

Reasoning about rights and duties:

Mental models, world knowledge and pragmatic interpretation

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Abstract

We address the way verb-based and rule-content knowledge are combined in understanding institutional deontics. Study 1 showed that the institutional regulations used in our studies were readily categorised into one of two content groups: rights or duties. Participants perceived rights as benefiting the addressees identified by the rule, whereas they perceived duties as benefiting the collective that imposed the rule. Studies 2, 3, and 4 showed that rule content (rights vs. duties) had clear effects on perceptions of violations and relevance of cases for explaining the rule, even when controlling for deontic verb, phrasing of the action permitted by a right, or the formality of the deontic verb. These effects are incompatible with a simple pragmatic disambiguation approach to pragmatic modulation, as they often induce permissibility judgments that contradict the core semantic meanings of the deontic verbs. Other ways of reconciling verb meaning with rule content should be considered in a fuller theory of the interpretation of institutional rules.

Keywords: deontic reasoning, pragmatic modulation, mental models, scripts

Reasoning About Rights and Duties:

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The concepts of “right” and “duty” (and its cognate “responsibility”) figure prominently in political and moral discourse. To cite one instance, in the French presidential debate of May 2012, the outgoing president Nicolas Sarkozy claimed that while immigrants to France had rights (e.g., to education, social services etc.) they also had “duties” (e.g., to learn the French language, to respect the French constitution, etc.). His opponent, François Hollande, evoked the “rights” of those who had been living in France to claim French citizenship, as well as the “responsibilities” of the wealthy to contribute their fair share to helping France out of its economic recession and debt crisis. Similar concerns motivated the attention given to British politicians and celebrities who (within their legal rights) reduced their tax liabilities, yet were widely felt to have failed in their duty as British citizens to contribute their fair share to the nation’s treasury. For many, justice requires that rights be attributed to those that have “earned” them (e.g., citizenship can be attributed to immigrants who have shown their commitment by living in a country for a certain length of time), whereas duties are required of those who “owe” society (e.g., through having become rich through benefiting from access to a country’s infrastructure and markets).

Rights and duties may thus be thought of as understandings shared by groups about what members may or must do (or not do), and which may be re-negotiated and redefined (e.g., at election time) by those groups (Louis & Taylor, 2005). They are often codified as universal statements of the form “All registered citizens without a job have the right to claim unemployment benefit” or “All taxpayers must pay 75% tax on earnings over 1 million euros a year”, expressing a relationship that obtains between a social group (represented by an “authority” who decrees the rule) and a class of individuals who belong to the group. Institutional deontics such as these have three characteristics shared with laws (Hart, 1961).

First, they are general and not addressed to any particular person. Second, they are standing orders, with sanctions for violators, which are independent of a particular time of utterance. And third, the authority of the giver or enforcer of the rule is permanent and independent of the occasion. Rights and duties thus fall into the category of social contracts that Cosmides (1989) calls “social laws” which regulate the behaviour of social groups, and can be distinguished from “private exchanges” which depend on a particular deal struck on a particular occasion between two individuals. Unlike other deontic statements such as promises, advice or instructions which are typically expressed in the 2nd person, institutional deontics such as rights and duties are typically expressed in the 3rd person, and may be expected to activate script-like expectations (Abelson, 1981; Sarbin, 1954; Schank & Abelson, 1977) associated with mentioned roles (e.g., taxpayers, the unemployed) and behaviours (e.g., paying taxes, claiming state benefits). In contrast to “private” deontic statements that create obligations and permissions between specified individuals, rights and duties fall into the public domain and are likely to form part of an acculturated individual’s stock of general knowledge.

Approaches to understanding and reasoning about rights and duties

But how do people understand assertions about such rights and duties and reason about them? How do they combine their linguistic knowledge of the meanings of deontic terms (such as *permits* and *obligates*) with their general knowledge of what is usually allowed, required or forbidden in a given social or institutional setting? How do they decide that people are acting within their rights or have fulfilled their duty, or recognize violations as when someone has exceeded their rights or failed to do their duty? Two general lines of approach to the above question can be discerned in psychology.

The first approach has focused mainly on the kind of *rule contents* that facilitate people's ability to select cases in which a deontic rule might be violated. The general thrust of this approach has been to focus on the deontic content of the rule by contrasting it to non-deontic content (e.g., Over, Manktelow, & Hadjichristidis, 2004), or by differentiating various categories of deontic rules such as permissions vs. obligations (e.g., Cheng & Holyoak, 1985) or social contracts vs. prudential rules (Fiddick, 2006). Yet others within this approach seek to identify the mechanisms through which the rule facilitates detection of violations, such as social contract theory (Cosmides, 1989) or decision theory (Manktelow & Over, 1991; see also Liberman & Klar, 1996; Politzer & Nguyen-Xuan, 1992). In this knowledge-based approach, we would expect people's deontic reasoning to be influenced by their knowledge concerning the rule content, e.g., whether it was a right (such as being able to drink alcohol at the age of eighteen) or a duty (such as being required to declare one's full earnings to the tax authorities).

However, another approach to the study of deontic reasoning in psychology is *language-based* as it focuses on the interpretation of elemental deontic terms in natural language understanding. Drawing on philosophical work on normative systems of deontic logic (Hilpinen, 2001; McNamara, 2010) this approach focuses on the meaning of and logical relations between deontic terms, such as the deontic modals, *permits*, *obligates* and *forbids*, and how these operators can yield judgments about the permissibility or impermissibility of certain behaviours. Bucciarelli & Johnson-Laird (2005) approached this question through the mental models perspective, which attempts to capture understanding and reasoning about deontic verbs through the creation of mental models that represent the natural language meaning of these verbs. To our knowledge, Bucciarelli and Johnson-Laird's study is the first that presents a systematic analysis of what deontic verbs such as *permits* and *obligates* mean

in ordinary discourse, along with an empirical test of the semantic interpretations people give to these verbs.

The rules used in Bucciarelli and Johnson-Laird's empirical study of mental models of deontic verbs (2005, Expt. 1) all appear to be examples of what we call the *institutional* deontic, where a rule is typically given in impersonal form by an authority to a public in order to regulate behaviour in a group (e.g., a society, a company), such as *Taxpayers who support charities are permitted to claim a rebate on their taxes*, *Branch managers who make credits are obligated to increase the interest rates*. The attribution of rights and the imposition of duties are prototypic functions of the institutional deontic. Because rights and duties form part of an acculturated individual's stock of general knowledge (e.g., adults may drink alcohol, wage earners must pay tax), the question then arises of how linguistic knowledge of deontic verbs (e.g., deontic modal verbs such as *permits*, *obligates*, *forbids* and *permits not*) is combined with general world knowledge about culturally familiar institutional deontic rules. In their study on understanding and reasoning about deontic statements, Bucciarelli & Johnson-Laird (2005, Expt. 1) only focused on the effects of deontic verbs on judgments. They did not examine the possible effects of the rule contents (e.g., rights vs. duties) in which these verbs were embedded, nor did they analyse whether these rule contents affected the salience of participants' mental models or their judgments of rule violations, leaving these important questions open. Bucciarelli & Johnson-Laird (2005) did however indicate that this question could be addressed by appealing to the notion of pragmatic modulation of verb-meaning (Johnson-Laird & Byrne, 2002), without giving a detailed account of how this would be done. Below we examine the mental models approach to representing deontic assertions and examine whether the pragmatic modulation approach to verb meaning can be extended to accommodate understanding and reasoning about deontic verbs used in the context of prior knowledge about rights and duties.

The mental models approach to understanding deontic expressions

Bucciarelli and Johnson-Laird (2005) propose that the fundamental relations involved in deontic reasoning are *permits*, *forbids* and *obligates*, which share characteristics with modal operators used in reasoning about indicative conditionals, for example, the epistemic *may* and *must*. In so doing, they give an account of deontic reasoning which is analogous to the account of how indicative conditionals are interpreted in the mental models theory of reasoning (Johnson-Laird & Byrne, 1991; 2002). The deontic modals *permit* and *obligate* are logical duals and their meanings can be defined in terms of each other. Duality is easiest to state in terms of the equivalent notions of permission and obligation. To say an action is permitted is equivalent to saying that one is not obliged not to perform it. To say an action is obligatory is equivalent to saying that one is not permitted not to perform it. What is obligatory is also permissible, and so *obligates* logically implies *permits* just as *must* logically implies *may*, making *must* the strong and *may* the weak modal operator. These are *linguistic* relations, as they hold by virtue of the semantic meaning of these expressions, independent of any particular utterance context (e.g., Hilton, Schmeltzer & Geurts, 2011; Horn, 1989).

These deontic relations can be expressed in a number of ways in natural language, and in English are often expressed by the deontic verbs *must*, *may*, *must not* and *need not*. According to Bucciarelli and Johnson-Laird, the meaning of each of these verbs can be captured in terms of mental models of what is considered permissible and impermissible. Each verb has two possible interpretations (See Table 1, itself derived and simplified from Table 1 of Bucciarelli and Johnson-Laird, 2005, p. 171), which are labelled *strong* and *weak* (not to be confused with the distinction introduced above between the strong modal operator, *must*, and weak modal operator, *may*). Strong interpretations are those that eliminate more

permissible states. For example, for the deontic relation *A obligates B*, the state *A & not-B* is considered impermissible under both strong and weak interpretations, but *not-A & B* is considered impermissible only under the strong interpretation. For example, it is only when there is a strong interpretation of Rule 1 that it would be violated by a taxpayer who did not support a charity but claimed a rebate:

(1) *Tax payers who support charities are permitted to claim a rebate on their taxes*

Representing the form of (1) as *A's are permitted to do B*, we see that, in its strong interpretation, a violation of it has the form *not-A & B*. Thus in the strong interpretation, *not-A & B* is impermissible given *A's are permitted to do B*. In the weak interpretation of *A's are permitted to do B*, all possible outcomes, *A & B*, *A & not-B*, *not-A & B*, and *not-A & not-B*, are permissible.

As a test of their model, Bucciarelli and Johnson-Laird (2005, Expt. 1) conducted a study in which participants were presented with rules which included one of four deontic verbs: *permitted/obligated/permitted not/forbidden*. Example rules in their study were *Tax payers who support charities are [deontic verb] to claim a rebate on their taxes* and *Branch managers who offer credits are [deontic verb] to increase the interest rates*, and all eight rules used were expressed in the same impersonal format. For each rule, for the form *A's are [deontic verb] to do B*, participants were required to write down what they considered to be permissible and impermissible states for each combination of A and B (*A & B*, *A & not-B*, *not-A & B*, *not-A & not-B*). The responses overwhelmingly fitted the possible interpretations detailed by Bucciarelli and Johnson-Laird (see Table 1), with a strong tendency to favour weak interpretations across all four deontic verbs.

According to Bucciarelli and Johnson-Laird (2005), the overall tendency to favour weak interpretations is noteworthy, as interpretations that fail to rule out possibilities are *a priori* less informative from a Gricean point of view (Johnson-Laird, 1983). Consequently,

they appeal to the notion of pragmatic modulation to help produce more informative interpretations, writing that “Daily usage may be more informative, and individuals are not normally called upon to list all the permissible and impermissible states corresponding to a deontic assertion. Similarly, the everyday interpretation of *obligates* and *prohibits* may be modulated by knowledge that rules out the state unique to their weak interpretation.” (p. 174). As Bucciarelli and Johnson-Laird (2005) did not give details about this process, we take over the theoretical analysis and empirical results of Johnson-Laird & Byrne (2002, Expt. 3) concerning the pragmatic modulation of indicative conditionals. They argued that indicative conditionals allow ten possible interpretations in terms of their mental models theory, and that the selection of these interpretations through pragmatic modulation will depend on the content of the conditional statement. For example, a statement such as “If a patient has malaria, then she has a fever” led the majority of participants to make a “conditional” interpretation, as evidenced by their listing the following possible states as compatible with the statement: has malaria and has fever ($A \ \& \ B$); does not have malaria and has fever ($not-A \ \& \ B$); and does not have malaria and does not have fever ($not-A \ \& \ not-B$). In contrast, a statement such as “If you log on to the computer then you may be able to receive e-mail” led participants to make an “enabling” interpretation as shown by the finding that most participants listed the following possibilities: logs on and able to receive email ($A \ \& \ B$); logs on and unable to receive email ($A \ \& \ not-B$); and does not log on and is not able to receive email ($not-A \ \& \ not-B$).

Johnson-Laird & Byrne (2002) argue that indicative and deontic conditionals yield equivalent semantic interpretations in terms of mental models theory. Whereas indicative conditionals describe physical possibilities and impossibilities, deontic conditionals describe deontic possibilities and impossibilities. Just as indicative conditionals that are given the “conditional” interpretation (A is sufficient for B) describe what *must happen* given the

presence of the antecedent, so deontic conditionals that describe obligation describe what *must be done* given the presence of the antecedent. Likewise, “enablement” interpretations of indicative conditionals (*A* is necessary for *B*) describe what *may happen* in the presence of the antecedent, and deontic conditionals that express permission describe what *may be done* in the presence of the antecedent. Johnson-Laird and Byrne also argue that knowledge of deontic rules of the form *If A then B* will lead participants to decide that certain cases are deontically impossible, with consequences for their behaviour on the Wason selection task.

For example, they suggest that a rule such as “If a person is drinking beer (*A*) then he must be over 18 (*B*)” (Griggs & Cox, 1982) will lead people to use their general world knowledge that this statement expresses an obligation to decide that *A & not B* are deontically impermissible, in that cases of people drinking beer (*A*) who are not over 18 (*not B*) are violations of the rule. Likewise, in the context of Cosmides’ (1989) experiments, they suggest that people will interpret statements such as “If a man has a tattoo on his face (*A*) then he eats cassava root (*B*)” as a permission, and thus use this knowledge to decide that cases of men who do not have a tattoo on their face (*not-A*) and who drink cassava root (*B*) are violations. Empirical confirmation of the hypothesis that rule contents will influence reasoning was provided by Quelhas & Byrne (2003), who showed that prudential obligations will make the impermissibility of *A & not-B* cases salient.

Combining linguistic and world knowledge in interpreting deontic statements: Verb-based vs. rule-content strategies

In this section we identify two possible strategies for combining linguistic knowledge of the meaning of deontic verbs with world-knowledge concerning rule content in understanding and reasoning about deontic statements. We focus on rules involving rights and duties, concentrating our analysis on cases where we expect *not-A & B* will be judged

deontically impermissible (e.g., in the case of rules referring to rights) and $A \ \& \ not-B$ will be judged deontically impermissible (e.g., in the case of rules referring to duties). In the analysis presented below, we focus on the predictions for the eight target cases created by combining four types of deontic verb (e.g., *permits*, *obligates*, *permits not*, *forbids*) with two kinds of permissibility judgment ($not-A \ \& \ B$ vs. $A \ \& \ not-B$).

In the first “verb-based” interpretation strategy, we expect that respondents will base their analysis of the deontic statement on the semantic meaning of the deontic verb used (e.g., *permits*, *obligates*, *permits not*, *forbids*) and only use world knowledge of the content of the rule (e.g., right vs. duty) to select interpretations in semantically ambiguous cases. We will refer to this as pragmatic modulation by verb disambiguation, and this seems to us to correspond to what Johnson-Laird and his colleagues have in mind when referring to pragmatic modulation (Bucciarelli & Johnson-Laird, 2005; Johnson-Laird & Byrne, 2002). According to this view of pragmatic modulation, world-knowledge will only become relevant when it enables selection of a strong or weak interpretation of an ambiguous deontic verb (see Table 1). Among the deontic terms analysed by Bucciarelli and Johnson-Laird (2005; see also Johnson-Laird & Byrne, 2002, p. 670), only *permits* and *obligates* have ambiguous interpretations, each for $not-A \ \& \ B$ cases (they yield two possible models compatible with the proposition). Following this verb-based strategy (verb semantic analysis supplemented by pragmatic disambiguation) we may predict that knowledge of the rule content that renders cases of $not-A \ \& \ B$ deontically impossible (e.g., rights) will favour strong interpretations of the deontic modals *permits* (*may*) and *obligates* (*must*). If participants follow the verb-based strategy, then we expect them to produce the pattern of impermissibility judgments detailed in Table 1, with a tendency to favour impermissibility judgments for $not A \ \& \ B$ cases for the verbs *may* and *must* in the case of rights, due to pragmatic modulation.

In contrast, a “rule-content” interpretation strategy predicts that respondents base their judgments of permissibility on the basis of rule content, regardless of the deontic verb used. Specifically, this approach predicts that respondents will always judge *not-A & B* cases to be violations in the case of rights, and *A & not-B* cases to be violations in the case of duties. While this approach (like the verb-based strategy) predicts verb disambiguation for *permits* and *obligates* in *not-A and B* cases, for the other six target cases (unlike the verb-based strategy) it also predicts *semantic contradictions* (judgments of permissibility that contradict the semantic analyses of deontic verbs given in Table 1). For example, the rule-content approach predicts that people who read a verb indicating a prohibition (e.g., *must not*) in the context of a duty rule-content, will judge cases of *A & not B* as impermissible, even though this violates the core meaning of “must not” (cf. Table 1). Thus people who read that “*People who drive a car must not hold a driving licence*” but consider that cases of *A & not B* are violations (i.e., because it violates the duty of people who drive cars to hold a driving licence) are contradicting the semantic interpretation of the verb “must not”. This is because the verb “must not” logically implies that cases of *A & not B* conform to the rule (i.e., it is permissible, and indeed obligatory, for drivers not to hold a driving licence). Similarly, respondents who read the rule “*People who have been made redundant need not claim unemployment benefits*” who consider that people who have not been made redundant (not-A) who claim unemployment benefit (B) are violating the rule (consistent with the widely shared belief that only unemployed people have a right to claim unemployment benefit) are contradicting the semantic meaning of the verb “need not” which implies that claiming unemployment benefits is always permissible (see Table 1). We list the full set of predictions of the rule-content approach in Table 2 for the eight target cases, noting that as well as predicting pragmatic disambiguations for *permits and obligates*, it also predicts semantic contradictions for the six other target cases (see Table 1).¹

Experimental hypotheses concerning permissibility judgments

We summarize the experimental predictions for Studies 2 to 4 as follows. The verb-based and rule-content interpretation strategies outlined above agree in predicting rule-content effects only in the two target cases where world-knowledge is needed for pragmatic modulation; i.e., to disambiguate strong and weak interpretations of the ambiguous deontic verbs *may* and *must* (i.e., deciding whether *not-A & B* is permissible or not). For example, if people who read that “*People who have been made redundant may claim unemployment benefits*” consider that people who have not been redundant (*not-A*) but claim unemployment benefit (*B*) are violating the rule, then they have adopted a strong reading of *may*. Equally, if people who read that “*People who drive a car must hold a driving licence*” consider that people who do not drive a car (*not-A*) and hold a driving licence (*B*) are violating the rule, then they have adopted a strong interpretation of *must*.

However, the two approaches differ in their predictions with respect to the other six target cases of *A & not-B* and *not-A & B* judgments. Whereas the verb-based approach does not predict effects of content in these cases, the rule-content approach predicts content effects that will lead to *semantic contradictions* of the meanings of the deontic verbs provided by Bucciarelli and Johnson-Laird (see Table 1). Beginning with the *not-A & B* cases, the rule-content approach predicts semantic contradictions for two deontic verbs *prohibits (must not)* and *permits not (need not)*, because prior knowledge of rights will lead respondents to consider *not-A & B* cases to be impermissible (whereas duties will lead them to be considered permissible). In addition, the rule-content approach also predicts semantic contradictions for all four deontic verbs for cases of *A & not-B*. In three target cases, this is because it predicts that rules that refer to duties will be perceived to make cases of *A & not-B* deontically impermissible, and thus be incompatible with the senses of *may*, *must not* and *need not*

(Bucciarelli and Johnson-Laird, 2005). For example, the rule-content approach predicts that people who read duty content rules such as “*Users of public transport may/must not/need not hold a transport pass*” will consider that people who use public transport but do not hold a transport pass ($A \ \& \ not \ B$) are violating the rule. This interpretation will contradict the semantic analyses of *permits* (*may*), *forbids* (*must not*) and *permits not* (*need not*) which all stipulate that $A \ \& \ not \ B$ is permissible according to Table 1. In the final target case, if a rights-based content leads participants to consider that $A \ \& \ not \ B$ is permissible in the case of *must* (e.g., when reading a rule such as *People who have been made unemployed must claim unemployment benefit*), then this leads to a semantic contradiction of the meaning of this deontic verb.

Relevance judgments

We were also interested in which logical case ($A \ \& \ B$, $A \ \& \ not \ B$, $not \ A \ \& \ B$, $not \ A \ \& \ not \ B$) would be most relevant to explain a rule to an interested party. As Bucciarelli and Johnson-Laird (2005, p. 173) point out, the salience of a case is likely to reflect the communicative intentions of the speaker. We developed a task designed to explicitly assess whether a given case is perceived to be relevant for explaining the rule. We expected that cases of *not-As who do B* would be judged as more relevant when explaining rights, and *As who do not B* as more relevant when explaining duties. This was based on the assumption that perceived utility will drive relevance judgments, and will reflect the perception that the perceived cost to society is high when cheats take benefits that they are not entitled to ($not \ A \ \& \ B$), or shirkers avoid performing duties that are required ($A \ \& \ not \ B$).

Our perceived relevance task is different in some respects to the salience task used by Bucciarelli and Johnson-Laird, where participants were asked to list cases that are compatible with each rule. Their results confirmed their predictions that the $A \ \& \ B$ cases will be listed first for all four deontic verbs (*permits*, *obligates* and *forbids* and *permits not*), and that $A \ \&$

not-B will frequently be listed first for *forbids* and *permit not*. Bucciarelli and Johnson-Laird (2005) justified the predictions for *forbids* and *permit not* on the basis of developmental evidence (Gralinski & Kopp, 1993). We expect that there will be considerable overlap in the patterns observed by Bucciarelli and Johnson-Laird for each verb in their salience task and in our perceived relevance task. We also examine the possibility that negative polarity deontic expressions such as *must not* and *need not* will spontaneously activate both the positive *A & B* and negative *A & not-B* cases (cf. Evans, 1998), thus influencing their perceived relevance.

Plan of the paper

We report four experiments in this paper. In Study 1, we show that people readily identify certain institutional deontics as rights or duties, and consider rights to primarily benefit the subjects of the rule (i.e. the *As*), and duties to benefit the collective that imposes the rule. On this basis, we select a number of prototypic rights and duties, which we use in Studies 2 to 4 to examine how rule content influences permissibility and relevance judgments. In particular, we will evaluate which of the alternative verb-based and rule content-based approaches best accounts for the data concerning permissibility judgments. We conclude by discussing the implications of our findings for theories of how institutional deontic statements are understood and reasoned about in context.

Study 1: Identifying how individuals classify institutional rules & perceived social transfers

We assumed that people have consensually shared beliefs about rights and duties that constitute common knowledge within a culture and that may vary between cultures (Moghaddam & Finkel, 2005). Rights are arrangements whereby a formally constituted social group (e.g., state, company, or club) uses its authority to grant a privilege to an

individual that allows her to do something that she would not otherwise be able to do. For example, in France someone who is under 18 will not have the right to buy alcohol in a bar, and someone whose income is above a level fixed each year by the government cannot claim poverty benefit. Duties on the other hand are arrangements whereby a social group imposes a requirement on an individual that obliges her to do something that she might not otherwise do, such as pay her taxes or buy a ticket to use public transport. For this reason, rights may be seen as transfers of benefits from society to the individual and duties as transfers of benefits from the individual to society (cf. Moghaddam & Riley, 2005). We therefore hypothesize that rights and duties will be perceived as involving an asymmetric redistribution of benefits and costs between an individual and a society, thus motivating the second prediction tested in Experiment 1.

We can make two key predictions from the above analysis. First, we expect that acculturated participants will be easily able to classify institutional deontics of the kind studied by Bucciarelli and Johnson-Laird (2005) into rights and duties. Second, rights and duties will be seen as transferring benefits and costs between an individual and a society in different ways. In particular, a key feature of rights is that they will be seen as principally benefiting individuals (at a cost to the group) whereas duties will be perceived as benefiting the relevant social group (at a cost to the individual).

Method

Participants and Procedure

A sample of 234 French undergraduate students from the University of Toulouse-II were asked to complete a questionnaire at the end of a psychology class. In order to keep the questionnaires relatively short, the study used a 2x2 between-subjects design whereby two sets of rules (list A & list B) were crossed with two types of framing (benefits versus costs). The eight rules from Bucciarelli & Johnson-Laird's (2005) first study were translated into

French and presented along with eight new rules.² Each questionnaire comprised of a list of 8 rules (four from Bucciarelli & Johnson-Laird and four new ones), which were accompanied with instructions that directed participants to classify rules as either rights or duties by choosing the most appropriate filler expression (e.g. “Nurses who do the day shift have *the duty/ the right* to attend adult professional training.”). In addition, for each “benefit” version of the questionnaire participants were asked to indicate which of the two entities involved in the social exchange would be likely to reap the greatest benefit from the rule; and for each “cost” version participants were asked to indicate which of the two parties would incur the greatest costs if the rule *was not* put into application. Four response options were then provided for these “utilities” questions. Participants could either select (a) the individual (e.g., “the nurse”), (b) the collective or organization (e.g., “the hospital”), (c) both parties or (d) neither party.

Results

Nature of the statements

Our results suggest most of our rules induced high agreement among participants regarding the nature of each statement (see Table 3). Between-subjects agreement rates (defined as the percentage of participants having chosen the same response) were computed for each type of “right vs. duty” response. We evaluated whether rules were scripted or not by using a 75% agreement criterion for consensual acceptance. Table 3 shows that 10 rules were perceived as prototypic rights, with agreement rates $\geq 78\%$ and 4 rules were perceived as prototypic duties, with agreement rates $\geq 96\%$. Fourteen rules could thus be considered as “scripted”, and the two remaining rules (Bucciarelli & Johnson-Laird’s *Nurse & Music* rules) were perceived as being ambiguous (41% right & 59% duty for both rules).

Who benefits?

Overall, participants mostly agreed that either one or both of the parties benefited from the rule, as there were very few “neither” responses (see Table 3). In order to examine to what extent participants associated duties with favouring the group and rights with favouring the individual, a benefit transfer index was created. This benefit transfer index was scored on a scale ranging from benefiting the individual to benefiting the collective, where statements identified as benefiting the “individual” were attributed a score of 0; statements identified as benefiting “both” or “neither” of the entities were attributed a score of 0.5; and statements identified as benefiting the “collective” were attributed a score of 1. An overall benefit transfer score for each type of content (right vs. duty) was then computed by adding the scores obtained and dividing them by the number of questions. A *t*-test was then conducted to assess whether overall scores significantly differed. Results revealed that, as predicted, participants perceived the application of rules imposing duties ($M = .61, SD = .22$) to be significantly more associated with benefits for the collective if the rule was applied, than those giving rights ($M = .19, SD = .15$), $t(117) = 17.27, p = .001$, two-tailed.

Who loses?

A potential cost index was used to compare pairs of responses for each “cost” statement if the rule was not applied (see Table 3). Potential costs if the rule was not applied were first rated using a scaling system ranging from individual to collective, where statements identified as potentially costing the “individual” were attributed a score of 0; statements identified as costing “both” or “neither” of the entities were attributed a score of 0.5. A *t*-test revealed once again that participants perceived duties ($M = .60, SD = .28$) to be more associated than rights with costs for the collective if the rule is not applied, than rights ($M = .23, SD = .14$), $t(113) = 11.75, p = .001$, two-tailed.

Discussion

This study confirms our two major hypotheses. First, our participants showed considerable agreement in identifying most of the deontic rules as either rights or duties, using a fairly stringent criterion of 75% consensus. Only two out of the sixteen rules could not be classified in this way, indicating that few of our rules might be perceived as “neutral”, i.e. *a priori* neither a right or duty. Both were rules used by Bucciarelli and Johnson-Laird (*The nurses who do the day-work [deontic verb] attend adult professional training and Musicians who play wind instruments [deontic verb] arrive one hour before the concert*³). For both rules, 41% of the participants considered the rule to be a right and 59% saw it as a duty. Six of the rules used by Bucciarelli and Johnson-Laird were clearly perceived as rights (Rules 1-3, 9-11), suggesting that they did not use a set of rules that was completely neutral in terms of our analysis (i.e. perceived as neither a right nor a duty). Second, our hypotheses that rules classified as rights would primarily be perceived as favouring the individual (and costing the collective), and duties would primarily favour the collective (and cost the individual), were both strongly confirmed.

Having established that the institutional deontics under consideration are usually consensually understood as either rights or duties, and possess the predicted characteristics (i.e., concerning benefit and cost transfer), we are in a position to examine how these consensual understandings (or shared world knowledge about rule contents) influence the interpretation of institutional deontic statements. Below, we test the rival predictions listed in Table 2 about how scripted knowledge of the rule content associated with rights and duties will affect perceived rule violations and perceived relevance of cases for explaining a rule.

Study 2: Effect of rule content on judgments of permissibility and relevance

The present study examines whether scripted knowledge about rule content (rights vs. duties) influence permissibility judgments and perceptions of the relevance of a case for explaining a rule. We summarize our predictions in the following way with reference to Table 2. First, for the eight cases of *A & B*, and *not-A & not-B*, we do not expect rights and duties to affect permissibility or relevance judgments, and we expect patterns of permissibility judgments to be driven by the four deontic verbs and thus follow the pattern detailed in Table 1. Second, following the rule-content approach we expect that rule content will lead to the judgment that *not-A and B* cases are impermissible in the case of rights, and that *A and not-B* cases are impermissible in the case of duties.

If participants follow a verb-based pragmatic disambiguation strategy, then we expect rule content effects only in the cases of *may* and *must*. Specifically, the verb-based pragmatic disambiguation approach predicts that rules whose contents refer to rights will lead to the selection of strong interpretations of *permits (may)* and *obligates (must)* whereas those whose contents refer to duties will favour weak interpretations. The verb-based approach predicts that knowledge of rule content (rights vs. duties) will only be used to select possible interpretations of ambiguous deontic verbs. The rule-content interpretation strategy also predicts that people will select between strong and weak interpretations of *may* and *must*, but also predicts semantic contradictions of the core meanings of deontic verbs in the other six target cases. Specifically it predicts that: participants will judge *not-A and B* cases to be impermissible for *must not* and *need not* in the case of right rule contents; *A and not-B* cases to be impermissible for *must not*, *may* and *need not* in the case of duty rule contents; and permissible for *must* in the case of right rule contents. Observation of such “anomalous” interpretations would be taken as showing that participants do not follow a verb-based strategy (semantic analysis plus pragmatic modulation) in understanding deontic statements,

which predicts that they will only use world-knowledge for interpretation when selecting between strong and weak interpretations of ambiguous deontic verbs (i.e., for *may* and *must*).

Method

Participants

A total of 163 French undergraduates participated in this study (age: $M = 20.54$, $SD = 1.26$, 50.3% women). Ninety-five students were Business and Administration Management (G.E.A.) students from the *Institut Universitaire de Technologie* of Tarbes, and the remaining 68 students were Business and Management students from the Toulouse Business School.

Procedure

Participants were recruited at the end or beginning of their classes. First their teachers asked them if they would be willing to participate in a psychology experiment investigating everyday reasoning. Teachers then distributed short questionnaires, randomly assigning each student to one of the eight conditions devised by the experimenters. Students filled them in while remaining seated inside the classroom.

Materials

Each of the eight versions of the questionnaire instructed participants to perform two simple reasoning tasks with two distinct institutional deontic rules. The first rule presented involved a scripted deontic rule with a *duty content* (e.g., the SNCF ticket-punching rule); whereas the second involved a scripted deontic rule with a *right content* (e.g., the unemployment benefit rule). We rotated each deontic rule-type (two duties and two rights) over each of the four deontic verbs (*may*, *must*, *must not*, *need not*) in a Latin square design. This resulted in a fractionated block design in which all pairs of rules were paired with all kinds of deontic verb across the experimental blocks. We ensured strong manipulations of deontic rule content by selecting two duties and rights from the first study that had obtained

high agreement rates from students (all four rules had classification rates > 75%) and involved the same type of societal contract (between the state and the public). The first rule (R1) “People whose income does not reach the minimum wage [deontic verb] receive the RMI” (Minimum Income Support Allowance) and second rule (R2) “People who have been made redundant [deontic verb] receive unemployment benefits” had been identified by Study 1 participants as referring to rights involving a transfer of benefits to the individual; whereas the third rule (D1) “Passengers travelling in SNCF trains [deontic verb] punch their tickets” and fourth rule (D2) “Users of public transport [deontic verb] hold a transport pass” had been identified as referring to duties involving a transfer of benefits to the collective.³ These 4 rules were redesigned as 16 conditional statements which paired each of four deontic verbs (*may, must, must not, need not*⁴) with each of the four rule contents. Thus, eight questionnaires were generated and distributed equally among participants to enable a test of every possible combination (2 rule contents x 4 verbs). Each of the eight questionnaires presented a duty paired with a deontic verb, and a right paired with a different deontic verb. On both pages of the questionnaires (one containing a duty, the other a right), participants were required to read the rule and 1) indicate which combinations of the occurrence and non-occurrence of A and B (i.e. *A, B; A, not-B; not-A, B; not-A, not-B*) would constitute a violation of the given rule, and 2) indicate an order of preference for using each case (*A, B; A, not-B; not-A, B; not-A, not-B*) to explain the rule to someone else. Judgments were classified as semantic contradictions of the meanings of deontic verbs in the following cases: Judgments of *A & not-B* cases as impermissible for the verbs *may, must not and need not* and as permissible for the verb *must*; and judgments of *not-A and B* cases as *impermissible* for the verbs *must not* and *need not*.

Results

Bucciarelli and Johnson-Laird (2005)'s overall predictions concerning the interpretation of deontic verbs were broadly supported. For rights, *a, b* cases were most frequently perceived as impermissible when the modal *must not* was used ($\chi^2(3) = 76.46, p < .01$, two-tailed, $N = 163$); *a, not-b* were most frequently perceived as impermissible when the modal *must* was used ($\chi^2(3) = 55.63, p < .01$, two-tailed, $N = 162$); and *not-a, b* were most frequently perceived as impermissible when the modals *may* or *must* were used ($\chi^2(3) = 40.22, p < .01$, two-tailed, $N = 163$). Finally, participants' responses did not significantly differ for *not-a, not-b* cases ($p = .30$).⁵ Identical analyses were performed for duties. Results showed that for duties: *a, b* cases were most frequently perceived as impermissible when the modal *must not* was used ($\chi^2(3) = 88.47, p < .05$, two-tailed, $N = 163$) and *a, not-b* were most frequently perceived as impermissible when the modal *must* was used ($\chi^2(3) = 59.04, p < .05$, two-tailed, $N = 163$). However, participants' responses did not significantly differ for *not-a, b* and *not-a, not-b* cases (all p -values $> .05$).⁶

We then turned to tests of the two alternative interpretation strategies in the eight target cases created by the four deontic verbs and two cases of permissibility judgment (*not-A & B* vs. *A & not-B*). The verb-based pragmatic disambiguation strategy predicts rule content effects only in cases where the semantic analysis is ambiguous, specifically more impermissibility judgments for *not-a, b* cases in *may* and *must* for rights than duties (but not in other *not-a, b* cases, nor in any of the *a, not-b* cases). In contrast, whatever the deontic verb used to formulate the rule, the rule-content strategy predicts more frequent impermissibility judgments for *a, not-b* cases if the rule-content refers to a duty and more frequent impermissibility judgments for *not-a, b* cases if the rule-content refers to a right.

This leads the rule-content approach to predict differences in six cases where the verb-based approach predicts none.

In order to test these competing hypotheses, we computed two-by-two chi square comparisons between the two types of content (right vs. duty) for each modal operator used (*may*, *must*, *must not*, *need not*) and each of the four logical cases (*a, b*; *a, not-b*; *not-a, b*; *not-a, not-b*). Table 4 shows that the convergent predictions of the verb-based pragmatic disambiguation and rule-content strategies were supported, as participants were significantly more likely to judge *not-a,b* as impermissible for rights rather than duties with the operators *may* ($\chi^2(1) = 35.24, p < .05$, two-tailed, $n = 78$) and *must* ($\chi^2(1) = 32.66, p < .05$, two-tailed, $n = 81$). However, the predictions of the rule-content approach are supported in all critical comparisons where they diverge from those of the verb-based approach, with four out the six predicted differences being statistically significant. Thus in the two critical *not-a, b* comparisons, we observed significant differences predicted by the rule content approach for *need not* ($\chi^2(1) = 17.49, p < .05, n = 84$), and a non-significant pattern in the predicted direction for *must not*. Turning to predictions for *a, not-b* cases, as predicted by the rule-content strategy, there was a significant tendency for more *a, not-b* responses to be judged as impermissible in the case of duties than rights for *may* ($\chi^2(1) = 10.62, p < .05$, one-tailed, $n = 78$), *must* ($\chi^2(1) = 17.96, p < .05$, two-tailed, $n = 81$) and *need not* ($\chi^2(1) = 12.73, p < .05$, two-tailed, $n = 84$), with a non-significant difference in the expected direction for *must not*. These findings are incompatible with the verb-based strategy, which predicts that rule-content effect effects will only occur for *not-a, b* comparisons for the operators *may* and *must*.

In sum, predicted effects of rule content (right vs. duty) were observed in six out of the eight cases predicted (*not-a, b* and *a, not-b* cases across all four deontic verbs). These included two differences predicted by both the verb-based pragmatic disambiguation and the

rule content strategies, but also four significant differences in the six critical cases where semantic contradictions were predicted uniquely by the rule content strategy (with tendencies in the predicted direction in the other two critical comparisons). We therefore conclude that rule content effects are not restricted to cases where the deontic verb was ambiguous (*not-a, b* cases for *may* and *must*) as suggested by the pragmatic disambiguation approach.

Perceived relevance of cases for explaining rules: Effects of verb and rule content

Overall, deontic verbs influenced the perceived relevance of cases for explaining deontic rules in line with the analysis given by Bucciarelli & Johnson-Laird (2005). Thus for the positive deontic terms, respondents overwhelmingly selected *a, b* cases in first place (67% for *may*, 63% for *must*) compared to *not-b* cases (17% for *may* and 31% for *must*). However, in response to negative deontic terms respondents made a substantially lower number of first-place *a, b* selections (35% for *need not* and 45% for *must not*) and a higher number of first-place selections of *a, not-b* cases (48% for *need not* and 43% for *must not*). The effect of the polarity of the deontic term on the perceived relevance of cases for explaining deontic rules thus closely tracks the pattern of salience judgments observed by Bucciarelli and Johnson-Laird (2005) in their listing task.

In addition, as predicted by the rule-content approach, we observed significant effects of rule-type (rights vs. duties) on perceived relevance of cases for explaining the rule (see Table 5). Results confirmed our expectations for 1st choice selections, as participants tended to select *a, not-b* cases more frequently when the statement was a duty than a right (99% vs. 69%), and *not-a, b* cases more frequently when the statement was a right than a duty (31% vs. 1%, $\chi^2(1) = 26.59, p < .001$, two-tailed, $n_1 = 67$ for rights and $n_2 = 82$ for duties). For 2nd choice selections participants also expressed the same tendency, selecting *a, not-b* cases more

frequently when the statement was a duty than a right (75% vs. 59%) and *not-a, b* cases more frequently when the statement was a right than a duty (42% vs. 25%, $\chi^2(1) = 4.33$, $p < .05$, one-tailed, $n_1 = 82$ for rights and $n_2 = 64$ for duties).

Discussion

Our results replicate and extend Bucciarelli and Johnson-Laird's approach in a number of ways, while demonstrating the importance of differentiating the influence of deontic verb (e.g., *may*, *must*, *must not*, *need not*) and type of deontic rule (e.g., rights vs. duties) on permissibility and relevance judgments. First, we replicated Bucciarelli and Johnson-Laird's general findings with respect to deontic verbs using permissibility judgments, as well as with a perceived relevance task rather than a listing task for salience judgments. While they used the Italian equivalents of the more formal deontic verbs *permits*, *obligates*, *permits not* and *forbids*, we obtained highly similar results in French using the deontic verbs *may*, *must*, *need not* and *must not*, suggesting that their analysis of deontic verbs is robust across language and measurement method. Second, we extended their analysis by making the novel prediction that when the deontic rule content in question denotes a right rather than a duty, participants will give strong interpretations of the rule in the cases of *may* and *must*. However, we also found that across all four deontic verbs, participants were more likely to judge *not-As who do B* as impermissible in the case of rights, and *As who do not B* as impermissible in the case of duties. In particular, our findings that participants' judgment of the permissibility of *not-A & B* and *A & not-B* are significantly influenced by rule content (rights vs. duties) in four of six critical cases where no pragmatic modulation is possible clearly identifies a potential shortcoming in Bucciarelli & Johnson-Laird's analysis. This is because these judgments are driven by deontic rule content and appear to contradict the semantic analysis of the deontic verb. These findings suggest that

knowledge of rule content was being accessed for judgments in most of the critical cases and that rule knowledge is not just deployed to disambiguate semantic analyses of deontic verbs where necessary, as suggested by the verb-based pragmatic disambiguation approach.

Given the importance of these observations, below we rule out two alternative interpretations of a methodological nature, concerning the phrasing of the target action (Study 3) and of the deontic verb (Study 4) before turning to a discussion of the implications of these results.

Study 3: Replication and extension with rephrased rights and other duties

In the present study, we seek to address certain interpretational issues that could have affected participants' responses in Study 2. For example, the statement that "People whose income does not reach the minimum wage *must* receive the Minimum Income Support Allowance (RMI)" could plausibly be interpreted as a rule given to social security clerks by their institutional superiors. In this perspective, the intended addressee of the rule is no longer the subject of the sentence (People whose income does not reach the minimum wage) but the class of people (e.g., social security clerks) whose duty it is to apply the rule in distributing benefits. This change in perspective would effectively change the rule content from a right (given to potential claimants) into a duty (imposed on social security officials). In order to eliminate the possibility that a change in perspective of this kind may have influenced interpretation of the rule, we used the more specific verb "claim" whose use can only be understood as a directive addressed to the potential recipients of the benefit (i.e., People whose income does not reach the minimum wage). For example, participants in Study 3 were asked to judge whether people whose income is lower than the minimum wage should *claim* the Minimum Income Support or not. An additional advantage of testing the rights rules with the verb *claim* substituted for *receive* is that they invite the interpretation that the individuals

concerned had intentionally attempted to cheat the system (cf. Levinson, 1983, p. 134), and should facilitate perceptions that *Not-A & B* cases are violations (cf. Cosmides, 1989). This formulation should eliminate other possible interpretational problems, such as considering *Not-A & B* cases as non-violations because the addressee may have unintentionally received the benefit in question (e.g., they might perhaps just be the lucky beneficiaries of an administrative error rather than actual rule violators who are trying to cheat the system).

Interestingly, the question of perspective does not seem to be as relevant to the interpretation of statements about duties. Statements such as (e.g., “Passengers of international flights must hold an identity card” or “SNCF passengers must punch their tickets.”) seem to be uniquely addressed to the target category concerned, not the officials (e.g., ticket collectors) whose job it is to administer the rule, not to obey it. In addition, while taking a right non-intentionally seems likely to be forgiven (e.g., someone who receives administrative benefit by error), failing to perform a duty non-intentionally (e.g., failing to produce an identity card at an airport gate because it has just been stolen) is not likely to lead the duty to be dispensed with (e.g., the passenger is not likely to be allowed to get on the plane anyway). One reason for this asymmetry between rights and duties may be that it is often much easier for an authority to check that someone has actually accomplished their duty, than to check whether they had the intention to do so. Indeed, an institution that means business cannot take the risk of encouraging people to think they are allowed to simply intend (but fail) to accomplish their duties. We therefore decided to take the opportunity to test the generality of our results by replacing the duties used in Study 2 with two other duties from Study 1.

Method

Participants and procedure

A hundred and twenty four students participated in our third study (age: $M = 21.26$, $SD = 2.13$, 79.8% women). Fifty were in their third year at the Toulouse Business School and the remaining 74 participants were in the third year of a degree in Psychology. The same procedure was followed as in Study 2: Teachers recruited the volunteer students at the end (or beginning) of their classes and explained that the task would involve filling in a short questionnaire for a psychology experiment. They then randomly distributed the eight versions of the questionnaire to their pupils, who filled them in while seated in the classroom.

Materials

Respondents were presented with identical tasks to those used in Study 2, the difference being that the two rights which had been previously used were slightly reformulated (using the verb “claim” rather than “receive”) and two new duties were introduced to replace those used previously. These two new duties were: D1- People who drive a car [*deontic verb*] hold a driver's licence, and D2 - Passengers of international flights [*deontic verb*] hold an identity card). They had both obtained high agreement rates from students in Study 1 (> 94%).

Results

The predictions and analyses followed the same pattern as in Study 2.⁷ We begin by noting that the semantic analysis of deontic verbs proposed by Bucciarelli and Johnson-Laird (2005) is once again broadly supported. We computed results for rights and duties separately and adjusted the p -values accordingly (by multiplying the p -value by the number of comparisons). Thus collapsing data for the two rules classified as rights showed that a, b cases were most frequently perceived as impermissible when the modal *must not* was used ($\chi^2(3) = 68.83, p < .01$, two-tailed, $N = 123$) and $a, not-b$ cases were most frequently perceived as impermissible when the modal *must* was used ($\chi^2(3) = 57.67, p < .01$, two-

tailed, $N = 123$). Finally, participants' responses did not significantly differ for the *not-a, b* cases and *not-a, not-b* cases (all p -values $> .05$). Collapsing data for the two rules classified as duties showed once more that for duties: *a, b* cases were most frequently perceived as impermissible when the modal *must not* was used ($\chi^2(3) = 58.07, p < .01$, two-tailed, $N = 124$) and *a, not-b* cases were most frequently perceived as impermissible when the modal *must* was used ($\chi^2(3) = 51.85, p < .01$, two-tailed, $N = 124$). As before, no significant differences were found for the *not-a, b* cases and *not-a, not-b* cases (all p -values $> .05$).

Effects of rule content on permissibility judgments

We now turn to tests of rule content effects (see Table 6 for details). The first, verb-based strategy predicts rule content effects only in cases where the verb semantic analysis is ambiguous. These predictions are confirmed for *may* and *must*, as *not-a, b* cases were significantly more often judged to be impermissible in the case of rights than duties for both *may* ($\chi^2(1) = 24.47, p < .05$, two-tailed, $n = 63$) and *must* ($\chi^2(1) = 30.99, p < .05$, two-tailed, $n = 61$).

The rule-content strategy predicts the above results for *may* and *must*, but also makes the critical predictions that rights and duties will lead to different patterns of judgments for *must not* and *need not* in the *not-a, b* cases, and for all four deontic verbs in the *a, not-b* cases. Table 6 shows that the predictions of the rule-content approach are supported in all six cases, with statistically significant differences in four out of the six critical comparisons. Thus participants were significantly more likely to judge *not-a, b* as impermissible for rights rather than duties in the case of *need not* ($\chi^2(1) = 11.10, p < .05$, one-tailed, $n = 60$) and *must not* ($\chi^2(1) = 19.80, p < .05$, two-tailed, $n = 63$). Turning to predictions for *a, not-b* cases, as predicted by the rule-content strategy, there were significant tendencies for more *a, not-b* responses to be judged as impermissible in the case of duties than rights for *must* ($\chi^2(1) = 9.97, p < .05$, one-tailed, $n = 61$) and *need not* (Fisher's test, $p < .05$, one-tailed, $n = 60$).

Finally, this pattern also emerged for the deontic verbs *may* and *must not*, although the tendency was not statistically significant. None of the remaining comparisons concerning *a, b* and *not-a, not-b* cases were significant ($p > .05$).

Perceived relevance of cases for explaining rules: Effects of verb and rule content

Deontic verbs again influenced the perceived relevance of cases for explaining deontic rules in line with the pattern of salience judgments observed by Bucciarelli and Johnson-Laird (2005) in their listing task. Thus for the positive deontic terms, respondents selected substantially more *a, b* cases first (62% for *may*, 55% for *must*) and *a, not-b* cases second (28% for *may* and 33% for *must*). In addition, as expected, there was an overall increase in selections of *a, not- b* cases to explain the rule for the negative deontic terms, with similar rates of selection of *a, b* cases (49% for *need not* and 50% for *must not*) and *a, not-b* cases (49% for *need not* and 45% for *must not*) in first place.

As predicted by the knowledge-based approach, rule content influenced perceptions of the perceived relevance of cases for explaining rules. Once again results showed that for first-place selections, participants tended to select *a, not-b* cases more frequently when the statement was a duty than a right (99% of first-place selections for duties vs. 63% for rights) and *not-a, b* cases tended to be selected more frequently if the statement was a right than a duty (37% of first-place selections for rights vs. 1% for duties, $\chi^2(1) = 25.20, p < .005$, two-tailed, $n_1 = 43$ for rights and $n_2 = 66$ for duties). As for second-place selections, no significant differences were found ($p = .86$).

Discussion

Study 3 confirms the overall pattern of results observed in the previous study. Even when *claim* was substituted for *receive* in the minimum revenue and unemployment benefit

rules, and two new duties (driver's licence, identity card) were added, cases of *not-As who do B* were more likely to be judged as impermissible in the case of rights than duties, and cases of *As who do not-B* to be impermissible in the case of duties than rights. These results eliminate the possibility that the results obtained in Study 2 were due to specific re-interpretations of the rules used (e.g., re-interpreting rights given to potential claimants as duties imposed on those whose job it is to administer these benefits).

Study 4: Formal expressions of the deontic verbs

Studies 2 and 3 have shown consistent content effects of rights and duties on perceptions of violations and on salience of cases using the standard deontic verbs *may*, *must*, *need not* and *must not*. Bucciarelli and Johnson-Laird (2005) do not report such content effects, and one possible reason is that the deontic vocabulary used by Bucciarelli and Johnson-Laird (2005) – the cognates in Italian of *permits*, *obligates*, *forbids* and *permits not* – seems to be more formal and more specific in its application than the modal verbs that we used. These expressions are also unambiguously deontic in English, and unlike *may* and *must* (and *peuvent* and *doivent* in French) exclude non-deontic readings.

In particular, use of the formal vocabulary seems more likely to be restricted to situations where an authority stipulates a rule. This seems particularly clear when one considers the differences between informal expressions such as *having to* or *being obliged to* do something, and more formal expressions such as *having the duty* or *having the obligation to* do something (cf. Hart, 1961). For example, a bank worker may be obliged by threats to her life to hand over money to a thief, but that is not the same thing as having the institutional obligation or duty to hand money over to that thief. Rather, she has the institutional obligation to hand over money to bank clients who ask for their money following due form.

In the first case, she is acting in her rational self-interest (her feeling obliged to hand the money over to the thief depends on her beliefs about what will happen to her if she does not, such as the probability of losing her life), and the value she places on those outcomes. In the second case, the formal obligation exists regardless of the particular circumstances: The bank worker is not under a formal contractual obligation to the thief to hand over the money to him, even if he is holding a gun to her head. When threatened with her life by the thief, she might explain her action to a colleague by saying “I *must/have to/am obliged to* hand the money over”. However, an exceptional circumstance in which she might justify her action to a colleague by saying “I *have the duty to* hand the money over” proves the rule about institutional obligation: She could say this if the bank has a special rule which stipulates that this is what employees must do in such circumstances.

We therefore reasoned that it was possible that with the more formal expressions people might ignore the situational implications (carried by the rule content, right vs. duty), and simply rely on their notion of permission and obligation carried by the expressions “have the right” and “have the duty” in making their judgments about what is and is not permissible. It is possible that more institutionalized, “legalistic” modal expressions will incite participants to reason in a more formal, logical way and thus ignore the effects of content. We therefore substituted *may, must, must not* and *may not* with *have the right, have the duty, do not have the right* and *have the right to not* in Study 4 to test this hypothesis with more prototypically institutional deontic expressions.

Method

Participants & procedure

A total of 130 French undergraduates at the *Institut Universitaire de Technologie*, Tarbes, of which 89 were Marketing Techniques students and 41 Communication Services

and Networks students, participated in this study (age: $M = 18.78$, $SD = 1.87$, 57.7% men). The protocol used in Study 3 was replicated using the expressions “have the right” (*ont le droit*), “have the right to not” (*ont le droit de ne pas*), “have the duty” (*ont le devoir*), “don’t have the right” (*n’ont pas le droit*) to replace modals *may*, *need not*, *must* and *must not* in each statement. Rights and duties remained otherwise unchanged. So for example, for the international passenger rule, participants read “Passengers of international flights *have the right/have the duty/don’t have the right/have the right to not* hold identity cards”.

Results

Overall effects of deontic verb on permissibility judgments

Predictions and statistical procedures were identical to those described in Studies 2 & 3 and the results are presented in Table 7. Once again, we observed the overall effects predicted by Bucciarelli and Johnson-Laird’s (2005) analysis of deontic verbs on permissibility judgments. In the case of rights, *a, b* cases were most frequently perceived as impermissible when the expression *do not have the right* was used ($\chi^2(3) = 65.44$, $p < .01$, two-tailed, $N = 130$) and *a, not-b* cases were most frequently identified as impermissible when the expression *have the duty* was used ($\chi^2(3) = 59.49$, $p < .01$, two-tailed, $N = 130$). Significant differences were also found for the *not-a, b* and *not-a, not-b* cases: *not-a, b* cases were most frequently perceived as impermissible when the expressions *have the duty, have the right* and *have the right not to* were used ($\chi^2(3) = 14.59$, $p < .05$, two-tailed, $N = 130$). No significant differences were found for the *not-a, not-b* cases ($p > .05$). In the case of duties *a, b* cases were most frequently perceived as impermissible when the expression *do not have the right* was used ($\chi^2(3) = 76.50$, $p < .01$, two-tailed, $N = 130$) and *a, not-b* cases were most frequently identified as impermissible when the expression *have the duty* was used ($\chi^2(3) = 56.44$, $p < .01$, two-tailed, $N = 130$). A significant difference was also found for the

not-a, b cases, which were most frequently perceived as impermissible when the expression *have the right* was used ($\chi^2(3) = 11.49, p < .05$, one-tailed, $N = 130$). No significant difference was found for the *not-a, not-b* cases ($p > .05$).

Effects of rule content on permissibility judgments

We now turn to tests of rule content effects. Table 7 shows that the convergent predictions of the verb-disambiguation strategy and the rule-content strategies are supported for *have the right* and *have the duty*, as *not-a,b* cases were significantly more often judged to be impermissible in the case of rights than duties for both *have the right* ($\chi^2(1) = 21.73, p < .05$, two-tailed, $n = 63$) and *have the duty* ($\chi^2(1) = 35.05, p < .05$, two-tailed, $n = 68$).

In addition, the rule-content strategy also predicts that rights and duties will lead to different patterns of judgments for *do not have the right* and *have the right to not* in *not-a,b* cases, and for all four deontic verbs in *a, not-b* cases. Table 7 shows that the predictions of the rule-content approach are supported in all cases with statistically significant differences in four out of six critical comparisons. Thus participants were significantly more likely to judge *not-a, b* as impermissible for rights rather than duties in the case *do not have the right to* ($\chi^2(1) = 9.23, p < .05$, one-tailed, $n = 62$) and in the case of *have the right to not* ($\chi^2(1) = 36.46, p < .05$, two-tailed, $n = 67$). Turning to predictions for *a, not-b* cases, as predicted by the rule-content strategy, there was a significant tendency for more *a, not-b* responses to be judged as impermissible in the case of duties than rights for *have the right* ($\chi^2(1) = 14.19, p < .05$, two-tailed, $n = 63$) and *have the duty* ($\chi^2(1) = 10.13, p < .05$, one-tailed, $n = 68$). The differences between rights and duties were also in the expected direction for *do not have the right* and *have the right to not* but were not statistically significant.

Perceived relevance of cases for explaining rules: Effects of verb and rule content

We observed the expected tendency for positive deontic terms (*have the right* and *have the duty*) to lead to more selections of *a, b* cases first (63% for *have the right*, 50% for *have the duty*) and *a, not-b* cases second (19% for *have the right* and 37% for *have the duty*). However, we did not observe the previously observed tendency (in Studies 2 and 3) of negative deontic terms to increase selections of *a, not- b* cases to explain the rule. Thus we observed overall more first place selections of *a, b* cases (40% for *have the right not to* and 63% for *do not have the right to*) compared to *a, not-b* cases (37% for *have the right not to* and 26% for *do not have the right to*). Although the deontic verb *do not have the right to* had the predicted (logical) effect on permissibility judgments, its failure to replicate the pattern of perceived relevance selections observed for *must not* in Studies 2 and 3, raising questions about the psychological equivalence of these two verbs.

As predicted, rule content (rights vs. duties) influenced respondents' perceptions of the perceived relevance of cases for explaining the rule. Results showed, as expected, that for first place selections, participants tended to select *a, not-b* cases more frequently when the statement was a duty (91% of first place selections for duties vs. 60% for rights) and *not-a, b* cases tended to be selected more frequently if the statement was a right (40% first place selections for rights vs. 9% for duties, $\chi^2(1) = 13.08, p < .005$, two-tailed, $n_1 = 50$ for rights and $n_2 = 53$ for duties). No significant differences were found for second place selections ($p = .59$).

Discussion

These results show that the effects of rule content (right vs. duty) on permissibility and salience judgments emerge even when the formal expressions “have the right”, “have the duty”, “do not have the right” and “have the right to not” are used. This enables us to

generalise the results obtained in Studies 2 and 3, and suggests that the emergence of these rule-content effects cannot be attributed to the informality of the deontic expressions used.

General conclusions

In Study 1 we showed that French participants have little difficulty in consensually classifying 16 institutional deontics (including the eight used by Bucciarelli and Johnson-Laird, 2005) as either rights or duties, and that rights are commonly seen as benefiting the individual whereas duties benefit the group imposing the rule. As rights are permissions given by society to an individual, whereas duties are obligations imposed by society on an individual, we expected that they identify different cases as deontically impermissible (Cheng & Holyoak, 1985; Johnson-Laird & Byrne, 2002). Accordingly, in Studies 2-4 we show that rules that have been classified as rights lead *not-A & B* cases (where an individual performs a behaviour without fulfilling the precondition) to be classified as deontically impermissible whereas rules that have been classified as duties lead *A & not-B* cases (where an individual fulfils the precondition but does not perform the behaviour) to be classified as deontically impermissible. Participants also judged these cases as more relevant for explaining the rule.

Our experiments, which used some of the same deontic rules as Bucciarelli and Johnson-Laird (2005) as well as new ones of our own devising, demonstrated the importance of considering the effects of rule content (e.g., rights vs. duties) on judgments of permissibility and relevance. Whereas earlier research had not disentangled the effects of deontic verb and deontic rule content (e.g., Quelhas, Johnson-Laird & Juhos, 2010), our results demonstrate the importance of varying deontic verb and deontic rule independently in order to assess their effects. Specifically, the finding that *not-A & B* cases were classified as impermissible in the case of rights and that *A & not-B* cases were classified as impermissible

in the case of duties regardless of deontic term indicated that participants adopted a rule-content mode of processing. These rule-content effects emerged whether the actual act of violating the rule (Expt. 2) or the mere intention to violate the rule (Expt. 3) was specified in the case of rights, and even when the deontic expression used the formal institutional language of *have the right* and *have the duty* (Expt. 4). We observed evidence for pragmatic modulation (understood as pragmatic disambiguation of the deontic verb) whereby the deontic verbs of permission (*may* and *have the right*) and obligation (*must* and *have the duty*) were given “stronger” interpretations in the case of rights than in the case of duties. However, Studies 2-4 also revealed clear and consistent rule content effects such that, as predicted, *not-A & B* cases were more likely to be perceived as violations and as salient for rights, and likewise *A & not-B* cases for duties even in cases where these judgments contradict the core semantics of the deontic verbs concerned. Across Experiments 2-4, these effects were statistically significant in twelve out of eighteen critical comparisons, and in the direction predicted by the rule-content approach in the remaining six. These findings signal that the “verb-based” approach to pragmatic modulation (semantic interpretation + pragmatic disambiguation) is unable to account for our data, and support the “rule-content” approach, which suggests that people activate their everyday knowledge of rule content (e.g., of a right vs. a duty) not only when interpreting ambiguous deontic verbs, but also when interpreting unambiguous ones. Our results therefore indicate that the verb-based pragmatic modulation approach does not exhaust the ways world knowledge about rule content can be brought to bear on the interpretation of deontic statements.

Dealing with rule-based semantic contradictions of the deontic verb

How might participants have dealt with the cases where there is an apparent “semantic contradiction” between the deontic verb and the deontic rule? At least three kinds of response may be distinguished. First, we note that there may be specific conventions of

usage which naturally allow the normal interpretation of a rule to be “suspended” by certain verbs. In particular, the use of *need not* or *has the right not to* in the context of a duty seems to be quite naturally interpreted as a release from the obligation imposed by that duty (Beller, 2008). Consistent with this observation, the effect of the verb seemed to systematically override that of rule content where the verb *need not* (or its equivalent *has the right not to*) was combined with a rule content signifying a duty. Thus when the rule was a duty, people judged *A & not-B* cases to be permissible in 38% and 28% of cases for the verb *need not* (Experiments 2 and 3) and in 16% of cases for the phrase *have the right not to* (Experiment 4). In contrast, when the logically similar *may* (or *have the right*) were used, there was overall less tendency for the verb to override the rule. Thus our participants judged the number of impermissible *A & not-B* cases to be higher for duties when *may* (56% in Experiment 2 and 28% in Experiment 3) and *has the right to* (48%) were used. It therefore seems that there may be pragmatic factors at work that distinguish the use of *need not* and *has the right not to* in the context of duties from the logically equivalent forms *may* and *has the right to*.

Second, in some cases participants may accept that the rule is generally valid, but imagine exceptional circumstances that “explain” why the deontic verb that should be used in the exceptional context is not the one normally expected. For example, although our respondents know that normally in France passengers travelling on SNCF trains must punch their tickets before getting on board, they can also imagine that there will sometimes be exceptional circumstances where it would make sense for the SNCF to announce the contrary rule *Passengers on SNCF trains must not punch their tickets*. This might happen if there was a strike, and the company required people who planned travelling that day not to punch their tickets (e.g., in order to be able to refund the passengers). Such exceptions could perhaps be justified by a decision theoretic analysis which implies that deontic rules are stipulated to

avoid costly violations (e.g., Hilton, Kemmelmeier & Bonnefon, 2005; Over, Manktelow & Hadjichristis, 2004; Perham & Oaksford, 2005), and modified when context modifies the relevant costs and benefits. For example, where it becomes costly to respect the normal rule (because punched tickets create administrative problems), the situation changes and script-deviant obligations have to be imposed (e.g., *not* to punch tickets).

Finally, in some cases it may simply not be possible to reconcile the deontic verb and the deontic rule content. This may have been the case with our public transport rule (translated into English as “Users of public transport may hold a transport pass”), where the rule as expressed in French allows little or no room for exceptions (“Les personnes qui utilisent les transports en commun peuvent se munir d'un titre de transport”), as the literal translation of “titre de transport” is a “document showing entitlement to travel”. Here, participants may be unable to resolve the contradiction between the deontic verb and the rule content in a meaningful way, and have to opt for an interpretation that is consistent with one but not the other. Further research is needed to investigate the strategies people use to resolve semantic contradictions in such cases.

Questions for future research.

Our research has highlighted ways in which deontic verbs and scripted knowledge about rule contents may combine or conflict in institutional deontic assertions. A question for future research is to investigate whether verb meaning and world knowledge can be combined in a similar way in indicative conditionals. For example, is there a similar leeway for re-interpretation of contradictions of modal verbs and causal rule contents in causal conditionals? Thus in statements of causal relations (e.g., *Animals starved of air need not die*) it is possible to imagine that the modal verb *need not* would invite inferences that a consequent that normally follows might not do so in certain contexts (e.g., if there is some exceptional disabler of the normal causal relation *Animals starved of air die* such as fitting

the animal with a breathing apparatus). In contrast, while it seems intuitively simple to give an indicative interpretation to a modal statement such as *Animals starved of air must die*, it seems intuitively easier to give a deontic interpretation to *Animals starved of air must not die* than to give an indicative one. Examining rationales for how people resolve semantic contradictions between modal verbs (*may, must not, etc.*) and causal relations (enablement, cause) in indicative conditionals may lead to insights into the similarities and differences between indicative and deontic reasoning about the same modal verbs (*may, must not, etc.*).

In conclusion, it seems that people may indeed be “pragmatic virtuosos” (cf., Girotto et al., 2001) who are quite capable of finding meaningful interpretations for the anomalous combinations created by combining four rules (two rights and two duties) with four deontic verbs in Studies 2 to 4. If this is so, then the question arises as to how they do it. Any theory that is proposed will first have to incorporate the insights of the mental models approach to understanding and reasoning about deontic verbs, and capture their effects on impermissibility judgments and perceived relevance of cases, as observed by Bucciarelli and Johnson-Laird (2005) and in our Studies 2 to 4. However, richer approaches will also be needed to account for the new findings reported in this paper, notably concerning the effect of world-knowledge on classification, interpretation and reasoning about deontic statements. But whatever comprehensive model of deontic understanding and reasoning is finally developed, we suspect that a richer theory of pragmatic interpretation is needed which will need to do more than simply describe how people use world-knowledge to disambiguate semantic expressions. In order to reconcile the apparent semantic contradictions between a deontic term and the content of a rule it will also need to specify the utterance context of the proposition: Who says what, to whom, and why.

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Table 1

Interpreting deontic verbs: Bucciarelli & Johnson Laird's (2005) predictions concerning permissibility and impermissibility judgments

		<u>A permits B</u>		<u>A obligates B</u>		<u>A prohibits B</u>		<u>A permits \negB</u>	
		<i>Weak</i>	<i>Strong</i>	<i>Weak</i>	<i>Strong</i>	<i>Weak</i>	<i>Strong</i>	<i>Weak</i>	<i>Strong</i>
A	B	P	P	P	P	I	I	P	P
A	\neg B	P	P	I	I	P	P	P	P
\neg A	B	P	I	P	I	P	P	P	P
\neg A	\neg B	P	P	P	P	P	I	P	I

Note. P: permissible, I: impermissible

Table 2

Predictions of rule-content effects on “impermissible” responses for rights versus duties

		MAY		MUST		MUST NOT		NEED NOT	
		Right	Duty	Right	Duty	Right	Duty	Right	Duty
A	B	P	P	P	P	I	I	P	P
A	¬B	P	<u>I</u>	<u>P</u>	I	P	<u>I</u>	P	<u>I</u>
¬A	B	<i>I</i>	<i>P</i>	<i>I</i>	<i>P</i>	<u>I</u>	P	<u>I</u>	P
¬A	¬B	P	P	P	P	P	I	P	I

Note 1. P: permissible, I: impermissible.

Note 2. Cases where scripted world-knowledge predicts judgments of permissibility and impermissibility are given in **boldface**. Cases where these predictions are compatible with the verb-based strategy (semantic analysis plus pragmatic disambiguation) are given in ***italic boldface***. Cases where impermissibility or permissibility judgments predicted by rule content produce semantic contradictions are **underlined in boldface**.

Table 3

Study 1: Participants' agreement rates for classification of rules and perceived distribution of benefits and costs for each rule

Rule	Type		Benefits (if it is applied) Costs (if the rule is NOT applied)			
	Right	Duty	Individual	Group	Both	Neither
Rule 1 "Taxpayers who support charities have <i>the duty/ the right</i> to claim a tax rebate."	99%	1%	69.5% 68.4%	1.7% 3.5%	28.8% 12.3%	0% 15.8%
Rule 2 "Branch managers who give credits have <i>the duty/ the right</i> to increase the interest rates"	95%	5%	20.3% 5.3%	49.2% 52.6%	28.8% 35.1%	1.7% 7%
Rule 3 "Invalids who use wheelchairs have <i>the duty/ the right</i> to use small elevators"	88%	11%	72.9% 75.4%	6.8% 1.8%	16.9% 12.3%	3.4% 10.5%
Rule 4 "Musicians who play wind instruments have <i>the duty/ the right</i> to arrive one hour before the concert"	41%	59%	13.8% 8.8%	25.9% 17.5%	56.9% 49.1%	3.4% 24.6%
Rule 5 "People whose income does not reach the minimum wage have <i>the duty/ the right</i> to receive the Minimum Income Support Allowance (RMI)."	90%	9%	87.9% 78.9%	1.7% 0%	10.3% 17.5%	0% 3.5%
Rule 6 "People who have been made redundant have <i>the duty/ the right</i> to receive unemployment benefits "	87%	13%	94.9% 86%	0% 0%	5.1% 12.3%	0% 1.8%
Rule 7 "Passengers of international flights have <i>the duty/ the right</i> to hold an identity card"	3%	97%	3.5% 22.8%	33.3% 24.6%	52.6% 38.6%	10.5% 14%
Rule 8 "People who drive a car have <i>the duty/ the right</i> to hold a driver's licence "	2%	98%	5.1% 26.3%	33.9% 17.5%	57.6% 45.6%	3.4% 10.5%
Rule 9 "Students who attend prestigious universities have <i>the duty/ the right</i> to wear shorts"	95%	5%	69% 47.5%	5.2% 8.5%	10.3% 10.2%	15.5% 33.9%
Rule 10 "The competitors in the singing competition have <i>the duty/ the right</i> to participate in the musical competition "	78%	22%	38.6% 40.7%	3.5% 8.5%	52.6% 37.3%	5.3% 13.6%
Rule 11 "People who work in big companies have <i>the duty/ the right</i> to go on holiday in August "	94%	6%	67.8% 62.7%	1.7% 10.2%	30.5% 23.7%	0% 3.4%
Rule 12 "Nurses who do the day shift have <i>the duty/ the right</i> to attend adult professional training"	41%	59%	5.1% 10.2%	8.5% 8.5%	83.1% 78%	3.4% 3.4%
Rule 13 "People whose income does not reach the minimum wage have <i>the duty/ the right</i> to claim the Minimum Income Support Allowance (RMI)"	94%	5%	82.8% 88.1%	3.4% 0%	12.1% 10.2%	1.7% 1.7%
Rule 14 "People who have been made redundant have <i>the duty/ the right</i> to claim unemployment benefits "	90%	9%	83.1% 88.1%	1.7% 0%	15.3% 10.2%	0% 1.7%
Rule 15 "Users of public transport have <i>the duty/ the right</i> to hold a transport pass. "	4%	96%	16.9% 10.2%	44.1% 69.5%	37.3% 16.9%	1.7% 3.4%
Rule 16 "Passengers of SNCF trains have <i>the duty/ the right</i> to punch their tickets "	0%	100%	5.3% 8.5%	54.4% 62.7%	35.1% 18.6%	5.3% 10.2%

Note. For classification of rules n = 116, for benefits of rules n = 118, for costs of rules n = 116.

Table 4

Study 2: Percentages of “impermissible” responses for rights versus duties

		MAY		MUST		MUST NOT		NEED NOT	
		Right	Duty	Right	Duty	Right	Duty	Right	Duty
A	B	2.6	2.6	0	0	72.1	69.2	20.0 ⁶	4.4
A	¬B	20.5	<u>56.4</u>*	<u>63.4</u>	100**	2.3	<u>18.0</u>	5.1	<u>37.8**</u>
¬A	B	<i>89.7**</i>	23.2	<i>75.6**</i>	12.5	<u>25.6</u>	20.5	<u>60.0**</u>	15.9
¬A	¬B	5.1	10.3	7.3	0	2.3	10.3	12.5	2.3

Note 1. Two-by-two comparisons between right and duty contents were computed for each separate logical case and modal operator (16 comparisons).

Note 2. * p -value < .05 after Bonferroni correction (p -value \times 16), one-tailed; ** p -value < .05 after Bonferroni correction (p -value \times 16), two-tailed.

Note 3. Cases where the rule-content approach predicts judgments of permissibility and impermissibility are given in **boldface**. Cases where rule-content predictions are compatible with the verb-based strategy (semantic analysis plus pragmatic disambiguation) are given in ***italic boldface***. Cases where impermissibility or permissibility judgments predicted by rule content produce semantic contradictions are **underlined in boldface**.

Table 5

Study 2: Percentages of respondents having selected each case as a first and second choice for explaining the rule to another

		RIGHTS		DUTIES	
		1 st choice	2 nd choice	1 st choice	2 nd choice
A	B	53.5	29.3	43.9	50.3
A	¬B	29.7	30.6	51.6	30.6
¬A	B	13.5	21.7	0.6	10.2
¬A	¬B	3.2	18.4	3.8	8.9

Note 1. $n_1 = 77$ for rights and $n_2 = 80$ for duties.

Note 2. Relevance effects predicted by rule content are printed in **boldface**.

Table 6

Study 3: Percentages of “impermissible” responses for rights versus duties

		MAY		MUST		MUST NOT		NEED NOT	
		Right	Duty	Right	Duty	Right	Duty	Right	Duty
A	B	3.2	0	0	0	70	54.5	3.2	0
A	¬B	3.2	<u>28.1</u>	<u>64.5</u>	96.7*	6.7	<u>15.2</u>	0	<u>27.6*</u>
¬A	B	<i>74.2**</i>	12.5	<i>67.7**</i>	0	<i>46.7**</i>	0	<i>54.8*</i>	13.8
¬A	¬B	0	6.3	0	3.3	0	15.2	6.5	27.6

Note 1. Two-by-two comparisons between right and duty contents were computed for every separate case and modal operator (16 comparisons).

Note 2. * p -value < .05 after Bonferroni correction (p -value \times 16), one-tailed; ** p -value < .05 after Bonferroni correction (p -value \times 16), two-tailed.

Note 3. Cases where the rule content approach predicts judgments of permissibility and impermissibility are given in **boldface**. Cases where these predictions are compatible with the verb-based strategy (semantic analysis plus pragmatic disambiguation) are given in *italic boldface*. Cases where impermissibility or permissibility judgments predicted by rule content produce semantic contradictions are **underlined in boldface**.

Table 7

Study 4: Percentage of “impermissible” responses for rights versus duties

		Have the right		Have the duty		Don't have the right		Have the right
		Right	Duty	Right	Duty	Right	Duty	Right
A	B	0	3.2	3.1	2.8	74.2	80.6	14.3
A	¬B	6.3	48.4**	<u>68.8</u>	97.2*	3.2	22.6	5.7
¬A	B	81.3**	22.6	71.9**	5.6	38.7*	6.5	71.4**
¬A	¬B	0	19.4	3.1	11.1	9.7	12.9	20

Note 1. Two-by-two comparisons between right and duty contents were computed for every separate case and modal operator (16 comparisons).

Note 2. * p -value < .05 after Bonferroni correction (p -value x 16), one-tailed; ** p -value < .05 after Bonferroni correction (p -value x 16), two-tailed.

Note 3. Cases where the rule content approach predicts judgments of permissibility and impermissibility are given in **boldface**. Cases where these predictions are compatible with the verb-based strategy (semantic analysis plus pragmatic disambiguation) are given in *italic boldface*. Cases where impermissibility or permissibility judgments predicted by rule content produce semantic contradictions are **underlined in boldface**.

Footnotes

¹It is of course possible to imagine contexts in which statements such as *Users of public transport must not hold a transport pass* can make sense, a point we return to in the discussion. Our point here is simply that this kind of semantic contradiction cannot be handled by a pragmatic disambiguation approach to pragmatic modulation.

²Two of the rules were slightly modified to make them sound more common and comprehensible in French:

- “Branch managers who make credits to clients have *the duty/ the right* to increase the interest the rates offered to those clients.” (rather than “Bankers who make credits... to increase the interest the rates”)

-“Nurses who do the day shift have *the duty/ the right* to attend adult professional training.” (rather than “Nurses who do the day-work... to attend the adjournment course”).

³We give English translations of the French rules, themselves translated from Bucciarelli and Johnson-Laird’s originals, and have focused on equivalence of meaning rather than literal equivalence. For this reason, we translate the original Italian version of the rule as “adult professional training” rather than “adjournment course”.

⁴Technically speaking, the expression *may not* would be more accurate and closer to the French translation *peuvent ne pas*, when interpreted as *Those who cannot swim are allowed not to attend swimming class tomorrow*. However, the English expression *Those who cannot swim may not attend swimming class tomorrow* is often heard as an interdiction. We thus choose to use *need not* as a practical shorthand which is readily understandable, as it is always closer to the first meaning of English *may not*, which is conveyed by French *peut ne pas*.

⁵When reporting empirical results we use italic lower case letters (*a*, *not-a*, *b*, *not-b*) that correspond to the logical cases described in upper case in the introduction (A, not-A, B, not-B).

⁶A series of chi square tests were run to identify which modal operator would elicit the highest level of impermissibility judgments for each logical case. Bonferroni corrections were applied to adjust the *p*-values of all tests, following a procedure recommended by Keppel & Wickens (2004). Specifically, for Studies 2, 3, 4: the *p*-values were multiplied by 8 when comparisons were made for rights and duties separately and multiplied by 16 when rights were additionally compared with duties.

⁷We checked whether the choice of verb influenced perceptions of permissibility for rights. The only overall significantly different pattern of response found was that participants in Study 2 ('receive' version) tended to infer more frequently that *not-a*, *not-b* cases were impermissible ($\chi^2(1) = 4.24, p < .05, N = 286$). However, when controlling for verbs, we did find the effect we had hypothesized but only for the modals 'may' and 'must not'. When the modal 'may' was used, *a*, *not-b* cases were more frequently considered impermissible in Study 2 (i.e. when the verb 'receive' was used) than in Study 3 (i.e. when the verb 'claim' was used) ($p < .038$, one-tailed); whereas for statements involving the modal 'must not', *not-a*, *b* cases were more frequently considered impermissible in Study 3 (verb 'claim') ($p < .031$, one-tailed). These results tend to support the prediction that wording may influence concern for different types of cheating.