Quantification Annotation in Discourse Representation Theory

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Abstract

We annotated 26 sentences of the ISA-17 shared task on quantification in meaning representations. The formalism we use is Simplified Box Notation, an annotation format that facilitates annotators to encode Discourse Representations Structures for sentences and texts using a simple text editor. Most of the example sentences can be simply accounted for. Only universal quantification and presupposition accommodation places a burden on the annotator, as movement of semantic material is required.

1 The Shared Task at ISA-17

Quantification is an interesting phenomenon in representing meaning of textual expressions. It involves uncovering complex relationships between entities, assigning scopes to operators, and interpreting scope ambiguities. A sensible procedure of annotating quantification is therefore of utmost importance to anyone interested in computational semantics. A proper meaning representation for quantification must find a balance between theoretical needs (the inferential predictions that follow logically) and practical reality constrained by automated reasoning.

The ISA-17 workshop at the IWCS 2021 conference featured a special track on the semantic annotation of quantification. In this shared task participants were asked to annotate a batch of around thirty English sentences. In this project note we present the results of annotating these sentences in the style of the Parallel Meaning Bank (Abzianidze et al., 2017), where texts are paired with Discourse Representation Structures, similar to those as proposed in Discourse Representation Theory (Kamp, 1981; Heim, 1982; Asher, 1993; Kamp and Reyle, 1993; Van Eijck and Kamp, 1997; Kadmon, 2001; Kamp et al., 2011; Geurts et al., 2020).

Since there are several variants of DRT proposed over the years, we will introduce our version in Section 2. In Section 3 we describe how we annotated the test sentences of the shared task. However, we rebelliously deviate here from the instructions given at the shared task and don't use QuantML (Bunt, 2020), but our own method based on SBN (Simplified Box Notation), because we belief it's faster and easier to use. In fact, the method is utterly simple and doesn't require any dedicated software—a simple text editor will suffice. The results of this exercise are attached in the appendix of this article, and are analysed in Section 4.

2 Semantic Formalism

We follow the main principles of Discourse Representation Theory (Kamp and Reyle, 1993), with capturing meaning of sentences in recursive Discourse Representation Structures (DRSs), conveniently displayed as boxes with discourse referents at the top and conditions in the bottom part. But there are some important differences between classic DRT and the style of DRSs that we adopted from the Parallel Meaning Bank (Abzianidze et al., 2017).

Conceptual predicates are represented by WordNet (Fellbaum, 1998) synsets, effectively dealing with lexical disambiguation. (At one point we deviate from the PMB-style annotations: We represent agent nouns as a single predicate rathern than two predicates connected by a role.) Events are represented in a neo-Davidsonion fashion, with extended VerbNet (Kipper et al., 2008; Bonial et al., 2011) roles to connect participants to eventualities. We use negation to represent universal quantification, conditionals, and disjunction. Our way of representing collections and plurals is simple (we assume all entities are collections/sets, with singular noun phrases denoting singleton sets). This approach to quantification is similar to an approach by Remco Scha (Scha, 1984). The biggest differ-

ence is the way we manually encode DRSs. This is based on a new semantic annotation method for DRS: Simplified Box Notation (SBN), proposed by Johan Bos (Bos, 2021).

3 Annotation Method

In a first step the selected examples were manually annotated (by the authors) in SBN, Simplified Box Notation. SBN is a compact notation for meaning representations that uses indices instead of variables. In a second step all representations in SBN were automatically converted into the box notation of DRS, and translated into a discourse representation graph (DRG) as well (Abzianidze et al., 2020). In a third step these two representations (DRS and DRG) were inspected for idosyncrisaties that could have been resulted from annotation mistakes. If such errors were discovered the SBN were corrected and again converted. This process was repeated until the annotators were satisfied with their annotation efforts. As all of the sentences ara in isolation, ambiguities arise naturally. In such case the most plausible interpreation is chosen by the annotator.

To illustrate this procedure, consider Example S (in the appendix): "The woman did not smile." First we identify the concepts and represent them as WordNet synsets. Here we have `woman.n.01` (the first sense of the noun "woman" in WordNet), `time.n.08`, and `smile.v.01`. This sequence of three concepts is displayed from top to bottom in a text editor. Next we add the roles. Here the main role for `smile.v.01` is Agent, fulfilled by the woman. The concept for woman (woman.n.01) is two positions before the smiling events, so the relative index for this role is -2. Hence, we add `Agent -2` directly after `smile.v.01`. Although tense could be ignored for this shared task, here we choose to associate the auxiliary verb "did" with past tense. So add we the role `Time -1` to the smiling event. And because it's past tense, we add the comparision `TPR now`, indicating temporal precedence with respect to the constant `now`, to `time.n.08`. This gives us the sequence: `woman.n.01 time.n.08 TPR now smile.v.01 Agent -2 Time -1`. In the third and final step we add negation. This is done by inserting the discourse structure marker `NEGATION -1` at the right place in the sequence: after the concept `time.n.08`, and before the concept `smile.v.01`. (If we had add it *before* `time.n.08`, we would have gotten the meaning for "The woman never smiled.") And there you have it. The DRS in box notation and corresponding graph (shown in Example S) are automatically generated from this representation.

4 Annotation Results

We annotated a large subset of the sentences provided by the shared task. The complete results are attached as appendices to this article, where one page is dedicated to each example. Below we refer to these with the letters A–Z, and if you read this in PDF perhaps your electrononic reader allows you to click on these letters to redirect you instantly to the page with the mentioned example sentence.

4.1 Proper Names

Named entities are represented by introducing a conceptual predicate describing the entity as specific as possible, connected with the literal provided by the name. Examples are B, D, J, Q, and Z. In DRT, proper names "float" to the main DRS (Kamp and Reyle, 1993; Van der Sandt, 1992) when they appear in a subordinated DRS (within the scope of negation or conditional). This can be seen in Examples K and P. Example D shows an instance of plural summation.

4.2 Negation and Disjunction

In DRT, negation introduces scope in the form of a subordinated DRS. Examples are C, G, K, and S. We also express disjunction in terms of negation, using the logical equivalence $(p \vee q) \leftrightarrow \neg(\neg p \wedge \neg q)$, illustrated in Example E.

4.3 Universal Quantification

Universal quantification is expressed by negation, using the logical law $(p \rightarrow q) \leftrightarrow \neg(p \wedge \neg q)$. Examples in SBN are G and R. Usually, SBN aligns nicely with the surface text. But in order to assign the correct scope to quantification we need raising in cases where the universal quantiier is not in subject position. Examples of this kind are H, P, and W. Sentences X and Y are instances of Rob van der Sandt's examples of intermediate and local presupposition accommodation (Van der Sandt, 1992).

5 Critical Reflection

Most of the annotations for these English sentences could be carried out straightforwardly. Universal

quantification is a notorious troublemaker, as it requires movement of semantic material from its original position to an earlier position in order to get its scope correct. This is hard to do in SBN. This is also true for presuppositional accommodation. The recent proposal to include "articulated contexts" in DRT could be a natural solution for the latter.

Several semantic phenomena are currently impossible to capture correctly in SBN. We are not aware of simple, attractive annotation solutions to account for factives (Example K), focus particles (Example I), and generics (Example q12). All of these meaning representation puzzles deserve a shared task of their own.

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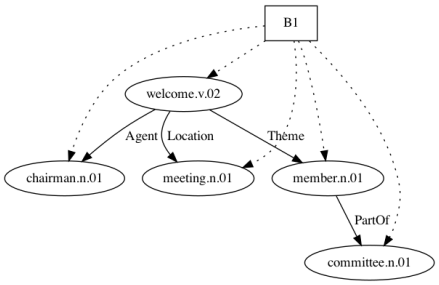
A SBN, DRS, and DRG for Example q2 (discussed in Annotation Results)

chairman.n.01		% The chairman
welcome.v.02	Agent -1 Theme +2 Location +3	% welcomed
committee.n.01		% the committee
member.n.01	PartOf -1	% members
meeting.n.01		% to the meeting.

(a) SBN for q2

x1 e2 x5 x3 x4
chairman.n.01(x1)
welcome.v.02(e2)
Agent(e2, x1)
Theme(e2, x3)
Location(e2, x4)
committee.n.01(x5)
member.n.01(x3)
PartOf(x3, x5)
meeting.n.01(x4)

(b) DRS for q2



(c) DRG for q2

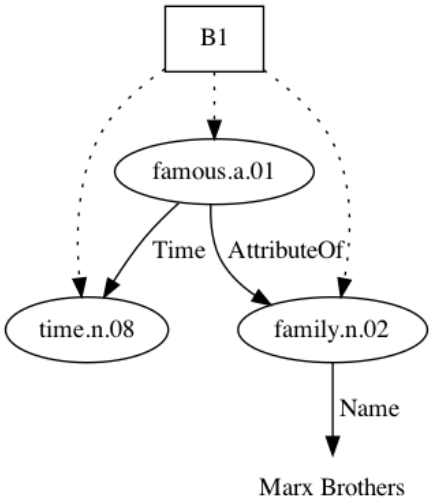
B SBN, DRS, and DRG for Example q3 (discussed in Annotation Results)

```
time.n.08                          %  Are
family.n.02   Name "Marx Brothers"  %  the Marx Brothers
famous.a.01   Time -2 AttributeOf -1  %  famous?
```

(a) SBN for q3

t1 x2 s3
time.n.08(t1) **family.n.02**(x2) Name(x2, "Marx Brothers") **famous.a.01**(s3) Time(s3, t1) AttributeOf(s3, x2)

(b) DRS for q3

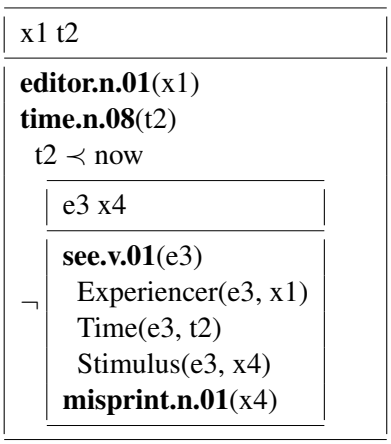


(c) DRG for q3

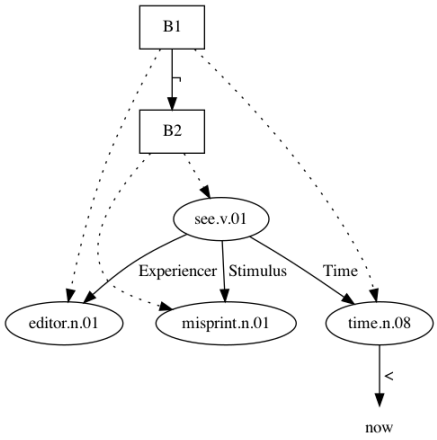
C SBN, DRS, and DRG for Example q5 (discussed in Annotation Results)

```
editor.n.01                                  % The editors
time.n.08   TPR now                          % did
            NEGATION -1                      % n't
see.v.01    Experiencer -2 Time -1 Stimulus +1 % see
misprint.n.01                                % a misprint.
```

(a) SBN for q5



(b) DRS for q5



(c) DRG for q5

D SBN, DRS, and DRG for Example q6 (discussed in Annotation Results)

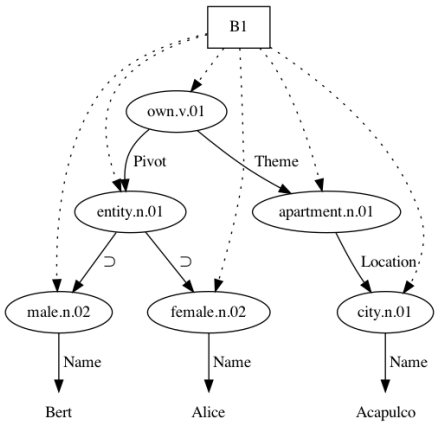
```
male.n.02       Name "Bert"          %  Bert
entity.n.01     Sub -1 Sub +1        %  and
female.n.02     Name "Alice"         %  Alice
own.v.01        Pivot -2 Theme +1    %  own
apartment.n.01  Location +1          %  an apartment in
city.n.01       Name "Acapulco"      %  Acapulco.
```

(a) SBN for q6

x1 x2 x3 e4 x5 x6

male.n.02(x1)
  Name(x1, "Bert")
entity.n.01(x2)
  x2 ⊃ x1
  x2 ⊃ x3
female.n.02(x3)
  Name(x3, "Alice")
own.v.01(e4)
  Pivot(e4, x2)
  Theme(e4, x5)
apartment.n.01(x5)
  Location(x5, x6)
city.n.01(x6)
  Name(x6, "Acapulco")

(b) DRS for q6



(c) DRG for q6

E SBN, DRS, and DRG for Example q9 (discussed in Annotation Results)

person.n.01		% Some people
visit.v.01	Agent -1 Theme +1 Frequency +3	% visited
museum.n.01	Location +1	% the museum in
city.n.01	Name "Amsterdam"	% Amsterdam
time.n.01	Quantity +1	% two or three times.
quantity.n.01		
	NEGATION -1	
	NEGATION -1	
quantity.n.01	EQU -1 EQU 2	
	NEGATION -2	
quantity.n.01	EQU -1 EQU 3	

(a) SBN for q9

x1 e2 x3 x5 t4 x6

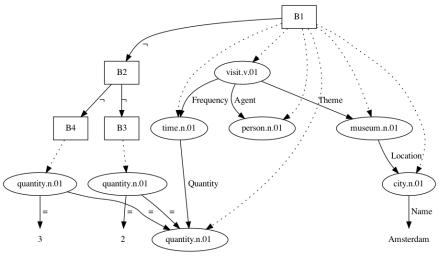
person.n.01(x1)
visit.v.01(e2)
Agent(e2, x1)
Theme(e2, x3)
Frequency(e2, t4)
museum.n.01(x3)
Location(x3, x5)
city.n.01(x5)
Name(x5, "Amsterdam")
time.n.01(t4)
Quantity(t4, x6)
quantity.n.01(x6)

¬ [ ]

¬ [x7 | ¬ [**quantity.n.01**(x7) x7 = x6 x7 = 3]]

¬ [x7 | ¬ [**quantity.n.01**(x7) x7 = x6 x7 = 2]]

(b) DRS for q9



(c) DRG for q9

F SBN, DRS, and DRG for Example q10 (discussed in Annotation Results)

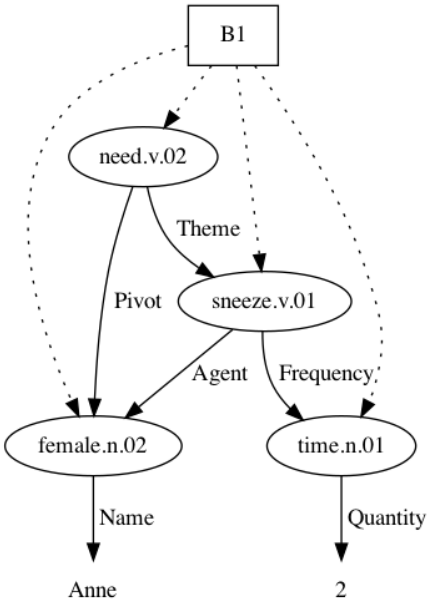
```
female.n.02   Name "Anne"            %  Anne
need.v.02     Pivot -1 Theme +1      %  needed
sneeze.v.01   Agent -2 Frequency +1  %  to sneeze
time.n.01     Quantity 2             %  twice.
```

(a) SBN for q10

x1 e2 e3 t4

female.n.02(x1)
  Name(x1, "Anne")
need.v.02(e2)
  Pivot(e2, x1)
  Theme(e2, e3)
sneeze.v.01(e3)
  Agent(e3, x1)
  Frequency(e3, t4)
time.n.01(t4)
  Quantity(t4, 2)

(b) DRS for q10

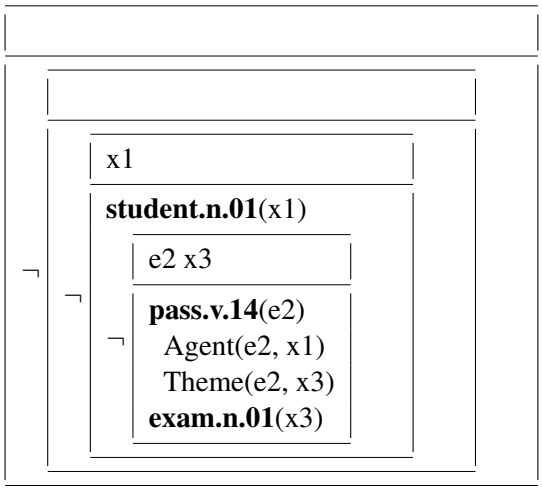


(c) DRG for q10

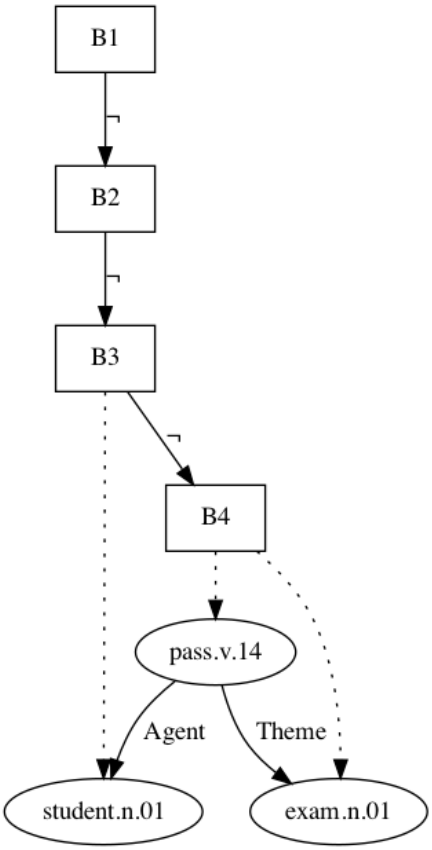
G SBN, DRS, and DRG for Example q11 (discussed in Annotation Results)

```
                    NEGATION -1        %  Not
                    NEGATION -1        %  all
student.n.01                           %  the students
                    NEGATION -1        %
pass.v.14           Agent -1 Theme +1  %  passed
exam.n.01                              %  the exam.
```

(a) SBN for q11



(b) DRS for q11

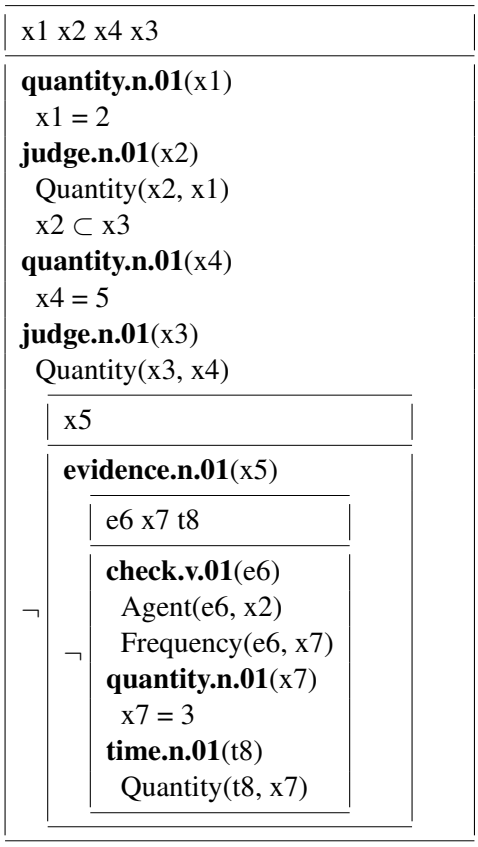


(c) DRG for q11

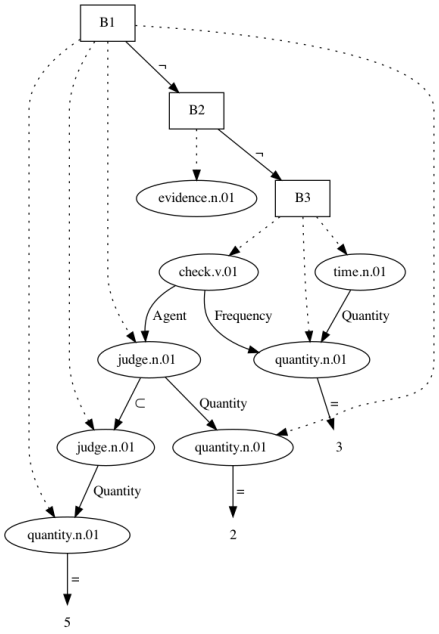
H SBN, DRS, and DRG for Example q13 (discussed in Annotation Results)

```
quantity.n.01   EQU 2                  %  Two
  judge.n.01    Quantity -1 SubOf +2   %  of
quantity.n.01   EQU 5                  %  the five
  judge.n.01    Quantity -1            %  judges
                NEGATION -1
evidence.n.01
                NEGATION -1
  check.v.01    Agent -4 Frequency +1  %  checked all the evidence
quantity.n.01   EQU 3                  %  three
  time.n.01     Quantity -1            %  times.
```

(a) SBN for q13



(b) DRS for q13



(c) DRG for q13

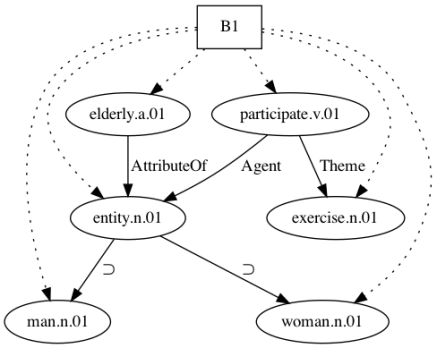
I SBN, DRS, and DRG for Example q14 (discussed in Annotation Results)

```
elderly.a.01      AttributeOf +2        %  Only elderly
man.n.01                                %  men
entity.n.01       Sub -1 Sub +1         %  and
woman.n.01                              %  women
participate.v.01  Agent -2 Theme +1     %  participate in
exercise.n.01                           %  these exercises.
```

(a) SBN for q14

s1 x3 x2 x4 e5 x6
elderly.a.01(s1)
AttributeOf(s1, x2)
man.n.01(x3)
entity.n.01(x2)
x2 ⊃ x3
x2 ⊃ x4
woman.n.01(x4)
participate.v.01(e5)
Agent(e5, x2)
Theme(e5, x6)
exercise.n.01(x6)

(b) DRS for q14



(c) DRG for q14

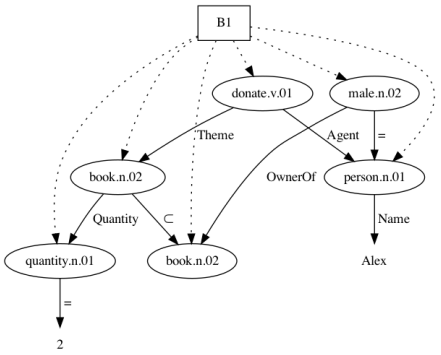
J SBN, DRS, and DRG for Example q15 (discussed in Annotation Results)

```
person.n.01     Name "Alex"          %  Alex
donate.v.01     Agent -1 Theme +2    %  donated
quantity.n.01   EQU "2"              %  two
book.n.02       Quantity -1 SubOf +2 %  of
male.n.02       EQU -4 OwnerOf +1    %  his
book.n.02                            %  books.
```

(a) SBN for q15

x1 e2 x4 x3 x6 x5
person.n.01(x1) Name(x1, "Alex") **donate.v.01**(e2) Agent(e2, x1) Theme(e2, x3) **quantity.n.01**(x4) x4 = "2" **book.n.02**(x3) Quantity(x3, x4) x3 ⊂ x5 **male.n.02**(x6) x6 = x1 OwnerOf(x6, x5) **book.n.02**(x5)

(b) DRS for q15



(c) DRG for q15

K SBN, DRS, and DRG for Example q16 (discussed in Annotation Results)

female.n.02	Name "Mary"	
car.n.01	User -1	
person.n.01	EQU speaker	% I
time.n.08	TPR now	% did
	NEGATION -1	% n't
know.v.01	Experiencer -2 Time -1 Stimulus +2	% know that
entity.n.01	EQU -4	% Mary's car
break-down.v.04	Patient -1	% broke down.

(a) SBN for q16

x1 x2 x3 t4

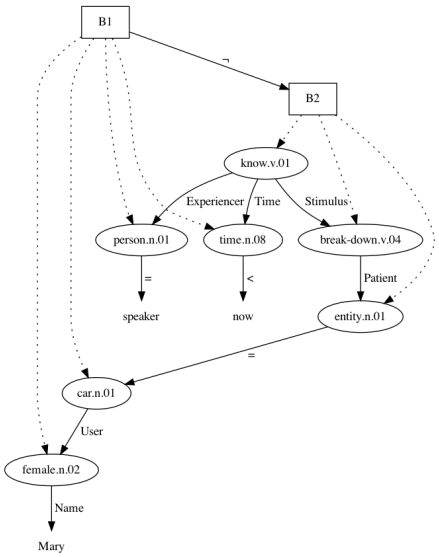
female.n.02(x1)
Name(x1, "Mary")
car.n.01(x2)
User(x2, x1)
person.n.01(x3)
x3 = speaker
time.n.08(t4)
t4 ≺ now

¬

e5 x7 e6

know.v.01(e5)
Experiencer(e5, x3)
Time(e5, t4)
Stimulus(e5, e6)
entity.n.01(x7)
x7 = x2
break-down.v.04(e6)
Patient(e6, x7)

(b) DRS for q16



(c) DRG for q16

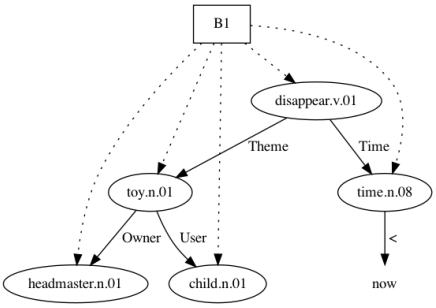
L SBN, DRS, and DRG for Example q17 (discussed in Annotation Results)

```
headmaster.n.01                 %  The headmaster's
child.n.01                      %  childrens'
toy.n.01      User -1 Owner -2  %  toys
time.n.08     TPR now           %  have
disappear.v.01 Theme -2 Time -1 %  disappeared.
```

(a) SBN for q17

x1 x2 x3 t4 e5
headmaster.n.01(x1)
child.n.01(x2)
toy.n.01(x3)
User(x3, x2)
Owner(x3, x1)
time.n.08(t4)
t4 ≺ now
disappear.v.01(e5)
Theme(e5, x3)
Time(e5, t4)

(b) DRS for q17



(c) DRG for q17

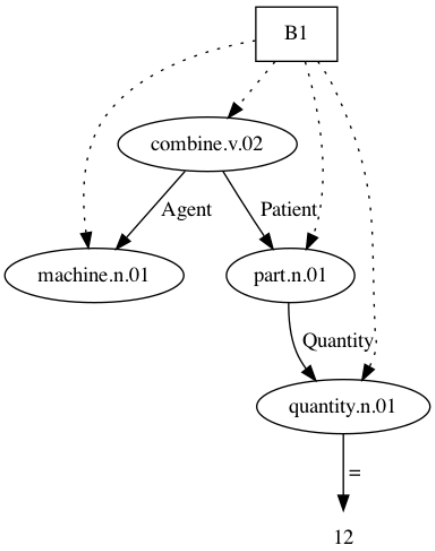
M SBN, DRS, and DRG for Example q18 (discussed in Annotation Results)

```
machine.n.01                        %  These machines
combine.v.02    Agent -1 Patient +2 %  combine
quantity.n.01   EQU 12              %  12
part.n.01       Quantity -1         %  parts.
```

(a) SBN for q18

x1 e2 x4 x3
machine.n.01(x1) **combine.v.02**(e2) Agent(e2, x1) Patient(e2, x3) **quantity.n.01**(x4) x4 = 12 **part.n.01**(x3) Quantity(x3, x4)

(b) DRS for q18



(c) DRG for q18

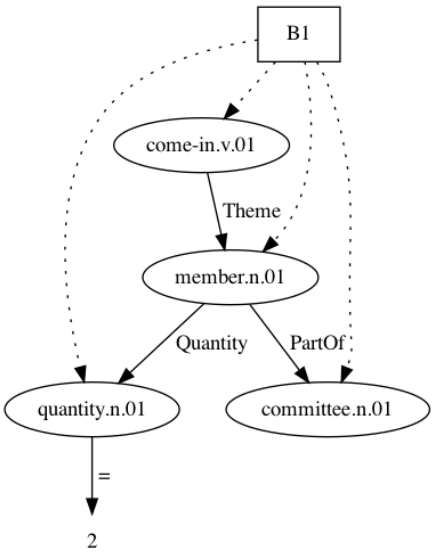
N SBN, DRS, and DRG for Example q19 (discussed in Annotation Results)

```
quantity.n.01    EQU 2                 %  TWO
committee.n.01                         %  committee
member.n.01      Quantity -2 PartOf -1 %  members
come-in.v.01     Theme -1              %  came in.
```

(a) SBN for q19

x1 x2 x3 e4
quantity.n.01(x1) x1 = 2 **committee.n.01**(x2) **member.n.01**(x3) Quantity(x3, x1) PartOf(x3, x2) **come-in.v.01**(e4) Theme(e4, x3)

(b) DRS for q19



(c) DRG for q19

O SBN, DRS, and DRG for Example q20 (discussed in Annotation Results)

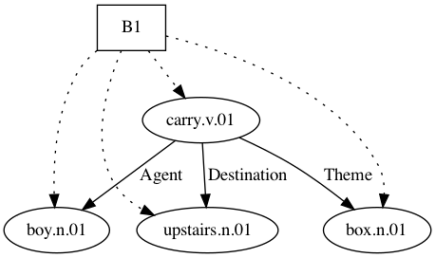
```
boy.n.01                                  %  The boys
carry.v.01    Agent -1 Theme +1 Destination +2  %  carried
box.n.01                                  %  the boxes
upstairs.n.01                             %  upstairs.
```

(a) SBN for q20

x1 e2 x3 x4

boy.n.01(x1)
carry.v.01(e2)
  Agent(e2, x1)
  Theme(e2, x3)
  Destination(e2, x4)
box.n.01(x3)
upstairs.n.01(x4)

(b) DRS for q20

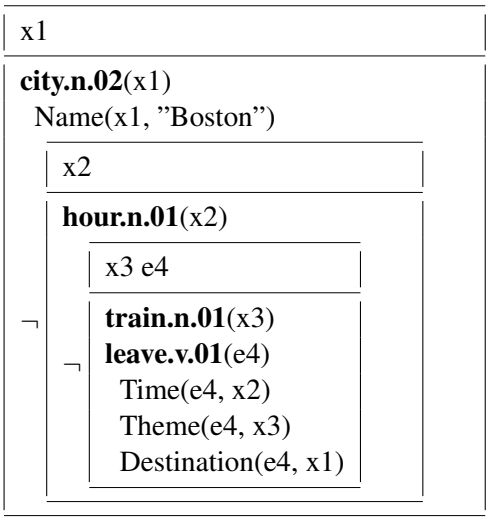


(c) DRG for q20

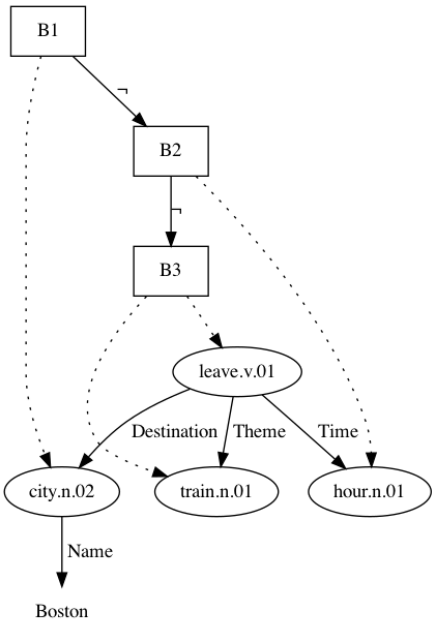
P SBN, DRS, and DRG for Example q21 (discussed in Annotation Results)

```
city.n.02     Name "Boston"
              NEGATION -1
hour.n.01
              NEGATION -1
train.n.01                                  %  A train
leave.v.01    Time -2 Theme -1 Destination -3  %  leaves to Boston every hour.
```

(a) SBN for q21



(b) DRS for q21



(c) DRG for q21

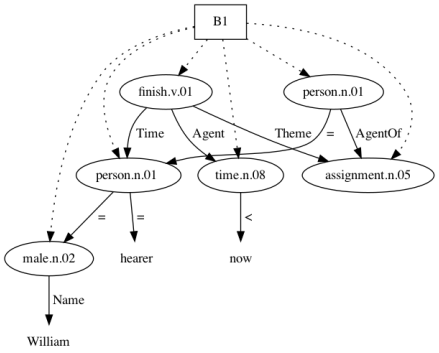
Q SBN, DRS, and DRG for Example q22 (discussed in Annotation Results)

```
male.n.02       Name "William"              %  William,
time.n.08       TPR now                     %  have you
person.n.01     EQU hearer EQU -2
finish.v.01     Agent -2 Time -1 Theme +2   %  finished
person.n.01     EQU -2 AgentOf +1           %  your
assignment.n.05                             %  assignment?
```

(a) SBN for q22

x1 t2 x3 e4 x6 x5
male.n.02(x1)
Name(x1, "William")
time.n.08(t2)
t2 $\prec$ now
person.n.01(x3)
x3 = hearer
x3 = x1
finish.v.01(e4)
Agent(e4, t2)
Time(e4, x3)
Theme(e4, x5)
person.n.01(x6)
x6 = x3
AgentOf(x6, x5)
assignment.n.05(x5)

(b) DRS for q22

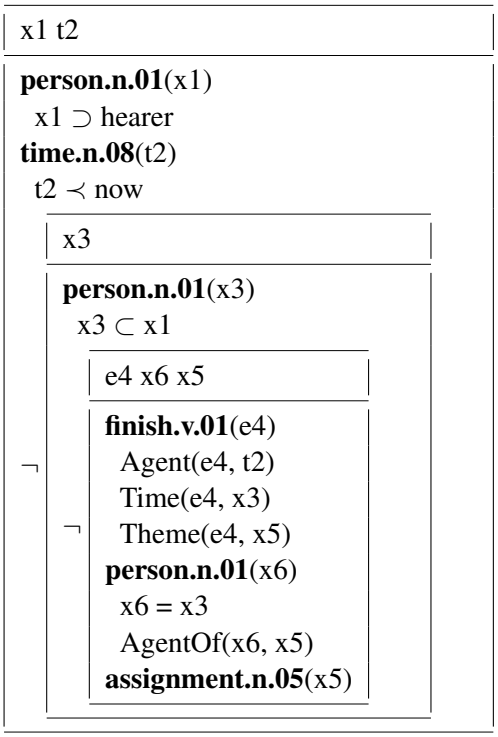


(c) DRG for q22

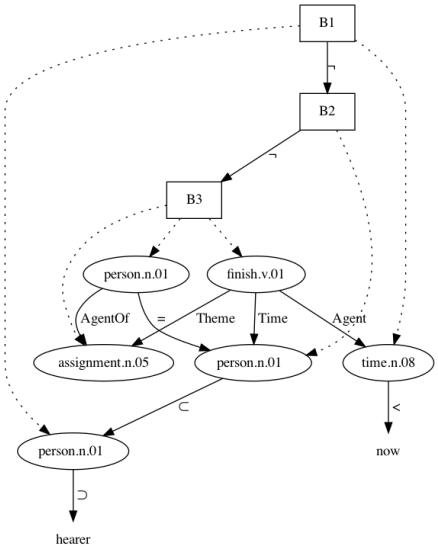
R SBN, DRS, and DRG for Example q23 (discussed in Annotation Results)

```
person.n.01     Sub hearer
  time.n.08     TPR now                    %  have you
                NEGATION -1                %  all
person.n.01     SubOf -2
                NEGATION -1
 finish.v.01    Agent -2 Time -1 Theme +2  %  finished
person.n.01     EQU -2 AgentOf +1          %  your
assignment.n.05                            %  assignment?
```

(a) SBN for q23



(b) DRS for q23

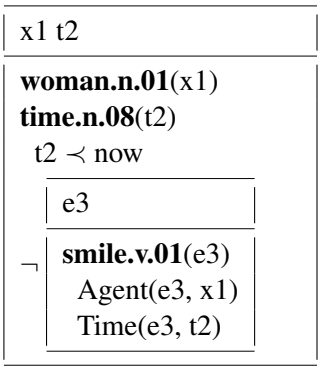


(c) DRG for q23

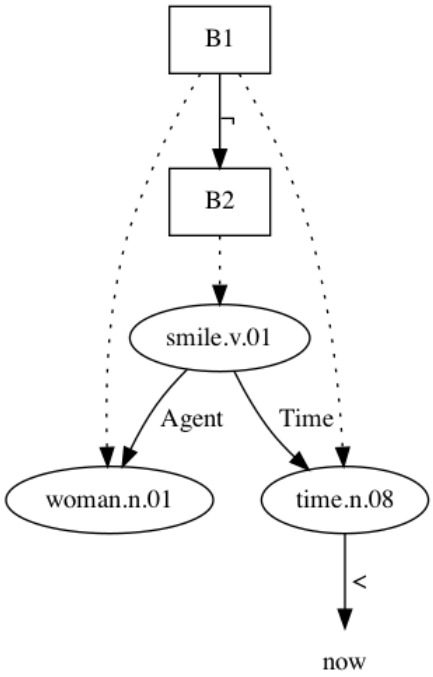
S SBN, DRS, and DRG for Example q24 (discussed in Annotation Results)

```
woman.n.01                    %  The woman
time.n.08   TPR now           %  did
            NEGATION -1       %  not
smile.v.01  Agent -2 Time -1  %  smile.
```

(a) SBN for q24



(b) DRS for q24



(c) DRG for q24

T SBN, DRS, and DRG for Example q25 (discussed in Annotation Results)

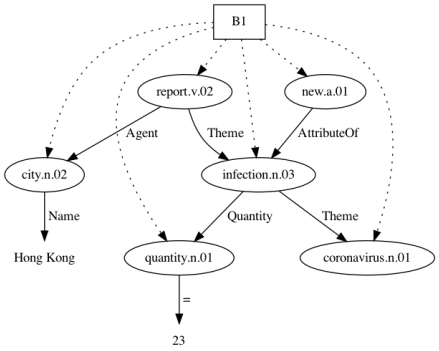
```
city.n.02        Name "Hong Kong"      %  Hong Kong
report.v.02      Agent -1 Theme +4    %  reports
quantity.n.01    EQU 23               %  twenty-three
new.a.01         AttributeOf +2       %  new
coronavirus.n.01                      %  corona virus
infection.n.03   Quantity -3 Theme -1 %  infections.
```

(a) SBN for q25

x1 e2 x4 s5 x6 x3

city.n.02(x1)
  Name(x1, "Hong Kong")
report.v.02(e2)
  Agent(e2, x1)
  Theme(e2, x3)
quantity.n.01(x4)
  x4 = 23
new.a.01(s5)
  AttributeOf(s5, x3)
coronavirus.n.01(x6)
infection.n.03(x3)
  Quantity(x3, x4)
  Theme(x3, x6)

(b) DRS for q25



(c) DRG for q25

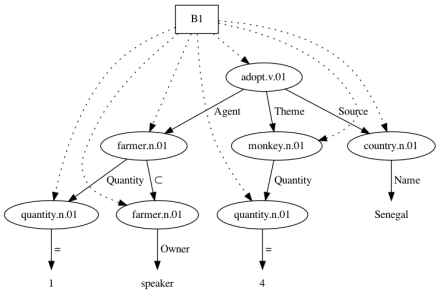
U SBN, DRS, and DRG for Example q26 (discussed in Annotation Results)

quantity.n.01	EQU 1	%	`One`
farmer.n.01	Quantity -1 SubOf +1	%	`of`
farmer.n.01	Owner speaker	%	`my farmers`
adopt.v.01	Agent -2 Theme +2 Source +3	%	`adopted`
quantity.n.01	EQU 4	%	`four`
monkey.n.01	Quantity -1	%	`moneys`
country.n.01	Name "Senegal"	%	`from Senegal.`

(a) SBN for q26

x1 x2 x3 e4 x7 x5 x6
quantity.n.01(x1)
x1 = 1
farmer.n.01(x2)
Quantity(x2, x1)
x2 ⊂ x3
farmer.n.01(x3)
Owner(x3, speaker)
adopt.v.01(e4)
Agent(e4, x2)
Theme(e4, x5)
Source(e4, x6)
quantity.n.01(x7)
x7 = 4
monkey.n.01(x5)
Quantity(x5, x7)
country.n.01(x6)
Name(x6, "Senegal")

(b) DRS for q26



(c) DRG for q26

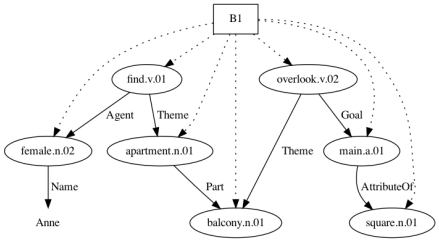
V SBN, DRS, and DRG for Example q27 (discussed in Annotation Results)

female.n.02	Name "Anne"	%	Anne
find.v.01	Agent -1 Theme +1	%	found
apartment.n.01	Part +1	%	an apartment with
balcony.n.01		%	a balcony that
overlook.v.02	Theme -1 Goal +1	%	overlooks the
main.a.01	AttributeOf +1	%	main
square.n.01		%	square.

(a) SBN for q27

x1 e2 x3 x4 e5 s6 x7
female.n.02(x1)
Name(x1, "Anne")
find.v.01(e2)
Agent(e2, x1)
Theme(e2, x3)
apartment.n.01(x3)
Part(x3, x4)
balcony.n.01(x4)
overlook.v.02(e5)
Theme(e5, x4)
Goal(e5, s6)
main.a.01(s6)
AttributeOf(s6, x7)
square.n.01(x7)

(b) DRS for q27

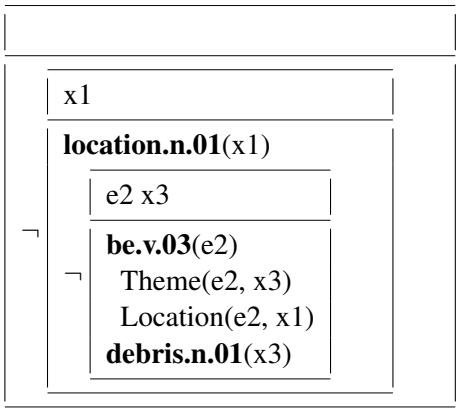


(c) DRG for q27

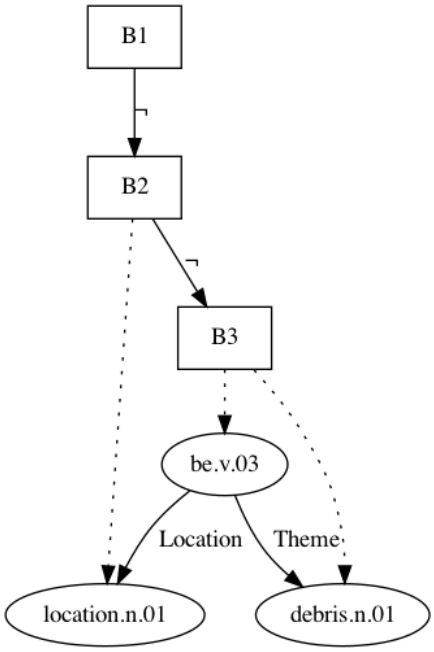
W SBN, DRS, and DRG for Example q28 (discussed in Annotation Results)

```
                    NEGATION -1
location.n.01
                    NEGATION -1
be.v.03     Theme +1 Location -1   %  There's
debris.n.01                        %  debris everywhere.
```

(a) SBN for q28



(b) DRS for q28

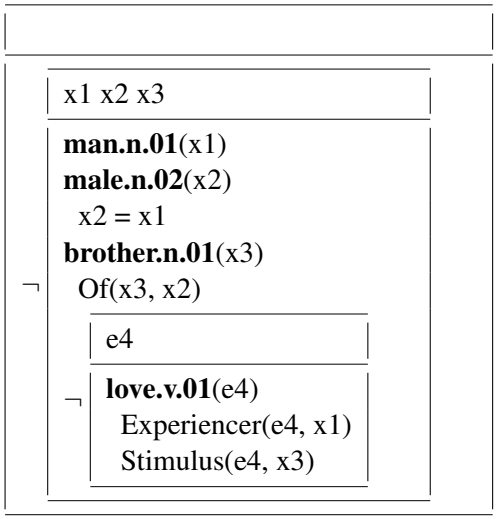


(c) DRG for q28

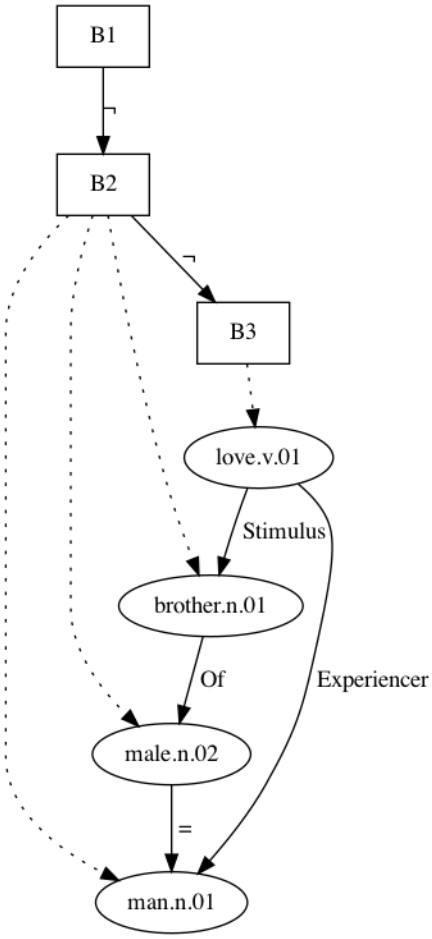
X SBN, DRS, and DRG for Example q29 (discussed in Annotation Results)

```
                NEGATION -1                 %  Every
man.n.01                                    %  man
male.n.02       EQU -1                      %
brother.n.01    Of -1                       %
                NEGATION -1                 %
love.v.01       Experiencer -3 Stimulus -1  %  loves his brother.
```

(a) SBN for q29



(b) DRS for q29

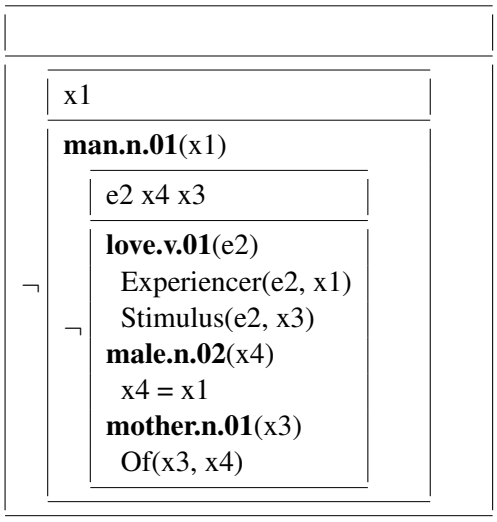


(c) DRG for q29

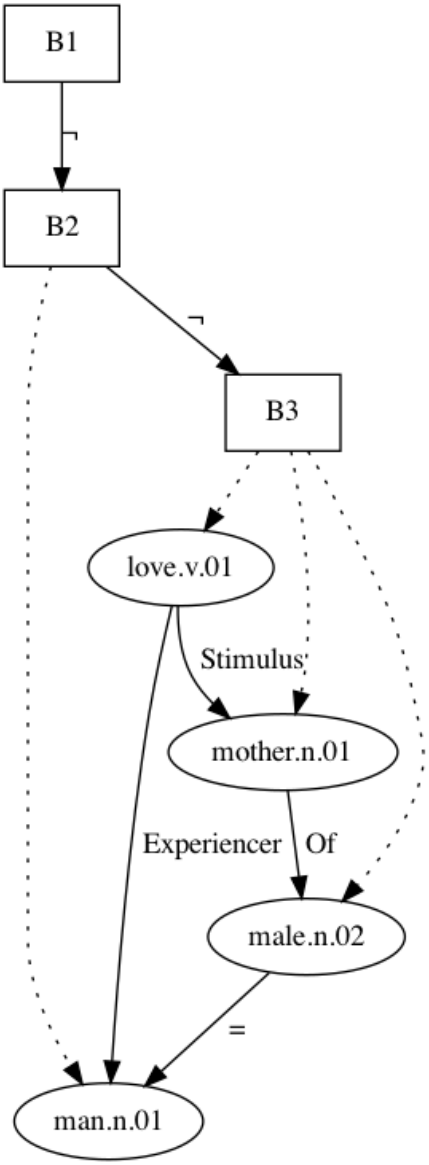
Y SBN, DRS, and DRG for Example q30 (discussed in Annotation Results)

```
                NEGATION -1                 %  Every
man.n.01                                    %  man
                NEGATION -1                 %
love.v.01       Experiencer -1 Stimulus +2  %  loves
male.n.02       EQU -2                      %  his
mother.n.01     Of -1                       %  mother.
```

(a) SBN for q30



(b) DRS for q30



(c) DRG for q30

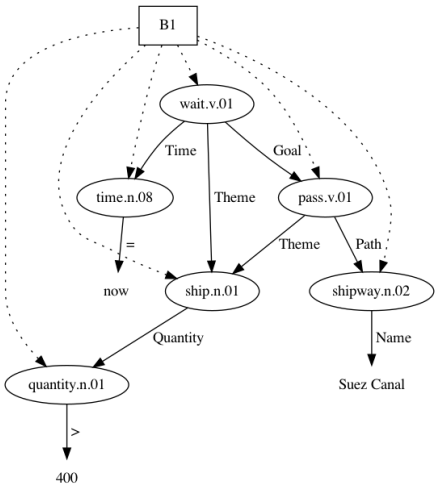
Z SBN, DRS, and DRG for Example q31 (discussed in Annotation Results)

```
quantity.n.01   GRE 400                  %  More than four hundred
ship.n.01       Quantity -1              %  ships
time.n.08       EQU now                  %  are
wait.v.01       Theme -2 Time -1 Goal +1 %  waiting
pass.v.01       Theme -3 Path +1         %  to pass through
shipway.n.02    Name "Suez Canal"        %  the Suez Canal.
```

(a) SBN for q31

x1 x2 t3 e4 e5 x6
quantity.n.01(x1)
x1 > 400
ship.n.01(x2)
Quantity(x2, x1)
time.n.08(t3)
t3 = now
wait.v.01(e4)
Theme(e4, x2)
Time(e4, t3)
Goal(e4, e5)
pass.v.01(e5)
Theme(e5, x2)
Path(e5, x6)
shipway.n.02(x6)
Name(x6, "Suez Canal")

(b) DRS for q31



(c) DRG for q31