The FraCaS test suite

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1 Generalized quantifiers

1.1 Conservativity

- Q As are $B\mathbf{s}\leftrightarrow Q$ As are As who are $B\mathbf{s}$
- (1) An Italian became the world's greatest tenor. Was there an Italian who became the world's greatest tenor? [Yes]
- (2) Every Italian man wants to be a great tenor. Some Italian men are great tenors. Are there Italian men who want to be a great tenor? [Yes]
- (3) All Italian men want to be a great tenor. Some Italian men are great tenors. Are there Italian men who want to be a great tenor? [Yes]

1)	Each Italian tenor wants to be great.
	Some Italian tenors are great.
	Are there Italian tenors who want to be great?
	[Yes]
`	
)	The really ambitious tenors are Italian.
	Are there really ambitious tenors who are Italian!
	[Ies]
)	No really great tenors are modest.
/	Are there really great tenors who are modest?
	[No]
)	Some great tenors are Swedish.
	Are there great tenors who are Swedish?
	[Yes]
)	Many great tenors are German.
	Are there great tenors who are German?
	[Yes]
)	Several great tenors are British
)	Are there great tenors who are British?
	[Yes]
	[100]
0)	Most great tenors are Italian.
	Are there great tenors who are Italian?
	[Yes]
1)	A few great tenors sing popular music.
	Some great tenors like popular music.
	Are there great tenors who sing popular music?
	[Yes]
9)	Four great topord are pace
2)	rew great tenors are poor.

Are there great tenors who are poor? [Not many]

(13)	Both leading tenors are excellent.
	Leading tenors who are excellent are indispensable.
	Are both leading tenors indispensable?
	[Yes]
(14)	Noither leading tenor comes sheep
(14)	Neither leading tenor comes cheap.
	One of the leading tenors is Pavarotti.
	Is Pavarotti a leading tenor who comes cheap?
	[No]
(15)	At least three tenors will take part in the concert
(10)	Are there tenors who will take part in the concert?
	[Voc]
	[Tes]
(16)	At most two tenors will contribute their fees to charity.
	Are there tenors who will contribute their fees to charity?
	[At most two]

1.2 Monotonicity (upwards on second argument)

- Q As are Bs and all Bs are $C\mathbf{s} \to Q$ As are $C\mathbf{s}$
- (17) An Irishman won the Nobel prize for literature. Did an Irishman win a Nobel prize? [Yes]
- (18) Every European has the right to live in Europe. Every European is a person. Every person who has the right to live in Europe can travel freely within Europe.
 Can every European travel freely within Europe? [Yes]
- (19) All Europeans have the right to live in Europe. Every European is a person. Every person who has the right to live in Europe can travel freely within Europe. Can all Europeans travel freely within Europe? [Yes]

(20)	Each European has the right to live in Europe. Every European is a person. Every person who has the right to live in Europe can travel freely within Europe. Can each European travel freely within Europe? [Yes]
(21)	The residents of member states have the right to live in Europe. All residents of member states are individuals. Every individual who has the right to live in Europe can travel freely within Europe. Can the residents of member states travel freely within Europe? [Yes]
(22)	No delegate finished the report on time. Did no delegate finish the report? [Don't know]
(23)	Some delegates finished the survey on time. Did some delegates finish the survey? [Yes]
(24)	Many delegates obtained interesting results from the survey. Did many delegates obtain results from the survey? [Yes]
(25)	Several delegates got the results published in major national newspapers. Did several delegates get the results published? [Yes]
(26)	Most Europeans are resident in Europe. All Europeans are people. All people who are resident in Europe can travel freely within Europe. Can most Europeans travel freely within Europe? [Yes]

(27)	A few committee members are from Sweden. All committee members are people.
	All people who are from Sweden are from Scandinavia. Are at least a few committee members from Scandinavia? [Yes]
(28)	Few committee members are from Portugal. All committee members are people. All people who are from Portugal are from southern Europe. Are there few committee members from southern Europe? [Don't know]
(29)	Both commissioners used to be leading businessmen. Did both commissioners used to be businessmen? [Yes]
(30)	Neither commissioner spends a lot of time at home. Does neither commissioner spend time at home? [Don't know]
(31)	A least three commissioners spend a lot of time at home. Do at least three commissioners spend time at home? [Yes]
(32)	At most ten commissioners spend a lot of time at home. Do at most ten commissioners spend time at home? [Don't know]
1.3	Monotonicity (downwards on second argument)

Q As are Bs and all Cs are Bs \rightarrow Q As are Cs

 (33) An Irishman won a Nobel prize.
 Did an Irishman win the Nobel prize for literature? [Don't know]

(34)	Every European can travel freely within Europe.
	Every European is a person.
	Every person who has the right to live in Europe
	can travel freely within Europe.
	Does every European have the right to live in Europe?
	[Don't know]

 (35) All Europeans can travel freely within Europe. Every European is a person. Every person who has the right to live in Europe can travel freely within Europe. Do all Europeans have the right to live in Europe? [Don't know]

(36) Each European can travel freely within Europe.
 Every European is a person.
 Every person who has the right to live in Europe can travel freely within Europe.
 Does each European have the right to live in Europe?
 [Don't know]

 (37) The residents of member states can travel freely within Europe. All residents of member states are individuals. Every individual who has the right to live anywhere in Europe can travel freely within Europe. Do the residents of member states have the right to live anywhere in Europe?

[Don't know]

(38) No delegate finished the report. Did any delegate finish the report on time? [No]

- (39) Some delegates finished the survey. Did some delegates finish the survey on time? [Don't know]
- (40) Many delegates obtained results from the survey. Did many delegates obtain interesting results from the survey? [Don't know]

(41)	Several delegates got the results published. Did several delegates get the results published
	in major national newspapers? [Don't know]
(42)	Most Europeans can travel freely within Europe. All Europeans are people. All people who are resident in Europe can travel freely within Europe. Are most Europeans resident in Europe? [Don't know]
(43)	A few committee members are from Scandinavia. All committee members are people. All people who are from Sweden are from Scandinavia. Are at least a few committee members from Sweden? [Don't know]
(44)	Few committee members are from southern Europe. All committee members are people. All people who are from Portugal are from southern Europe. Are there few committee members from Portugal? [Yes]
(45)	Both commissioners used to be businessmen. Did both commissioners used to be leading businessmen? [Don't know]
(46)	Neither commissioner spends time at home. Does either commissioner spend a lot of time at home? [No]
(47)	A least three commissioners spend time at home. Do at least three commissioners spend a lot of time at home? [Don't know]
(48)	At most ten commissioners spend time at home. Do at most ten commissioners spend a lot of time at home?

[Yes]

1.4 Monotonicity (upwards on first argument)

Q As are Bs and all As are $C\mathbf{s} \to Q$ Cs are Bs

(49) A Swede won a Nobel prize.
 Every Swede is a Scandinavian.
 Did a Scandinavian win a Nobel prize?
 [Yes]

 (50) Every Canadian resident can travel freely within Europe. Every Canadian resident is a resident of the North American continent.
 Can every resident of the North American continent travel freely within Europe?

[Don't know]

 (51) All Canadian residents can travel freely within Europe. Every Canadian resident is a resident of the North American continent.
 Can all residents of the North American continent travel freely within Europe?

[Don't know]

 (52) Each Canadian resident can travel freely within Europe.
 Every Canadian resident is a resident of the North American continent.
 Can each resident of the North American continent travel freely within Europe?

[Don't know]

- (53) The residents of major western countries can travel freely within Europe.
 All residents of major western countries are residents of western countries.
 Do the residents of western countries have the right to live in Europe?
 [Don't know]
- (54) No Scandinavian delegate finished the report on time. Did any delegate finish the report on time?

[Don't know]

(55)	Some Irish delegates finished the survey on time. Did any delegates finish the survey on time? [Yes]
(56)	Many British delegates obtained interesting results from the survey. Did many delegates obtain interesting results from the survey? [Don't know]
(57)	Several Portuguese delegates got the results published in major national newspapers. Did several delegates get the results published in major national newspapers? [Yes]
(58)	Most Europeans who are resident in Europe can travel freely within Europe. Can most Europeans travel freely within Europe? [Don't know]
(59)	A few female committee members are from Scandinavia. Are at least a few committee members from Scandinavia? [Yes]
(60)	Few female committee members are from southern Europe. Are few committee members from southern Europe? [Don't know]
(61)	Both female commissioners used to be in business. Did both commissioners used to be in business? [Yes, if both commissioners are female. Otherwise there are more than two commissioners]
(62)	Neither female commissioner spends a lot of time at home. Does either commissioner spend a lot of time at home? [No, if both commissioners are female.

Otherwise there are more than two commissioners]

- (63) A least three female commissioners spend time at home. Do at least three commissioners spend time at home? [Yes]
- (64) At most ten female commissioners spend time at home. Do at most ten commissioners spend time at home? [Don't know]

1.5 Monotonicity (downwards on first argument)

Q As are Bs and all Cs are As $\rightarrow Q$ Cs are Bs

- (65) A Scandinavian won a Nobel prize. Every Swede is a Scandinavian Did a Swede win a Nobel prize? [Don't know]
- (66) Every resident of the North American continent can travel freely within Europe.
 Every Canadian resident is a resident of the North American continent.
 Can every Canadian resident freely within Europe?

[Yes]

- (67) All residents of the North American continent can travel freely within Europe.
 Every Canadian resident is a resident of the North American continent.
 Can all Canadian residents travel freely within Europe? [Yes]
- (68) Each resident of the North American continent can travel freely within Europe.
 Every Canadian resident is a resident of the North American continent.
 Can each Canadian resident travel freely within Europe?

(69)	The residents of western countries can travel freely within Europe. All residents of major western countries are residents of western countries.
	Do the residents of major western countries have the right to live in Europe? [Yes]
(70)	No delegate finished the report on time. Did any Scandinavian delegate finish the report on time? [No]
(71)	Some delegates finished the survey on time. Did any Irish delegates finish the survey on time? [Don't know]
(72)	Many delegates obtained interesting results from the survey. Did many British delegates obtain interesting results from the survey? [Don't know]
(73)	Several delegates got the results published in major national newspapers. Did several Portuguese delegates get the results published in major national newspapers? [Don't know]
(74)	Most Europeans can travel freely within Europe. Can most Europeans who are resident outside Europe travel freely within Europe? [Don't know]
(75)	A few committee members are from Scandinavia. Are at least a few female committee members from Scandinavia? [Don't know]
(76)	Few committee members are from southern Europe. Are few female committee members from southern Europe? [Yes]

(77)	Both commissioners used to be in business.
	Did both female commissioners used to be in business?
	[Yes, if both commissioners are female.
	Otherwise there are more than two commissioners]
(78)	Neither commissioner spends a lot of time at home.
(10)	Does either female commissioner spend a lot of time at home?
	[No, if both commissioners are female.
	Otherwise there are more than two commissioners]
(70)	A losst three commissioners spend time at home
(79)	A least three commissioners spend time at home.
	[Do at least three male commissioners spend time at nome? [Don't know]
()	
(80)	At most ten commissioners spend time at home.

Do at most ten female commissioners spend time at home? [Yes]

2 Plurals

A number of inferences pertaining to plurals are covered under the headings of generalized quantifiers and elsewhere. Here we concentrate on conjoined NPs; bare, existential and definite plurals; dependent plurals; and collective and distributive readings and scope ambiguity.

2.1 Conjoined Noun Phrases

(81)	Smith, Jones and Anderson signed the contract.
	Did Jones sign the contract?

[Yes]

(82) Smith, Jones and several lawyers signed the contract. Did Jones sign the contract?

[Yes]

(83)	Either Smith, Jones or Anderson signed the contract.
	Did Jones sign the contract?
	[Don't know]
(84)	Either Smith, Jones or Anderson signed the contract.
	If Smith and Anderson did not sign the contract,
	did Jones sign the contract?
	[Yes]
(85)	Exactly two lawyers and three accountants signed the contract.
	Did six lawyers sign the contract?
	[No]
	No scope relations between the two conjoined NPs
()	
(86)	Exactly two lawyers and three accountants signed the contract.
	Did six accountants sign the contract?

No scope relations between the two conjoined NPs

Conjoined Nbars

Nbar conjunction tends to be quite ambiguous. This may be the result of a syntactic ambiguity between (i) genuine Nbar conjunction, and (ii) NP conjunction where the determiner of one of the NPs is ellided.

[No]

- (87) Every representative and client was at the meeting. Was every representative at the meeting? [Yes, on one reading]
 Arguably NP conjunction: every representative and every client
- (88) Every representative and client was at the meeting. Was every representative at the meeting? [Don't know, on one reading] NBar conjunction: everyone who is both a representative and a client

(89) Every representative or client was at the meeting. Was every representative and every client at the meeting? [Yes] With disjunction, NP conjunction seems unavailable.

2.2 Definite Plurals

Definite plurals can often be non-anaphoric and behave like universally quantified noun phrases (90). However, as with (generic) bare plurals, the force of the quantification can also be less than universal (91). Whether this lessening of quantificational force is due to the noun phrase or to the predicate of which the NP is an argument is unclear (92,93).

(90) The chairman read out the items on the agenda. Did the chairman read out every item on the agenda? [Yes] Non-anaphoric, universal plural definite

(91) The people who were at the meeting voted for a new chairman. Did everyone at the meeting vote for a new chairman? [Don't know] Some people may have abstained from the vote

(92) All the people who were at the meeting voted for a new chairman. Did everyone at the meeting vote for a new chairman?

[Yes]

(93) The people who were at the meeting all voted for a new chairman. Did everyone at the meeting vote for a new chairman?

[Yes]

Closely related to this, plural definites can have a collective/institutional or even generic interpretation:

(94) The inhabitants of Cambridge voted for a Labour MP. Did every inhabitant of Cambridge vote for a Labour MP? [Don't know] (95) The Ancient Greeks were noted philosophers. Was every Ancient Greek a noted philosopher? [Don't know]

(96) The Ancient Greeks were all noted philosophers. Was every Ancient Greek a noted philosopher? [Yes]

2.3 Bare Plurals

Bare plurals can exhibit existential, (quasi) universal, generic or dependent plural behaviour. The circumstances giving rise to these different behaviours a poorly understood, so we only give a few illustrative examples.

- (97) Software faults were blamed for the system failure. Was the system failure blamed on one or more software faults? [Yes]
 - Existential bare plural
- (98) Software faults were blamed for the system failure. Bug # 32-985 is a known software fault. Was Bug # 32-985 blamed for the system failure? [Don't know] Existential interpretation: not every software fault contributed to the failure.
- (99) Clients at the demonstration were all impressed by the system's performance. Smith was a client at the demonstration.
 Was Smith impressed by the system's performance?

[Yes]

(Quasi) universal bare plural

(100) Clients at the demonstration were impressed by the system's performance. Were most clients at the demonstration impressed by the system's performance? [Yes]

(Quasi) universal bare plural

(101) University graduates make poor stock-market traders. Smith is a university graduate. Is Smith likely to make a poor stock market trader? [Yes]

Generic interpretation

 (102) University graduates make poor stock-market traders. Smith is a university graduate.
 Will Smith make a poor stock market trader? [Don't know]
 Generic interpretation

2.4 Dependent Plurals

(103) All APCOM managers have company cars. Jones is an APCOM manager. Does Jones have a company car?

[Yes]

(104) All APCOM managers have company cars. Jones is an APCOM manager. Does Jones have more than one company car? [Don't know]

2.5 Negated Plurals

- (105) Just one accountant attended the meeting. Did no accountants attend the meeting? [No]
- (106) Just one accountant attended the meeting. Did no accountant attend the meeting? [No]

- (107) Just one accountant attended the meeting. Did any accountants attend the meeting? [Yes]
- (108) Just one accountant attended the meeting. Did any accountant attend the meeting? [Yes]
- (109) Just one accountant attended the meeting. Did some accountants attend the meeting? [No/Just one]
- (110) Just one accountant attended the meeting. Did some accountant attend the meeting? [Yes]

2.6 Collective and Distributive Plurals

- (111) Smith signed one contract. Jones signed another contract. Did Smith and Jones sign two contracts? [Yes, on a collective/cumulative reading of the conclusion]
- (112) Smith signed two contracts. Jones signed two contracts.
 Did Smith and Jones sign two contracts? [Yes, on a distributive reading of "Smith and Jones"]
- (113) Smith signed two contracts. Jones also signed them. Did Smith and Jones sign two contracts? [Yes]

3 (Nominal) Anaphora

In the examples below we make the assumption (unless otherwise indicated) that there is no context beyond that provided by the mini-discourse. This is so that we can do away with explicit co-indexing of pronouns with their antecedents, on the grounds that context will provide only (or sometimes a strictly limited number) of possible antecedents.

3.1 Intra-Sentential

- (114) Mary used her workstation. Was Mary's workstation used? [Yes]
- (115) Mary used her workstation. Does Mary have a workstation? [Yes]
- (116) Mary used her workstation. Is Mary female? [Yes]
- (117) Every student used her workstation. Mary is a student. Did Mary use her workstation? [Yes]
- (118) Every student used her workstation. Mary is a student. Does Mary have a workstation? [Yes]

(119)No student used her workstation. Mary is a student. Did Mary use a workstation? [No]

3.2**Inter-Sentential**

- (120)Smith attended a meeting. She chaired it. Did Smith chair a meeting? [Yes]
- (121)Smith delivered a report to ITEL. She also delivered them an invoice. And she delivered them a project proposal. Did Smith deliver a report, an invoice and a project proposal to ITEL? [Yes]

Keeping track of same entities across more than two sentences.

(122)Every committee has a chairman. He is appointed its members. Does every committee have a chairman appointed by members of the committee? [Yes]

Modal subordination.

3.3**Plural Anaphora**

(123)ITEL has sent most of the reports Smith needs. They are on her desk. Are there some reports from ITEL on Smith's desk? [Yes]

(124)Two out of ten machines are missing. They have been removed. Have two machines been removed?

[Yes]

 (125) Two out of ten machines are missing. They have been removed. Have eight machines been removed? [Don't know] Set difference can't be used to construct plural antecedents

- (126) Two out of ten machines are missing. They were all here yesterday. Were ten machines here yesterday? [Yes]
- (127) Smith took a machine on Tuesday, and Jones took a machine on Wednesday. They put them in the lobby.

Did Smith and Jones put two machines in the lobby? [Yes, on a distributive reading of the question] Construction of plural antecedents from separate constituents.

(128) John and his colleagues went to a meeting. They hated it Did John's colleagues hate the meeting? [Yes]

 John and his colleagues went to a meeting. They hated it
 Did John hate the meeting?
 [Yes, on one possible reading]
 "They" can be resolved to John and his colleagues

 (130) John and his colleagues went to a meeting. They hated it
 Did John hate the meeting?
 [Don't know, on one possible reading]
 "They" can also be resolved to John's colleagues but not John

- (131) Each department has a dedicated line. They rent them from BT.
 Does every department rent a line from BT?
 [Yes]
 Dependent plural anaphora
- (132) Each department has a dedicated line. The sales department rents it from BT.
 Does the sales department rent a line from BT?
 [Yes]
 Paycheque pronoun

3.4 E-type and Donkey Pronouns

(133) GFI owns several computers. ITEL maintains them. Does ITEL maintain all the computers that GFI owns [Yes]

E-type anaphora

 (134)
 Every customer who owns a computer has a service contract for it.

 MFI is a customer that owns exactly one computer.

 Does MFI have a service contract for all its computers

Donkey sentence

[Yes]

(135) Every customer who owns a computer has a service contract for it. MFI is a customer that owns several computers. Does MFI have a service contract for all its computers

[Yes]

This pattern of inference, unlike (134), tends to some theory dependence. Although the inference seems correct in this example, compare with (136)

(136) Every executive who had a laptop computer brought it to take notes at the meeting. Smith is a executive who owns five different laptop computers.

Did Smith take five laptop computers to the meeting?

[Don't know]

Similar to (135), except for tense and pragmatic plausibility.

 (137) There are 100 companies. ICM is one of the companies and owns 150 computers. It does not have service contracts for any of its computers. Each of the other 99 companies owns one computer. They have service contracts for them. Do most companies that own a computer have a service contract for it? [Yes] Proportion problem

3.5 Functional and Subsectional

Due to the heavy domain dependence of functional (or better perhaps, relational) anaphora, it is hard to state general inferences that don't assume considerable background knowledge unless this is given explicitly.

(138) Every report has a cover page. R-95-103 is a report. Smith signed the cover page. Did Smith sign the cover page of R-95-103? [Yes]

3.6 Simple Reflexives

- (139) A company director awarded himself a large payrise. Has a company director awarded and been awarded a payrise? [Yes]
- (140) John said Bill had hurt himself. Did John say Bill had been hurt? [Yes]
- (141) John said Bill had hurt himself. Did anyone say John had been hurt? [Don't know]

4 Ellipsis

In nearly all cases the inferences presented here have conclusions that are simply reconstructions of the ellided constituent. Unfortunately, an inference test suite is not well suited to illustrating prohibitions on ellipsis resolution. For example, an ill-formed discourse like

John was in Paris yesterday. *So did Bill.

doesn't even get as far as supporting any inferences.

4.1 VP Ellipsis

- (142) John spoke to Mary. So did Bill Did Bill speak to Mary? [Yes] Basic example.
- John spoke to Mary. So did Bill
 John spoke to Mary at four o'clock.
 Did Bill speak to Mary at four o'clock? [Don't know]
 Temporal resolution of tense in antecedent is not carried across to ellipsis.
- (144) John spoke to Mary at four o'clock. So did Bill
 Did Bill speak to Mary at four o'clock? [Yes]
 Explicit temporal adverbials are carried across to ellipsis.

- John spoke to Mary at four o'clock.
 And Bill did at five o'clock
 Did Bill speak to Mary at five o'clock?
 [Yes]

 Explicit temporal adverbials are not carried across if overridden.
- (146) John has spoken to Mary.
 Bill is going to.
 Will Bill speak to Mary?
 [Yes]
 Tense agreement not necessary between ellipsis and antecedent.
- (147) John spoke to Mary on Monday.
 Bill didn't.
 Did Bill speak to Mary on Monday?
 [No]
 Polarity agreement not necessary between ellipsis and antecedent.
- (148) Has John spoken to Mary? Bill has. Has Bill spoken to Mary? [Yes] Mood agreement not necessary between ellipsis and antecedent.
- (149) John has spoken to Mary. The students have too. Have the students spoken to Mary? [Yes] Number agreement not necessary.

4.2 Gapping

(150) John went to Paris by car, and Bill by train. Did Bill go to Paris by train?

Basic example

[Yes]

(151) John went to Paris by car, and Bill by train to Berlin. Did Bill go to Berlin by train? *Another basic example*(152) John went to Paris by car, and Bill to Berlin. Did Bill go to Berlin by car? *Another basic example*(153) John is going to Paris by car, and the students by train.

153) John is going to Paris by car, and the students by train. Are the students going to Paris by train? [Yes]

Subject-verb agreement not necessary

(154) John went to Paris by car. Bill by train. Did Bill go to Paris by train? [Yes] Cross-sentential gapping

4.3 One Anaphora

- (155) John owns a car. Bill owns one too. Does Bill own a car? [Yes] Basic example
- (156) John owns a car.
 Bill owns one too.
 Is there a car that John and Bill own?
 [Don't know]
 It needn't be the same car that John and Bill own.

(157) John owns a red car. Bill owns a blue one. Does Bill own a blue car? [Yes]

(158) John owns a red car. Bill owns a blue one. Does Bill own a red car? [Don't know]

(159) John owns a red car. Bill owns a fast one. Does Bill own a fast car? [Yes]

(160) John owns a red car.
Bill owns a fast one.
Does Bill own a fast red car?
[Yes, on one possible reading]
The one anaphor may be resolved via the property of being a red car

(161) John owns a red car.
Bill owns a fast one.
Does Bill own a fast red car?
[Don't know, on one possible reading]
Or the one anaphor may just be resolved via the property of being a car

(162) John owns a fast red car. Bill owns a slow one.

> Does Bill own a slow red car? [Yes]

When semantically parallel (e.g. fast/slow) modifiers appear on the antecedent and one-anaphor, it appears that all non-parallel modifiers must form part of the resolution

4.4 Sluicing

(163) John had his paper accepted. Bill doesn't know why. Does Bill know why John had his paper accepted? [No]

4.5 Phrasal Ellipsis

- (164) John spoke to Mary. <u>And to Sue.</u> Did John speak to Sue? [Yes] *PP ellipsis (subcategorized)*
- (165) John spoke to Mary. On Friday.
 Did John speak to Mary on Friday? [Yes]
 PP ellipsis: adds PP to antecedent
- (166) John spoke to Mary on Thursday.
 And on Friday.
 Did John speak to Mary on Friday?
 [Yes]
 PP ellipsis: replaces PP in antecedent
- (167) Twenty men work in the Sales Department. But only one woman.
 Do two women work in the Sales Department? [No]
 NP ellipsis
- (168) Five men work part time. And forty five women. Do forty five women work part time? [Yes]

NP ellipsis

- John found Mary before Bill.
 Did John find Mary before Bill found Mary? [Yes, on one possible reading]
 NP ellipsis
- (170) John found Mary before Bill. Did John find Mary before John found Bill? [Yes, on one possible reading] NP ellipsis

(171) John wants to know how many men work part time.
 And women.
 Does John want to know how many women work part time?
 [Yes]
 Nbar ellipsis

(172) John wants to know how many men work part time, and which. Does John want to know which men work part time?

[Yes]

Determiner ellipsis

4.6 Antecedent Contained Deletion

Antecedent contained deletion is a notorious problem for copying approaches to ellipsis, since the antecedent clause contains the ellipsis and some way must be found of removing it from the copy.

(173) Bill spoke to everyone that John did. John spoke to Mary. Did Bill speak to Mary? [Yes]

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(174) Bill spoke to everyone that John did. Bill spoke to Mary. Did John speak to Mary? [Don't know]

4.7 Configurational Effects

There are a number of syntactic and other configurational constraints on what can constitute the antecedent to an ellipsis. These constraints varying depending on the type of ellipsis (VP, phrasal, gapping, etc).

- (175) John said Mary wrote a report, and Bill did too. Did Bill say Mary wrote a report? [Yes, on one possible reading/parse]
- (176) John said Mary wrote a report, and Bill did too. Did John say Bill wrote a report? [Yes, on one possible reading/parse]
- (177) John said that Mary wrote a report, and that Bill did too. Did Bill say Mary wrote a report?

[Don't know]

Note that the first sentence in (175) and (176) is syntactically ambiguous, depending on whether the conjunctive clause conjoins with the main or subordinate clause of *John said Mary wrote a report*. In (177) the conjunctive clause unambiguously conjoins with the subordinate clause, and only one interpretation of the ellipsis is possible. This appears to indicate that the antecedent clause to a VP ellipsis must be adjacent to the elliptical clause. However, as the examples below show, this is not correct.

(178) John wrote a report, and Bill said Peter did too. Did Bill say Peter wrote a report? [Yes] Embedded elliptical clause (179) If John wrote a report, then Bill did too. John wrote a report.

Did Bill write a report?

[Yes]

Elliptical and antecedent clause embedded (in parallel)

(180) John wanted to buy a car, and he did. Did John buy a car?

[Yes]

Embedded antecedent clause

(181) John needed to buy a car, and Bill did. Did Bill buy a car? [Don't know]

Other configurational effects of the kinds illustrated in Deliverable 7 are hard to exemplify using inference suites.

4.8 Ellipsis and Anaphora

The following inferences illustrate differences between strict and sloppy interpretations of anaphors in elliptical clauses

- (182) Smith represents his company and so does Jones. Does Jones represent Jones' company? [Yes, on one reading] Sloppy identity
- (183) Smith represents his company and so does Jones. Does Jones represent Smith's company? [Yes, on one reading] Strict identity
- (184) Smith represents his company and so does Jones. Does Smith represent Jones' company? [Don't know]

(185) Smith claimed he had costed his proposal and so did Jones. Did Jones claim he had costed his own proposal? [Yes, on one reading] Sloppy identity on both pronouns

(186) Smith claimed he had costed his proposal and so did Jones. Did Jones claim he had costed Smith's proposal? [Yes, on one reading] Sloppy identity "he", strict on "his"

- (187) Smith claimed he had costed his proposal and so did Jones. Did Jones claim Smith had costed Smith's proposal? [Yes, on one reading] Strict identity on both pronouns
- (188) Smith claimed he had costed his proposal and so did Jones. Did Jones claim Smith had costed Jones' proposal? [Don't know] Can't have strict identity on "he" and sloppy identity on "his"

(189) John is a man and Mary is a woman. John represents his company and so does Mary. Does Mary represent her own company? [Yes, on one reading] Sloppy identity, gender agreement not necessary

- John is a man and Mary is a woman.
 John represents his company and so does Mary.
 Does Mary represent John's company?
 [Yes, on one reading]
 Strict identity, gender agreement not necessary
- Bill suggested to Frank's boss that they should go to the meeting together, and Carl to Alan's wife.
 If it was suggested that Bill and Frank should go together,

was it suggested that Carl and Alan should go together?

Plural pronouns resolved in parallel

- Bill suggested to Frank's boss that they should go to the meeting together, and Carl to Alan's wife.
 If it was suggested that Bill and Frank should go together, was it suggested that Carl and Alan's wife should go together?
 [Don't know]
 Plural pronouns resolved in parallel
- (193) Bill suggested to Frank's boss that they should go to the meeting together, and Carl to Alan's wife. If it was suggested that Bill and Frank's boss should go together

If it was suggested that Bill and Frank's boss should go $toge$	tner,
was it suggested that Carl and Alan's wife should go togethe	er?

[Yes]

Plural pronouns resolved in parallel

(194) Bill suggested to Frank's boss that they should go to the meeting together, and Carl to Alan's wife.

If it was suggested that Bill and Frank's boss should go together, was it suggested that Carl and Alan should go together?

Plural pronouns resolved in parallel

(195) Bill suggested to Frank's boss that they should go to the meeting together, and Carl to Alan's wife.

If it was suggested that Bill, Frank and Frank's boss should go together, was it suggested that Carl, Alan and Alan's wife should go together?

[Yes]

[Don't know]

Plural pronouns resolved in parallel

4.9 Ellipsis and Quantification

Scope parallelism turns out to be rather tricky to illustrate through inference suites. This is because of the entailment relation: $\exists \forall \models \forall \exists$.

(196) A lawyer signed every report, and so did an auditor. That is, there was one lawyer who signed all the reports. Was there one auditor who signed all the reports?

[Yes]

5 Adjectives

The inferences below carve up adjectives into (a by no means exhaustive) crosscutting set of dimensions. Typical inferences are given for example adjectives.

5.1 Affirmative and Non-Affirmative

Affirmative adjectives map the denotation of the predicate they modify onto a subset of the denotation. So for example, an old man is a man. Most adjectives are affirmative, but a few like *former* and *fake* are not. Given that someone is a former student, one cannot conclude that they are now a student. But it is not entirely clear whether one can conclude that they are not now a student — they may have become one again.

- $\begin{array}{c} (197) & \underline{ \text{John has a genuine diamond.} } \\ \hline \text{Does John have a diamond?} \\ & [Yes] \\ Affirmative adjectives: Adj N \Rightarrow N \end{array}$
- (198) John is a former university student. Is John a university student? [No/Don't know] Non-affirmative: Adj $N \Rightarrow N$ (Opinions differ about whether "Adj $N \Rightarrow \neg N$ ")
- (199) John is a successful former university student. Is John successful? [Yes (for a former university student)] Ordering between affirmative and non-affirmative adjectives affects which adjectival predications are and aren't affirmed

(200) John is a former successful university student. Is John successful?

[Don't know]

(201) John is a former successful university student. Is John a university student? [Don't know]

John may currently be an unsuccessful university student

5.2 No Comparison Class

Gradable adjectives (e.g. *big, small*) usually assume some form of comparison class (i.e. 'big for an N'). But some others do not e.g. *four-legged*, or the adjectival phrase *ten foot long*. Adjectives not requiring a comparison class permit straightforward predication without reference to a nominal property providing a comparison class: a ten foot long alligator is ten foot long.

(202) Every mammal is an animal.
Is every four-legged mammal a four-legged animal?
[Yes]

$$[N1 \rightarrow N2] \Rightarrow [Adj(N1) \rightarrow Adj(N2)]$$

(203) Dumbo is a four-legged animal.
Is Dumbo four-legged?

$$Adj(N)(x) \Rightarrow Adj(x)$$
[Yes]

5.3 Opposites

Large and *small* (applied to the same comparison class) are opposites. If something is a small N it cannot be a large N, and vice versa. Some things can be neither large nor small Ns.

$$\begin{array}{ll} \mbox{(204)} & \underline{\mbox{Mickey is a small animal.}} \\ \hline \mbox{Is Mickey a large animal?} \\ & [No] \\ Small(N) \Rightarrow \neg Large(N) \end{array}$$

(205) Dumbo is a large animal.
Is Dumbo a small animal?
[No]

$$Large(N) \Rightarrow \neg Small(N)$$

(206) Fido is not a small animal. Is Fido a large animal? [Don't know] $\neg Small(N) \neq Large(N)$

- (208) Mickey is a small animal. Dumbo is a large animal Is Mickey smaller than Dumbo? [Yes] "Small" and "large" are related via the comparative "smaller"
- (209) Mickey is a small animal. Dumbo is a large animal Is Mickey larger than Dumbo? [No] "Small" and "large" are related via the comparative "larger"

5.4 Extensional Comparison Classes

Adjectives like *large* and *small* depend only on the extension of the comparison class they depend on.

(210) All mice are small animals. <u>Mickey is a large mouse.</u> <u>Is Mickey a large animal?</u> [No] (211) All elephants are large animals. Dumbo is a small elephant. Is Dumbo a small animal? [No]

 (212) All mice are small animals. All elephants are large animals. Mickey is a large mouse. Dumbo is a small elephant. Is Dumbo larger than Mickey? [Yes] Assume comparative relations exemplified in (208) and (209)

(213) All mice are small animals. Mickey is a large mouse. Is Mickey small?

??: Yes for a mouse

?? No for an animal]

Adjectives requiring a comparison class cannot usually be predicated in the absence of a common noun, unless some comparison class is clear from the wider context.

5.5 Extensional and Intensional Comparison Classes

Some adjectives require an 'intensional' comparison class: different inferences may follow when two distinct but co-extensive predicates provide the comparison class.

(214)	All legal authorities are law lecturers.
	All law lecturers are legal authorities.
	Are all fat legal authorities fat law lecturers?
	[Yes]
	Extensional comparison class

(215) All legal authorities are law lecturers. All law lecturers are legal authorities. Are all competent legal authorities competent law lecturers? [Don't know] Intensional comparison class

(216)	John is a fatter politician than Bill.
	Is John fatter than Bill?
	[Yes]

Extensional

(217) John is a cleverer politician than Bill. Is John cleverer than Bill? [Don't know] Intensional

Note that both intensional and extensional comparison class adjectives support comparatives.

5.6 Default Comparison Classes

Comparison class adjectives can sometimes pick up a default comparison class from the subject NP. For example, knowing that Kim is a person provides a default scale for assessing cleverness in people. If Kim were known to be a dog, the assessment scale would be different.

(218) Kim is a clever person. Is Kim clever? [Yes]

(219) Kim is a clever politician. Is Kim clever? [Don't know]

6 Comparatives

6.1 Phrasal Comparatives

(220) The PC-6082 is faster than the ITEL-XZ. The ITEL-XZ is fast. Is the PC-6082 fast?

[Yes]

- (221) The PC-6082 is faster than the ITEL-XZ. Is the PC-6082 fast? [Don't know]
- (222) The PC-6082 is faster than the ITEL-XZ. The PC-6082 is fast. Is the ITEL-XZ fast?

[Don't know]

(223) The PC-6082 is faster than the ITEL-XZ. The PC-6082 is slow. Is the ITEL-XZ fast?

[No]

(224) The PC-6082 is as fast as the ITEL-XZ. The ITEL-XZ is fast. Is the PC-6082 fast?

[Yes]

(225) The PC-6082 is as fast as the ITEL-XZ. Is the PC-6082 fast?

[Don't know]

(226) The PC-6082 is as fast as the ITEL-XZ. The PC-6082 is fast. Is the ITEL-XZ fast?

[Don't know]

(227) The PC-6082 is as fast as the ITEL-XZ. The PC-6082 is slow. Is the ITEL-XZ fast?

[No]

- (228) The PC-6082 is as fast as the ITEL-XZ. Is the PC-6082 faster than the ITEL-XZ? [Don't know]
- (229) The PC-6082 is as fast as the ITEL-XZ. Is the PC-6082 slower than the ITEL-XZ? [No]
- (230) ITEL won more orders than APCOM did. Did ITEL win some orders?

[Yes]

- (231) ITEL won more orders than APCOM did. Did APCOM win some orders? [Don't know]
- (232) ITEL won more orders than APCOM did. APCOM won ten orders. Did ITEL win at least eleven orders? [Yes]

Inferences (233)–(235) are similar to (230)–(232). Note however, that if "AP-COM" can be interpreted as referring to a particular order (e.g. "the APCOM contract"), as it can in (233), the sentence *ITEL won more orders than AP-COM* is ambiguous between a reading like that in (230)–(232), and one where ITEL won more than just the APCOM order — see (236)

(233) ITEL won more orders than APCOM. Did ITEL win some orders? [Yes]

(234) ITEL won more orders than APCOM. Did APCOM win some orders? [Don't know]

(235)	ITEL won more orders than APCOM.
	APCOM won ten orders.
	Did ITEL win at least eleven orders?
	[Yes]

- (236) ITEL won more orders than the APCOM contract. Did ITEL win the APCOM contract?
 - [Yes]
- (237) ITEL won more orders than the APCOM contract. Did ITEL win more than one order? [Yes]
- (238) ITEL won twice as many orders than APCOM. APCOM won ten orders Did ITEL win twenty orders?

[Yes]

6.2 Clausal Complement

(239) ITEL won more orders than APCOM lost. Did ITEL win some orders?

[Yes]

- (240) ITEL won more orders than APCOM lost. Did APCOM lose some orders? [Don't know]
- (241) ITEL won more orders than APCOM lost. APCOM lost ten orders. Did ITEL win at least eleven orders? [Yes]

6.3 Measure Phrases

(242) The PC-6082 is faster than 500 MIPS. The ITEL-ZX is slower than 500 MIPS Is the PC-6082 faster than the ITEL-ZX? [Yes]

6.4 Differential Comparatives

(243) ITEL sold 3000 more computers than APCOM. APCOM sold exactly 2500 computers. Did ITEL sell 5500 computers?

[Yes]

6.5 Attributive Comparatives

- (244) APCOM has a more important customer than ITEL. Does APCOM have a more important customer than ITEL is? [Yes, on one reading of the premise]
- (245) APCOM has a more important customer than ITEL. Does APCOM has a more important customer than ITEL has? [Yes, on one reading of the premise]

6.6 Comparatives and Quantifiers

- (246) The PC-6082 is faster than every ITEL computer. The ITEL-ZX is an ITEL computer. Is the PC-6082 faster than the ITEL-ZX? [Yes]
- (247) The PC-6082 is faster than some ITEL computer. The ITEL-ZX is an ITEL computer. Is the PC-6082 faster than the ITEL-ZX? [Don't know]

- (248) The PC-6082 is faster than any ITEL computer. The ITEL-ZX is an ITEL computer. Is the PC-6082 faster than the ITEL-ZX? [Yes]
- (249) The PC-6082 is faster than the ITEL-ZX and the ITEL-ZY. Is the PC-6082 faster than the ITEL-ZX?

[Yes]

(250) The PC-6082 is faster than the ITEL-ZX or the ITEL-ZY. Is the PC-6082 faster than the ITEL-ZX? [Yes, on one reading of the premise]

7 Temporal Reference

Inference patterns involving temporal reference are complicated by the interplay between tense, aspectual information, lexical semantics, defeasible interpretation principles such as narrative progression, rhetorical relations, a theory of action and causation, world knowledge, interaction between plurality, genericity and temporal/aspectual phenomena etc. Some of the inferences are very basic, some are more involved. The more complex examples give ample illustration of the fact that temporal phenomena are usually discourse phenomena.

7.1 Standard Use of Tenses

- (251) ITEL has a factory in Birmingham. Does ITEL currently have a factory in Birmingham? [Yes]
- (252) Since 1992 ITEL has been in Birmingham. It is now 1996. Was ITEL in Birmingham in 1993? [Yes]

(251) and (252) are instances of the subinterval property. This works only with stative verbs. C.f. the following example involving an accomplishment verb in the simple past:

(253) ITEL has developed a new editor since 1992. It is now 1996 Did ITEL develop a new editor in 1993? [Don't know]

Similarly with activity verbs and adverbial modification

(254) ITEL has expanded since 1992. It is now 1996. Did ITEL expand in 1993? [Don't know]

Also, the position of the "since" adverbial affects the range of readings available:

- (255) Since 1992 ITEL has made a loss. It is now 1996. Did ITEL make a loss in 1993? [Yes]
- (256) ITEL has made a loss since 1992.
 It is now 1996.
 Did ITEL make a loss in 1993?
 [Don't know, on one reading of the premise]
- (257) ITEL has made a loss since 1992.
 It is now 1996.
 Did ITEL make a loss in 1993?
 [Yes, on one reading of the premise]
- (258) In March 1993 APCOM founded ITEL. Did ITEL exist in 1992?
 - [No]
- (258) involves the lexical semantics of found.

7.2 Temporal Adverbials

7.2.1 Indexicals

Non-context dependent indexicals are reasonably straightforward:

(259) The conference started on July 4th, 1994. It lasted 2 days. Was the conference over on July 8th, 1994? [Yes]

Context dependent indexicals (e.g. *today*, *yesterday*) are evaluated with respect to some temporal reference point (e.g. *now*):

(260) Yesterday APCOM signed the contract. Today is Saturday, July 14th. Did APCOM sign the contract Friday, 13th.? [Yes]

7.2.2 'Before', 'After' (Temporal Subordinate Clauses)

Ignoring counterfactual readings, *before* and *after* have the following transitivity properties: if X, Y and Z are either all state or accomplishment or achievement or activity denoting sentences we have

(261)
$$X \triangleright Y.$$
$$Y \triangleright Z.$$
$$X \triangleright Z.$$
where $\triangleright \in \{before, after\}$

(262) Smith left after Jones left. Jones left after Anderson left. Did Smith leave after Anderson left? [Yes]

In general transitivity does not hold when we mix aspectual classes in the premises:

(263) Smith was present after Jones left. Jones left after Anderson was present. Was Smith present after Anderson was present? [Don't know]

If X and Y are either all accomplishment or achievement denoting sentences with simple tenses *before* and *after* are inverses of each other:

(264) X before Y iff Y after X.

(265) Smith left. Jones left. Smith left after Jones left. Did Jones leave before Smith left? [Yes]

(266) Smith left. Jones left. Jones left before Smith left. Did Smith leave after Jones left? [Yes]

 (267) Jones revised the contract. Smith revised the contract. Jones revised the contract before Smith did.
 Did Smith revise the contract after Jones did. [Yes]

 (268) Jones revised the contract. Smith revised the contract. Jones revised the contract after Smith did.
 Did Smith revise the contract before Jones did. [Yes]

In general this is not so with activity verbs:

(269) Smith swam. Jones swam. Smith swam before Jones swam. Did Jones swim after Smith swam? [Don't know] However we do get

 (270) Smith swam to the shore. Jones swam to the shore.
 Smith swam to the shore before Jones swam to the shore.
 Did Jones swim to the shore after Smith swam to the shore? [Yes]

Here the PP to the shore provides an end point or conclusion for the activity.

Before and *after* are not inverses for state denoting sentences:

- (271) Smith was present. Jones was present.
 Smith was present after Jones was present.
 Was Jones present before Smith was present? [Don't know]
- (272) Smith was present. Jones was present. Smith was present before Jones was present. Was Jones present after Smith was present? [Don't know]
- (273) Smith was writing a report. Jones was writing a report.
 Smith was writing a report before Jones was writing a report. Was Jones writing a report after Smith was writing a report.? [Don't know]
- (274) Smith was writing a report. Jones was writing a report.
 Smith was writing a report after Jones was writing a report. Was Jones writing a report before Smith was writing a report? [Don't know]

Also *before*, but not *after*, can have a counterfactual meaning. Whether this is a distinct sense of *before* is open to debate:

(275) Smith left the meeting before he lost his temper. Did Smith lose his temper?

[Don't know]

With *when* things are even more complicated. The problem is that it is often very difficult to tease apart the temporal from the causal dimension of *when*, c.f.

(276) When they opened the M25, traffic increased.

7.2.3 'In', 'For' and 'On' Temporal Adverbials

In and *for* adverbials can be used as tests for the aspectual class of verb phrases (or sentences).

(277) Smith lived in Birmingham in 1991. Did Smith live in Birmingham in 1992? [Don't know]

Stative

(278) Smith wrote his first novel in 1991. Did Smith write his first novel in 1992? [No] (Unrepeatable) accomplishment

(279) Smith wrote a novel in 1991. Did Smith write it in 1992? [No] (Unrepeatable) accomplishment

(280) Smith wrote a novel in 1991. Did Smith write a novel in 1992? [Don't know] (Repeatable) accomplishment

- (281) Smith was running a business in 1991. Was Smith running it in 1992? [Don't know] Activity
- (282) Smith discovered a new species in 1991. Did Smith discover it in 1992? [No] (Unrepeatable) achievement
- (283) Smith discovered a new species in 1991. Did Smith discover a new species in 1992? [Don't know] (Repeatable) achievement
- (284) Smith wrote a report in two hours. Smith started writing the report at 8 am. Had Smith finished writing the report by 11 am? [Yes] Accomplishment
- (285) Smith wrote a report in two hours. Did Smith spend two hours writing the report? [Don't know] Smith may have written the report in less than two hours. It is unclear whether there are two different readings for the premise: one where Smith takes exactly two hours, and one where he does it within two hours.
- (286) Smith wrote a report in two hours. Did Smith spend more than two hours writing the report? [No]
- (287) Smith wrote a report in two hours. Did Smith write a report in one hour? [Don't know]

(288) Smith wrote a report in two hours. Did Smith write a report?

[Yes]

(289) Smith discovered a new species in two hours. Did Smith spend two hours discovering the new species [No] Achievements are typically (more or less) instantaneous

(290) Smith discovered a new species in two hours. Did Smith discover a new species [Yes]

(291) Smith discovered many new species in two hours. Did Smith spend two hours discovering new species [?Yes] Repeated achievement can last two hours

(292) Smith was running his own business in two years. Did Smith spend two years running his own business? [Don't know] Premise refers to time taken to inception of activity, not duration of activity.

(293) Smith was running his own business in two years. Did Smith spend more than two years running his own business? [Don't know] Cf similar inference for accomplishment, (286)

(294) Smith was running his own business in two years. Did Smith run his own business?

[Yes]

(295) In two years Smith owned a chain of businesses. Did Smith own a chain of business for two years? [Don't know] States behave like activities.

(296) In two years Smith owned a chain of businesses. Did Smith own a chain of business for more than two years? [Don't know]

(297) In two years Smith owned a chain of businesses. Did Smith own a chain of business?

[Yes]

- (298) Smith lived in Birmingham for two years. Did Smith live in Birmingham for a year? [Yes] State
- (299) Smith lived in Birmingham for two years. Did Smith live in Birmingham for exactly a year? [No]
- (300) Smith lived in Birmingham for two years. Did Smith live in Birmingham? [Yes]
- (301) Smith ran his own business for two years. Did Smith run his own business for a year? [Yes] Activity
- (302) Smith ran his own business for two years. Did Smith run his own business?

[Yes]

- (303) Smith wrote a report for two hours. Did Smith write a report for an hour? [Yes] Accomplishment
- (304) Smith wrote a report for two hours. Did Smith write a report? [Don't know] He may not have finished it
- (305) #Smith discovered a new species for an hour.
- (306) Smith discovered new species for two years. Did Smith discover new species? [Yes]

Repeated achievement

7.2.4 Quantificational Adverbials

(307) In 1994 ITEL sent a progress report every month. Did ITEL send a progress report in July 1994? [Yes]

Quantificational adverbials also introduce scope ambiguities with respect to other quantified NPs

(308) Smith wrote to a representative every week. Is there a representative that Smith wrote to every week? [Yes on one scoping; don't know on another scoping]

7.3 Anaphoric Dimension

Rhetorical relations like narrative progression are defeasible interpretation principles. They depend on a theory of action and causation and general world knowledge (c.f. (309) and (310)).

(309) Smith left the house at a quarter past five.

She took a taxi to the station and caught the first train to Luxembourg.

- (310) Smith lost some files. They were destroyed when her hard disk crashed.
- (311) Smith had left the house at a quarter past five. Then she took a taxi to the station.
 Did Smith leave the house before she took a taxi to the station
 [Yes]

7.4 Adverbs of Quantification

- (312) ITEL always delivers reports late. In 1993 ITEL delivered reports. Did ITEL delivered reports late in 1993? [Yes]
- (313) ITEL never delivers reports late. In 1993 ITEL delivered reports. Did ITEL delivered reports late in 1993? [No]

7.5 Some more Complex Examples

- (314) Smith arrived in Paris on the 5th of May, 1995. Today is the 15th of May, 1995.
 She is still in Paris.
 Was Smith in Paris on the 7th of May, 1995? [Yes]
- (315) When Smith arrived in Katmandu she had been travelling for three days. Had Smith been travelling the day before she arrived in Katmandu? [Yes]

(316)	Jones graduated in March and has been employed ever since. Jones has been unemployed in the past.
	Was Jones unemployed at some time before he graduated? [Yes]
(317)	Every representative has read this report. No two representatives have read it at the same time. No representative took less than half a day to read the report. There are sixteen representatives.
	[Yes]
(318)	While Jones was updating the program, Mary came in and told him about the board meeting. She finished before he did.
	Did Mary's story last as long as Jones's updating the program? [No]
(319)	
()	Before APCOM bought its present office building, it had been paying mortgage interest on the previous one for 8 years. Since APCOM bought its present office building it has been paying mortgage interest on it for more than 10 years. Has APCOM been paying mortgage interest for a total of 15 years or more?
()	Before APCOM bought its present office building, it had been paying mortgage interest on the previous one for 8 years. Since APCOM bought its present office building it has been paying mortgage interest on it for more than 10 years. Has APCOM been paying mortgage interest for a total of 15 years or more? [Yes]
(320)	Before APCOM bought its present office building, it had been paying mortgage interest on the previous one for 8 years. Since APCOM bought its present office building it has been paying mortgage interest on it for more than 10 years. Has APCOM been paying mortgage interest for a total of 15 years or more? [Yes] When Jones got his job at the CIA, he knew that he would never be allowed to write his memoirs. Is it the case that Jones is not and will never be allowed to write his memoirs? [Yes]
(320)	Betore APCOM bought its present office building, it had been paying mortgage interest on the previous one for 8 years. Since APCOM bought its present office building it has been paying mortgage interest on it for more than 10 years. Has APCOM been paying mortgage interest for a total of 15 years or more? [Yes] When Jones got his job at the CIA, he knew that he would never be allowed to write his memoirs. Is it the case that Jones is not and will never be allowed to write his memoirs? [Yes] Smith has been to Florence twice in the past. Smith will go to Florence twice in the coming year.

(322)	Last week I already knew that when, in a months time, Smith would discover that she had been duped she would be furious.
	Will it be the case that in a few weeks Smith will discover
	that she has been duped; and will she be furious? [Yes]
(323)	No one gambling seriously stops until he is broke. No one can gamble when he is broke.
	Does everyone who starts gambling seriously stop
	the moment he is broke?
	[Yes]
(324)	No one who starts gambling seriously stops until he is broke.
	Does everyone who starts gambling seriously continue until he is broke?
	[Yes]
(325)	Nobody who is asleep ever knows that he is asleep.
	But some people know that they have been asleep after they have been asleep.
	Do some people discover that they have been asleep? [Yes]

8 Verbs

8.1 Aspectual Classes

See also the inference pertaining to in and for adverbials.

(326)	ITEL built MTALK in 1993.
	Did ITEL finish MTALK in 1993?
	[Yes]

(327) ITEL was building MTALK in 1993. Did ITEL finish MTALK in 1993? [Don't know] (328) ITEL won the contract from APCOM in 1993. Did ITEL win a contract in 1993?

[Yes]

(329) ITEL was winning the contract from APCOM in 1993. Did ITEL win a contract in 1993?

[Don't know]

(330) ITEL owned APCOM from 1988 to 1992. Did ITEL own APCOM in 1990? [Yes]

8.2 Distributive and Collective Predication

- (331) Smith and Jones left the meeting. Did Smith leave the meeting [Yes]
- (332) Smith and Jones left the meeting. Did Jones leave the meeting [Yes]
- (333) Smith, Anderson and Jones met. Was there a group of people that met? [Yes]

9 Attitudes

9.1 Epistemic, Intentional and Reportive Attitudes

(334) Smith knew that ITEL had won the contract in 1992. Did ITEL win the contract in 1992?

[Yes]

(335)	Smith believed / said / denied / feared / hoped that ITEL had won the contract in 1992.
	Did ITEL win the contract in 1992? [Don't know]
(336)	ITEL managed to win the contract in 1992. Did ITEL win the contract in 1992? [Yes]
(337)	ITEL tried /wanted to win the contract in 1992. Did ITEL win the contract in 1992? [Don't know]
(338)	It is true that ITEL won the contract in 1992. Did ITEL win the contract in 1992? [Yes]
(339)	It is false that ITEL won the contract in 1992. Did ITEL win the contract in 1992? [No]
9.2	Preceptive Attitudes: "See" with Bare Infinitive Comple- ments
9.2.1	Inferences we do not get
(340)	Smith saw Jones sign the contract If Jones signed the contract, his heart was beating Did Smith see Jones' heart beat? [Don't know]
(341)	Smith saw Jones sign the contract When Jones signed the contract, his heart was beating

Did Smith see Jones' heart beat?

 $[{\rm Don't\ know}]$

9.2.2 Veridicality

 $a \operatorname{saw} \phi \to \phi$

9.2.3 Substitution

 $a \operatorname{saw} \phi(b), b = c \to a \operatorname{saw} \phi(c)$

(343) Smith saw Jones sign the contract Jones is the chairman of ITEL Did Smith see the chairman of ITEL sign the contract? [Yes]

9.2.4 Existential instantiation

- $a \operatorname{saw} \phi(b) \to \exists x \ a \operatorname{saw} \phi(x)$
- (344)Helen saw the chairman of the department answer the phone
The chairman of the department is a personIs there anyone whom Helen saw answer the phone?

[Yes]

9.2.5 Conjunction distribution

- $a \ \mathrm{saw} \ \phi \wedge \psi \rightarrow a \ \mathrm{saw} \ \phi \ \mathrm{and} \ a \ \mathrm{saw} \ \psi$
- (345) Smith saw Jones sign the contract and his secretary make a copy Did Smith see Jones sign the contract?

[Yes]

9.2.6 Disjunction distribution

 $a \operatorname{saw} \phi \lor \psi \to a \operatorname{saw} \phi \text{ or } a \operatorname{saw} \psi$

(346) Smith saw Jones sign the contract or cross out the crucial clause Did Smith either see Jones sign the contract or see Jones cross out the crucial clause?

[Yes]