Topics in the Linguistics and Logic of Deontic Concepts

Adam Wyner
University of Aberdeen
Computing Science

University of Luxembourg
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Prologue

• 1994 PhD in Linguistics – syntax and semantics of natural language, particularly adverbs *wisely, passionately*, and *reluctantly*. Issues were the scope of the operator and what the operator applied to.

• 2008 PhD in Computer Science – critique and formalisation of deontic concepts for contracting.

• Research has moved on.
Agenda

- From natural language expressions to formal representations of the deontic concepts (and back again).
- Motivating examples – text analysis and extraction, automated semantic representations, LegalRuleML.
- Decomposition of the analysis.
Decomposition of the Analysis

- Lexical semantic interpretations of the deontic operators *ought* and *obligated*.
- Aktionsart and compositional violations.
- Tense, plurals, negation.
- Scope of the deontic operator and other elements.
- Relative clauses (Good Samaritan Paradox).
Example – Rule Extraction
Wyner and Peters (2011)

- US Code of Federal Regulations, US Food and Drug Administration, Department of Health and Human Services regulation for blood banks on testing requirements for communicable disease agents in human blood, Title 21 part 610 section 40. 4 page document of 1,777 words.

(d) Autologous donations. You, an establishment that collects human blood or blood components from autologous donors, or you, an establishment that is a consignee of a collecting establishment, are not required to test donations of human blood or blood components from autologous donors for evidence of infection due to communicable disease agents listed in paragraph (a) of this section or by a serological test for syphilis under paragraph (i) of this section, except:

(1) If you allow any autologous donation to be used for allogeneic transfusion, you must assure that all autologous donations are tested under this section.

(2) If you ship autologous donations to another establishment that allows autologous donations to be used for allogeneic transfusion, you must assure that all autologous donations shipped to that establishment are tested under this section.
Example – Rule Extraction

You may use human blood from a donor with a previous record of a reactive screening test for evidence of infection due to a communicable disease agent that is designated in paragraph a of this section, if:

(1) At the time of donation, the donor is shown to be suitable by a requalification method; and
(2) tests performed under paragraphs a are nonreactive.

Consequence, list structure, and conjuncts of the antecedent.

Except as specified in paragraphs c, you, an establishment that collects blood, must test each donation of human blood that is intended for use in preparing a product for evidence of infection due to the following communicable disease agents:

(1) Human immunodeficiency virus, type I;
(2) Human T-lymphotropic virus, type I; and
(3) Human T-lymphotropic virus, type II.

Exception, agent NP, deontic concept, verb, theme.
Example – Rule Extraction

Required testing must be performed by a laboratory registered in accordance with part 607 of this chapter and either certified to perform such testing on human specimens under the Clinical Laboratory Improvement Amendments of 1988.

Theme, deontic modal, passive verb, agent with complex relative clause.
Example – Rule Extraction

<ExceptionClause2>Except as <Verb>specified</Verb> in paragraph c</ExceptionClause2>, <AgentNP>you, an establishment that <Verb>collects</Verb> blood, <AgentNP>must</AgentNP> <Obligation> <Verb>test</Verb> <ThemeNP>each donation of human blood that <Passive><Verb>is</Verb> <Verb>intended</Verb></Passive> for use in preparing a product for evidence of infection due to the following communicable disease agents</ThemeNP>:
Example – Rule Extraction
Example – Semantic Representation
Wyner et al. (2012)

British Nationality Act 1981
Section 1 Acquisition by birth or adoption.
(1) A person born in the United Kingdom after commencement, or in a qualifying territory on or after the appointed day, shall be a British citizen if at the time of the birth his father or mother is —
(a) a British citizen; or
(b) settled in the United Kingdom or that territory.
(1A) A person born in the United Kingdom or a qualifying territory on or after the relevant day shall be a British citizen if at the time of the birth his father or mother is a member of the armed forces.
Example – Semantic Representation
Parsed C&C
Example – Semantic Representation

DRT
In this section we illustrate the use of LegalRuleML by modelling a fragment of Section 29 of the Australian “National Consumer Credit Protection Act 2009” (Act No. 134 of 2009). The section of the act entitled “Prohibition on engaging in credit activities without a licence” recites

(1) A person must not engage in a credit activity if the person does not hold a licence authorising the person to engage in the credit activity.
Civil penalty: 2,000 penalty units.
[…]
Criminal penalty: 200 penalty units, or 2 years imprisonment, or both.
Example – LegalRuleML
Athan et al. (2013)

```
<lrml:PrescriptiveStatement key="ps2">
  <ruleml:Rule key=":rule2" closure="universal">
    <lrml:hasStrength>
      <lrml:Defeasible/>
      <lrml:hasStrength>
        <ruleml:if>
          <ruleml:Atom>
            <ruleml:Rel iri="#hasLicence"/>
            <ruleml:Var>X</ruleml:Var>
          </ruleml:Atom>
        </ruleml:if>
        <ruleml:then>
          <lrml:SuborderList>
            <lrml:Permission>
              <ruleml:Atom>
                <ruleml:Rel iri="#engageCreditActivity"/>
                <ruleml:Var>X</ruleml:Var>
              </ruleml:Atom>
            </lrml:Permission>
          </lrml:SuborderList>
        </ruleml:then>
      </ruleml:if>
    </lrml:hasStrength>
  </ruleml:Rule>
</lrml:PrescriptiveStatement>
```

```
<lrml:Penalty key="pen1">
  <lrml:SuborderList>
    <lrml:Obligation>
      <ruleml:Atom>
        <ruleml:Rel iri="#payCivilUnits"/>
        <ruleml:Var>X</ruleml:Var>
      </ruleml:Atom>
    </lrml:Obligation>
    <lrml:Ind>2000</lrml:Ind>
  </lrml:SuborderList>
</lrml:Penalty>
```
Summary about Examples

- What are we extracting?
  - Operator; Agent; Main verb; Negation; Complement of verb; Exceptions; Conditionals....
  - Scopal issues

- What formal (semantic/XML/RDF) representations?
- What reasoning do we want?
- These are interlinked issues.
Lexical Semantics

• Lexical semantic interpretations of the deontic operators *ought* and *obligated*.
• There is a difference between 'epistemic' and 'deontic' interpretations with respect to the semantic properties of the arguments (subject/bearer) of the obligation and the main verb.
• These sentential operators have selection restrictions; cannot apply indifferently to any proposition.
• Important to know which interpretation we are treating in complex examples so as not to 'skew' the results.
Lexical Semantics

• *It is obligatory that it rains
• It ought to be that it rains.

• *The stone is obliged to weigh 10 kilos.
• The stone ought to weigh 10 kilos.
Subcomponents of agentivity.

What can 'obligation' combine with?

Further selection restrictions.
Aspectual Classes

- **States:**
  - Bill is tall; Bill must be tall.

- **Activities:**
  - Jill ran; Jill must run.

- **Achievements:**
  - Bill recognised the picture; Bill must recognise the picture.

- **Accomplishments:**
  - Bill ran a mile; Bill must run a mile.
Aspectual Classes

- Aspectual classes can vary with respect to direct objects.
  - Bill is obligated to build a *house* in a month.
  - Bill is obligated to build *houses* for a month.
- The adverbial varies with respect to a telic interpretation (end point) or atelic (period).
- The violation conditions, the conditions under which we claim a violation arises, seems to vary systematically with the aspectual interpretation, i.e. compositionally with respect to the subject, verb, and object.
Grab Bag

- Birds fly. (plurals as generic/norm)
- Bill smokes.  (present tense as generic/norm)
- Scope of negation: Bill must not leave.
- Quantifiers: Everyone must leave.
- Alternative lexical forms: It is obligatory that, must, ought, obliged....
Conditionals and K

- Axiom K:
  - If $\text{OB}(P \rightarrow Q)$, then $(\text{OB}(P) \rightarrow \text{OB}(Q))$

- Does the antecedent appear in natural language?
  - $\text{OB}(P \rightarrow Q)$

- Does the consequent?
  - $(\text{OB}(P) \rightarrow \text{OB}(Q))$
Conditionals

- Given what we said about lexical semantics, OB can only apply to certain classes of propositions, those with particular semantic properties, e.g. agentive actions.
- This ought to rule out OB(P \(\rightarrow\) Q).
- Perhaps available under an interpretation where a legislator is obligated to insert some rule into a rulebase.
Conditionals

• Questions about what sorts of operators can appear in the antecedent of a conditional:
  – [a.] # If John must have time on his own, he will do it.
  – [b.] # Before John must have tampered with the tapes, we met him.
• *must* under the deontic, not the *epistemic*, interpretation.
  – If it must rain, then let it fall mainly on the plain in Spain.
• Consider violation conditions.
Conditionals

• Similar to other sentential operators:
  – # If (frankly John cannot cope), we will have to fire him.
  – # If (unfortunately we don't find our dog), we'll call the RSPCA.
  – # If (obligatorily you leave tomorrow), then let's drink tonight.
• Not like others:
  – If you want to go to Harlem, you have to take the A train.
Findings

- OB(P → Q), per se, is out unless with 'special' interpretation.
- OB(P → Q), where found, often interpreted as
  - (P → OB(Q))
- (OB(P) → OB(Q)), per se, is out.
- P → OB(Q)), is fine.
- K is out. Anything we want that depends on K must be had another way
  - RM: if (P → Q) and OB(P), then OB(Q).
Relative Clauses (Wyner, 2007)

- Relative clauses (Good Samaritan Paradox).
- Are deontic operators monotonic, e.g. O(P) and P -> Q, then O(Q)?
- Grammatical reanalysis.
- Open a different problem.
Example and Issue

• (A) It is obligatory that Bill help Phil, who has had an accident. (B) Therefore, it is obligatory that Phil has had an accident.

• Paradox: Intuitively, A does not entail B, but does follow from principles of SDL:

1. \[(P \land Q) \rightarrow Q\]. Propositional Logic
2. \[\text{OB}(R) \land [R \rightarrow S] \rightarrow \text{OB}(S)\]. RM Modal Logic
3. \[\text{OB}[P \land Q]\]. LF of first sentence
4. Therefore, \[\text{OB}(Q)\]. LF of second sentence by 1-3

• Accept 1, but not 3, so \[\text{OB}(Q)\] does not follow. Accept RM in 2?
Non-restrictive and Restrictive Relative Clauses

1. I bought the cheapest book, which was not a paperback. Non-restrictive Relative Clause (NRC)
2. I bought the cheapest book which was not a paperback. Restrictive Relative Clause (RRC)
3. I bought the cheapest book.
4. I bought the cheapest book. It was not a paperback.
   • Semantic difference: 1 entails 3; 2 does not entail 3.
   • NRC means the same as discourse in 4.
   • Other syntactic and semantic differences.
Other Grammatical and Interpretive Differences

• Negation: 2 and 3 ill-formed.
  1. Sam doesn’t own a car that has a broken window.
  2. #Sam doesn’t own a car, that has a broken window.
  3. #Sam doesn’t own a car. It has a broken window.

• Propositional Attitudes: 2 implies 3; 1 does not entail 3.
  1. Kim believes that linguists who use the IPA are clever.
  2. Kim believes that linguists, who use the IPA, are clever.
  3. Kim believes that linguists are clever.
RRC in DRT

- RRC in embedded clauses.
- Sam thinks a person who is tall will win.
• An NRC takes wide scope relative to the propositional attitude.

• Sam thinks Kim, who is tall, will win.

• How? Movement; higher type; referential transparency; backgrounding.
Obligations with RRCs in DRT

• It is obligatory that someone who takes the money leaves the house.

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\begin{tabular}{|c|c|}
\hline
\textbf{s} & \textbf{p} \\
\hline
\textbf{Obligatory}(s, \text{person}(p)) & \text{takes} \rightarrow \text{money}(p) \\
\text{leave} \rightarrow \text{house}(p) \\
\hline
\end{tabular}
```
Obligations with NRCs in DRT

- It is obligatory that Bill, who took the money, leaves the house.
- It is obligatory that Bill leaves the house. He took the money.
Operators, Quantifiers, and RCs

- Some student left the house.
- Exactly two students left the house.
- Every student left the house.
- No students left the house.
Operators, Quantifiers, and RCs

- [a.] Every student who attends class submits homework on Fridays.
- [b.] Every student who attends class submits homework.
- [c.] Every student submits homework on Fridays.
- [d.] Every student attends class.

- Substitute: 'no student', 'some student', 'exactly two students'.
- Test inferences a to b, a to c, b to d, c to d.
Operators, Quantifiers, and RCs

- [a.] It is obligatory that every student who attends class submits homework on Fridays.
- [b.] It is obligatory that every student who attends class submits homework.
- [c.] It is obligatory that every student submits homework on Fridays.
- [d.] It is obligatory that every student attends class.

- Substitute: 'no student', 'some student', 'exactly two students'.
Finding

• If a quantified expression Q implies P, then the quantified expression under the scope of obligation OB(Q) implies OB(P). OB abides by RM.
• But means the paradox returns (in a different context):
  • [a.] It is obligatory that some student who attended class submitted homework on Friday.
  • [b.] It is obligatory that some student attended class.
  • [c.] It is obligatory that some student submitted homework on Friday.
What To Do?

- Not clear.
  - Is there some other property that OB is sensitive to that will block the inference, e.g. OB associating with focus?
  - Only the agent of an action can bear the obligation?
- Analogous structures:
  - [a.] Yesterday, some student who attended class submitted homework.
  - [b.] Some student who attended class reluctantly submitted homework.
Proposal

- Explore syntactic and semantic representation of 'real' corpus of natural language data.
- Explore syntactic and semantic representation of 'canned' corpus, which represents more theoretical interests. Go through the work on deontic logic and consider the range of constructions.
- Propose some grammar with associated compositional semantics.
- Examine the outcomes and see if this 'works as intended'.
- Consider representational commitments or neutrality.
Thanks

Contact Information:

Adam Wyner

azwyner@abdn.ac.uk
Department of Computing Science
University of Aberdeen
Conversational Backgrounds and Ordering Sources

• Kratzer (see Portner 2009).
• Different interpretations of deontic operators arise form different conversational backgrounds.
  – How does this account for the lexical semantic differences?
• Ordering sources. A further parameterisation of preferences? What happens if this is multi-dimensional?
• How do these account for paradoxes systematically?
• Ensure that the 'solutions' do not presume in the conversational background that which needs to be solved.
• What are the constraints on backgrounds and sources?