition, in the sense of Castañeda (1981).
7. If p is false, then material implication allows us to derive $p \rightarrow \text{OB}(a)$ for any a . This may appear a counter-intuitive interpretation of conditionality. Some propose a

608 distinct notation for conditional obligation, such as $OB(a|p)$, as sketched in §5.2.
609 Others have used alternatives to material implication, such as *strong* implication
610 (Prior, 1958, for example).

611 8. Ross's Paradox was originally described in the context of imperatives.

612 9. See the note on Chisholm in McNamara (2006a), [http://plato.stanford.edu/](http://plato.stanford.edu/entries/logic-deontic/chisholm.html)
613 [entries/logic-deontic/chisholm.html](http://plato.stanford.edu/entries/logic-deontic/chisholm.html), for an extended discussion of this, and
614 of dyadic conditionals.

615 10. The use of relativised interpretations for deontic expressions appears similar to pro-
616 posals to use contextually relevant "comparison sets" in the pragmatic interpretation
617 of discourse focus (Rooth, 1993).

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