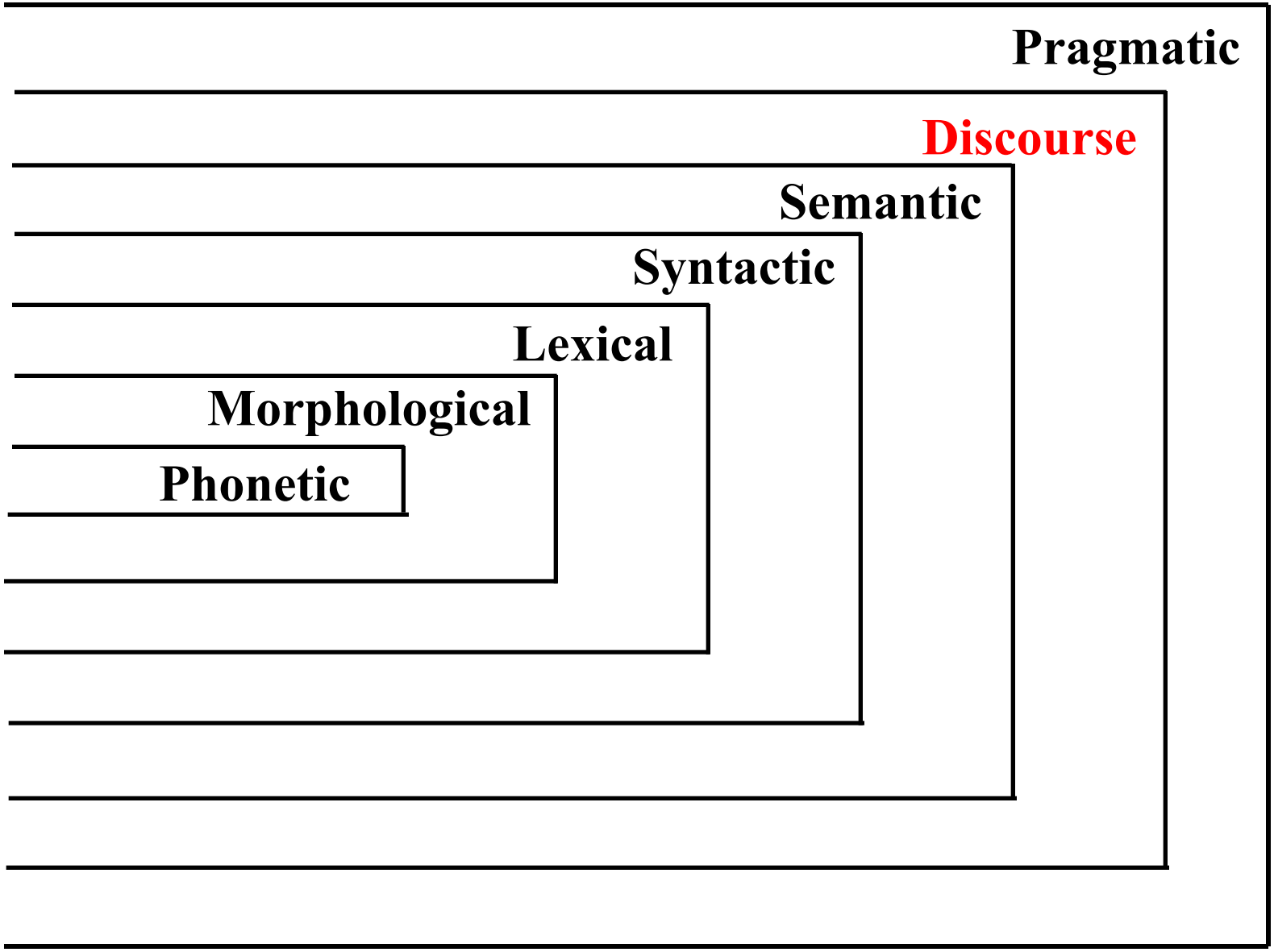
Discourse Linguistics:
Discourse Structure
Text Coherence and Cohesion
Reference Resolution

Synchronic Model of Language



Discourse Linguistics

" *No one is in a position to write a comprehensive account of discourse analysis. The subject is at once too vast, and too lacking in focus and consensus*. " (Stubbs, Discourse Analysis)

Definitional Elements

- Study of texts (linguistic units) larger than a sentence.

- Text is more than a sequence of sentences to be considered one by one.

- Rather, sentences of a text are elements whose significance resides in the contribution they make to the development of a larger whole.

- Texts have their own structure and way of conveying meaning.

- Issues of discourse understanding are closely related to those in pragmatics which studies the real world dependence of utterances.

Syntactician Vs. Discourse Analyst

- Single sentence
- Constructed data
- De-contextualized
- Introspectively evaluated
- Seeks rules
- Sentence-as-object

- Multi-sentence text
- Performance data
- Contextualized
- Existence‘s acceptability
- Seeks regularities
- Text-as-product
- Appeals for theory and methodology to psycholinguistics and sociolinguistics

European School Distinctions Between Text and Discourse

TEXT

- non-interactive monologue
- written

DISCOURSE

- interactive conversation
- spoken

American Linguists call both Discourse

Features which Characterize Spoken Language

1. Less structured syntax, including many incomplete sentences.
2. Little subordination.
3. Preponderance of active declarative forms.
4. Clauses are conjoined by conjunctives such as *and, but, then*, rather than more formal ones such as *firstly, more importantly, in conclusion*.
5. Shorter noun phrases with many fewer premodifiers.
6. Speaker continues to refine expressions (*this man, Uh, this fellow she was going out with*).
7. A good deal of rather generalized vocabulary, such as *a lot of, got to, thing, do, stuff*.
8. Many fillers, such as *well, ahem, I think, you know, of course.*

Scope of Discourse Analysis

- What does discourse analysis extract from text more than the explicit information discoverable by sentence-level syntax and semantics methodologies?
  - Structural organization of the text
  - Overall topic(s) of the text
  - Features which provide *cohesion* to the text
- What linguistic features of texts reveal this information to the analyst?

Discourse Structure

- Human discourse often exhibits structures that are intended to indicate common experiences and respond to them
  - For example, research abstracts are intended to inform readers in the same community as the authors and who are engaged in similar work
- Empirical study in dissertation by Liz Liddy identifies discourse structure of research abstracts
  - Hierarchical, componential text structure
  - See Appendix 1 of Oddy, Robert N., "Discourse Level Analysis of Abstracts for Information Retrieval: A Probabilistic Approach", p. 23

Discourse Segmentation

- Documents are automatically separated into passages, sometimes called fragments, which are different discourse segments
- Techniques include
  - Rule-based systems based on clue words and phrases
  - Probabilistic techniques to separate fragments and to identify discourse segments (Oddy)
  - TextTiling algorithm uses cohesion to identify segments, assuming that each segment exhibits lexical cohesion within the segment, but is not cohesive across different segments
    - Lexical cohesion score – average similarity of words within a segment
    - Boundary identification

Cohesion

- "A piece of text is intended and is perceived as more than a simple sequencing of independent sentences."
- Therefore, a text will exhibit unity / texture
  - on the surface level (cohesion)
  - at the meaning level (coherence)
- Halliday & Hasan's Cohesion in English (1976)
  - Sets forth the linguistic devices that are available in the English language for creating this unity / texture
  - Identifies the features in a text that contribute to an intelligent comprehension of the text
  - For generation, produces natural-sounding texts

Cohesive Relations

- Exist between elements in a text where the interpretation of one is dependent on others

"He said so."

- "*He*" and "*so*" presuppose elements in the preceding text for their understanding
- This presupposition and the presence of information elsewhere in text to resolve this presupposition provide COHESION

  - Part of the discourse-forming component of the linguistic system

  - Provides the means whereby structurally unrelated elements are linked together

6 Types of Cohesive Ties

GRAMMATCIAL

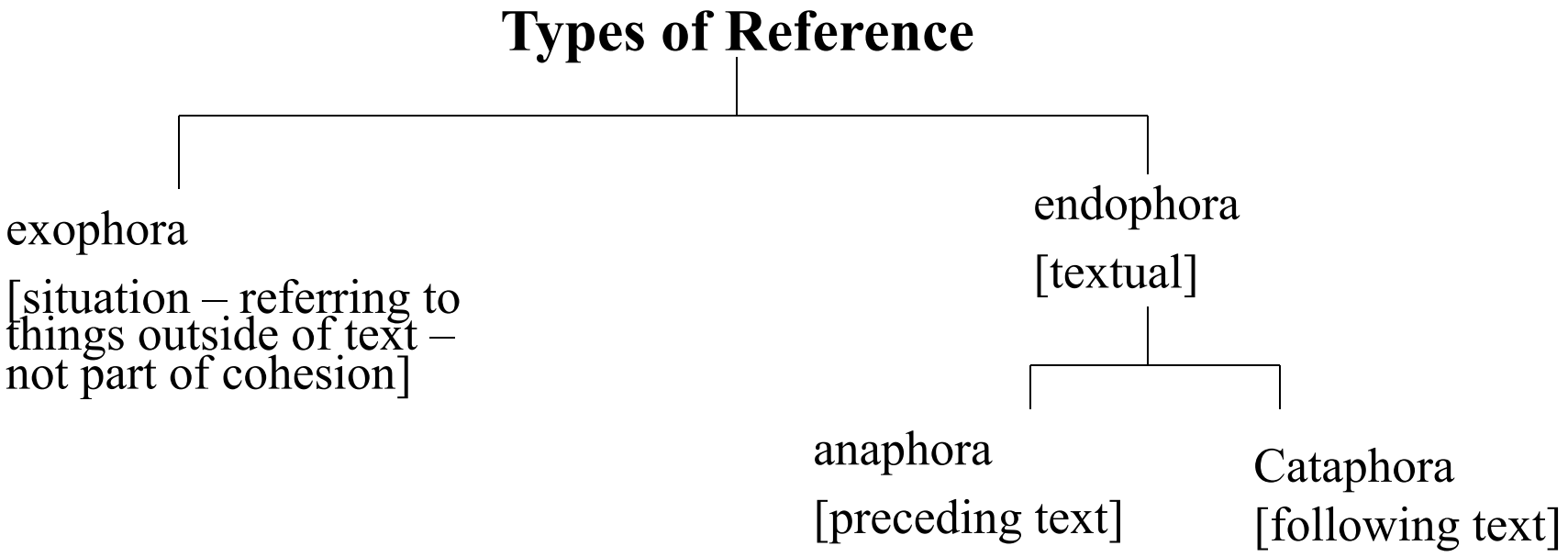
- reference
- substitution
- ellipsis
- conjunction

LEXICAL

- reiteration
- collocation

1. Reference – items in a language which, rather than being interpreted in their own right, make reference to something else for their interpretation.

"Doctor Foster went to Gloucester in a shower of rain. He stepped in a puddle right up to his middle and never went there again."



2. Substitution: a substituted item that serves the same structural function as the item for which it is substituted.

Nominal – *one, ones, same*

Verbal – *do*

Clausal – *so, not*

- *These biscuits are stale. Get some fresh ones.*
- Person 1 – *I'll have two poached eggs on toast, please.*

  Person 2 – *I'll have the same.*
- *The words did not come the same as they used to do. I don't know the meaning of half those long words, and what's more, don't believe you do either, said Alice.*

3. Ellipsis

- Very similar to substitution principles, embody same relation between parts of a text
- Something is left unsaid, but understood nonetheless
    - But limited subset of these instances
    - An elliptical item is one which leaves specific structural slots to be filled from elsewhere else
- As compared to substitution, where a place-marker is inserted in the structural slot
    - In ellipsis, substitution by zero.
- Types
    - Nominal
    - Verbal
    - Clausal

Ellipsis Examples

- *Smith was the first person to leave. I was the second _____.*
- *Joan brought some carnations and Catherine _____ some sweet peas.*
- *Who is responsible for sales in the Northeast? I believe Peter Martin is _____.*

4. Conjunction

- Different kind of cohesive relation
- Not a search instruction
- Rather, a specification of the way the text that follows is systematically connected to what has preceded

For the whole day he climbed up the steep mountainside, almost without stopping.

And in all this time he met no one.

Yet he was hardly aware of being tired.

So by night the valley was far below him.

Then, as dusk fell, he sat down to rest.

Now, 2 types of Lexical Cohesion

- Concerned with cohesive effects achieved by selection of vocabulary

5. Reiteration continuum –

I attempted an ascent of the peak. _X__ was easy.

- same lexical item – *the ascent*
- synonym – *the climb*
- super-ordinate term – *the task*
- general noun – *the act*
- pronoun - *it*

6. Collocations

- Lexical cohesion achieved through the association of semantically related lexical items
- Accounts for any pair of lexical items that exist in some lexico-semantic relationship, e. g.
  - complementaries
    - *boy / girl*
    - *stand-up / sit-down*
  - antonyms
    - *wet / dry*
    - *crowded / deserted*
  - converses
    - *order / obey*
    - *give / take*

Collocations (cont'd)

- pairs from ordered series

    Tuesday / Thursday

    sunrise / sunset

- part-whole

    brake / car

    lid / box

- co-hyponyms of same super-ordinate

    chair / table (furniture)

    walk / drive (go)

Uses of Cohesion Theory

1. Halliday & Hasan's theory has been captured in a coding scheme
   - is used to quantitatively measure the extent of cohesion in a text.
   - ETS has experimented with it as a metric in grading standardized test essays.
2. When building a semantic representation of a text, the theory suggests how the system can recognize relations between entities.

   - indicates **what** is related

   - suggests **how** they are related
3. Provides guidance to a NL Generation system so that the system can produce naturally cohesive text.
4. Delineates (for English) how the cohesive features of the language can be recognized and utilized by an MT system.

Coherence Relations

- The set of possible relations between the meanings of different utterances in the text
- Hobbs (1979) suggests relations such as
  - Result: state in first sentence could cause the state in a second sentence
  - Explanation: the state in the second sentence could cause the first

    John hid Bill's car keys. He was drunk.
  - Parallel: The states asserted by two sentences are similar

    The Scarecrow wanted some brains. The Tin Woodsman wanted a heart.
  - Elaboration: Infer the same assertion from the two sentences.

Anaphora / Reference Resolution

- A linguistic phenomenon of abbreviated subsequent reference
  - A cohesive tie of the grammatical type
  - A technique for referring back to an entity which has been introduced with more fully descriptive phrasing earlier in the text
  - Refers to this same entity but with a lexically and semantically attenuated form

Types of Entity Resolutions

- **Entity Resolution** is an ability of a system to recognize and unify variant references to a single entity.

- 2 levels of resolution:
  - within document (**co-reference resolution**)
    - e.g. *Bin Ladin = he*
    - *his followers = they*
    - *terrorist attacks = they*
    - *the Federal Bureau of Investigation = FBI = F.B.I*
  - across document (or **named entity resolution**)
    - e.g. *maverick Saudi Arabian multimillionaire = Usama Bin Ladin = Bin Ladin*
- **Event resolution** is also possible, but not widely used

Examples from Contexts

1. **The State Department** renewed **its** appeal for **Bin Laden** on Monday and warned of possible fresh attacks by **his** followers against U.S. targets.

…

2. One early target of the F.B.I.'s Budapest office is expected to be **Semyon Y. Mogilevich**, **a Russian citizen who** has operated out of Budapest for a decade. Recently **he** has been linked to the growing money-laundering investigation in the United States involving the Bank of New York. **Mr. Mogilevich** is also the target of a separate money laundering and financial fraud investigation by the F.B.I. in Philadelphia, according to federal officials.

…

3. **The F.B.I.** will also have the final say over the hiring and firing of the 10 Hungarian agents who will work **in the office**, alongside five American agents. **The bureau** has long had agents posted in American embassies

Glossary of Terminology

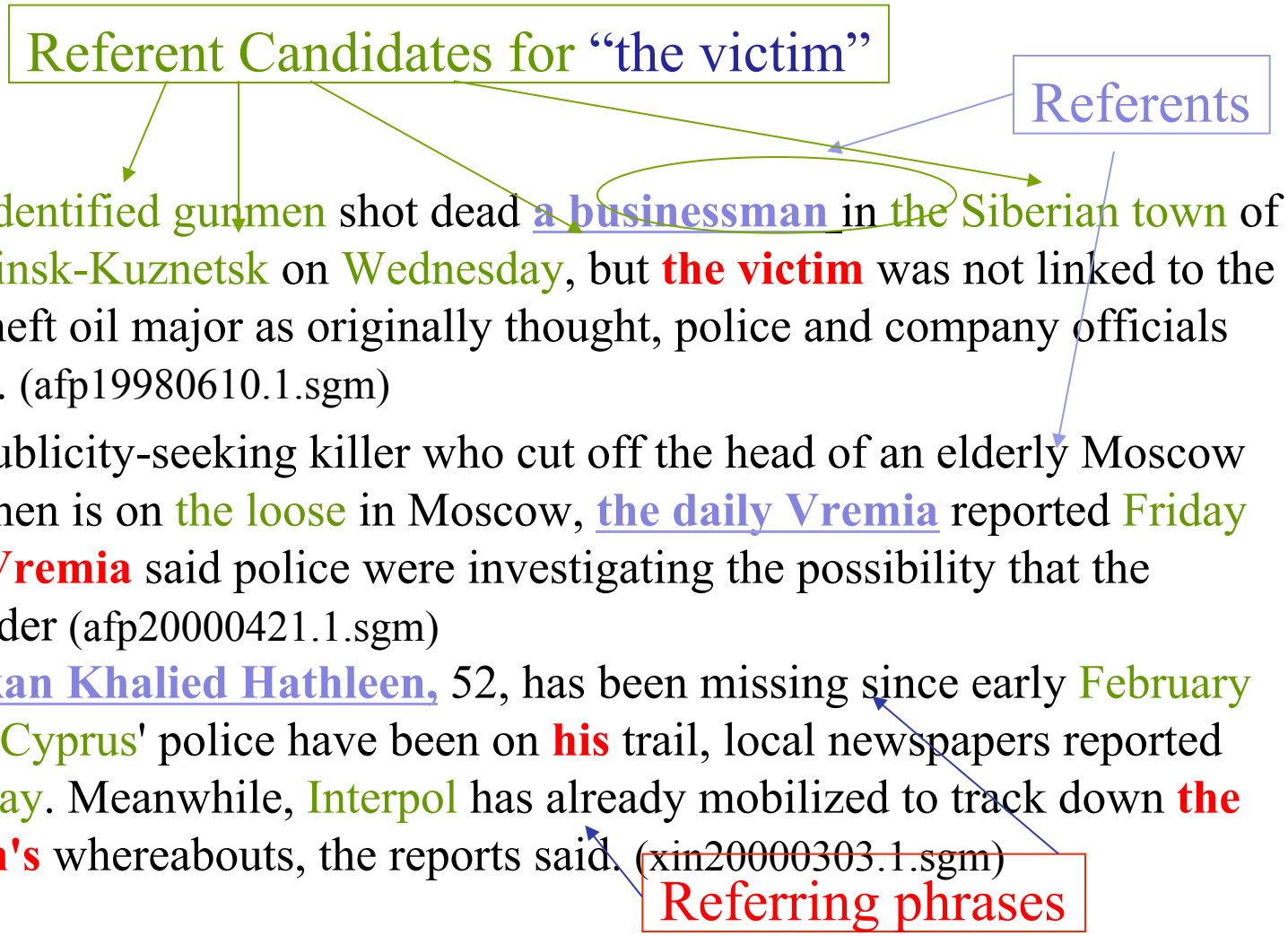
- *Referring phrase = Anaphora = Anaphoric Expression = Co-reference = Coreference*
  - an expression that identifies an earlier mentioned entity (including pronouns and definite noun phrases)

- *Referent = Antecedents* entity that a referring phrase refers back to

- *Referent Candidates* - all potential entities / antecedents that a referring phrase could refer to

- *Alias = Named Entity* - a cross document co-reference
  - includes proper names (mostly)

Terminology Examples



- Unidentified gunmen shot dead **a businessman** in the Siberian town of Leninsk-Kuznetsk on Wednesday, but **the victim** was not linked to the Sibneft oil major as originally thought, police and company officials said. (afp19980610.1.sgm)
- A publicity-seeking killer who cut off the head of an elderly Moscow women is on the loose in Moscow, **the daily Vremia** reported Friday … **Vremia** said police were investigating the possibility that the murder (afp20000421.1.sgm)
- **Rakan Khalied Hathleen,** 52, has been missing since early February and Cyprus' police have been on **his** trail, local newspapers reported Friday. Meanwhile, Interpol has already mobilized to track down **the man's** whereabouts, the reports said. (xin20000303.1.sgm)

Reference Types

Definite noun phrases – the X

- Definite reference is used to refer to an entity identifiable by the reader because it is either
  - a) already mentioned previously (in discourse), or
  - b) contained in the reader's set of beliefs about the world (pragmatics), or
  - c) the object itself is unique. (Jurafsky & Martin, 2000)
- E.g.
  - Mr. Torres and his companion claimed **a hardshelled black vinyl suitcase$_1$**. The police rushed **the suitcase$_1$** (a) to **the Trans-Uranium Institute$_2$** (c) where experts cut **it$_1$** open because they did not have the combination to the locks.

  - **The German authorities$_3$** (b) said **a Colombian$_4$** who had lived for a long time in **the Ukraine$_5$** (c) flew in from Kiev. He had **300 grams of plutonium 239$_6$** in his baggage. **The suspected smuggler$_4$** (a) denied that **the materials$_6$** (a) were his.

Pronominalization

- **Pronouns** refer to entities that were introduced fairly recently, 1-4-5-10(?) sentences back.
  - ***Nominative*** (he, she, it, they, etc.)
    - e.g. The German authorities said **a Colombian**$_1$ who had lived for a long time in the Ukraine flew in from Kiev. **He**$_1$ had 300 grams of plutonium 239 in his baggage.
  - ***Oblique*** (him, her, them, etc.)
    - e.g. Undercover investigators negotiated with **three members of a criminal group**$_2$ and arrested **them**$_2$ after receiving the first shipment.
  - ***Possessive*** (his, her, their, etc. + hers, theirs, etc.)
    - e.g. **He**$_3$ had 300 grams of plutonium 239 in **his**$_3$ baggage. The suspected smuggler$_3$* denied that the materials were **his**$_3$. ***(*chain)***
  - ***Reflexive*** (himself, themselves, etc.)
    - e.g. There appears to be a growing problem of **disaffected loners**$_4$ who cut **themselves**$_4$ off from all groups .

Indefinite noun phrases – a X, or an X

- Typically, an indefinite noun phrase introduces a new entity into the discourse and would not be used as a referring phrase to something else
  - The exception is in the case of cataphora:
    A Soviet pop star was killed at a concert in Moscow last night. Igor Talkov was shot through the heart as he walked on stage.
  - Note that cataphora can occur with pronouns as well:
    When he visited the construction site last month, Mr. Jones talked with the union leaders about their safety concerns.

Demonstratives – this and that

- Demonstrative pronouns can either appear alone or as determiners

  this ingredient, that spice

- These NP phrases with determiners are ambiguous
  - They can be indefinite
    I saw this beautiful car today.
  - Or they can be definite
    I just bought a copy of Thoreau's Walden. I had bought one five years ago. That one had been very tattered; this one was in much better condition.

Names

- Names can occur in many forms, sometimes called name variants.

  Victoria Chen, Chief Financial Officer of Megabucks Banking Corp. since 2004, saw her pay jump 20% as the 37-year-old also became the Denver-based financial-services company's president. Megabucks expanded recently . . . MBC . . .

  - (Victoria Chen, Chief Financial Officer, her, the 37-year-old, the Denver-based financial-services company's president)
  - (Megabucks Banking Corp. , the Denver-based financial-services company, Megabucks, MBC)
  -

- Groups of a referrent with its referring phrases are called a coreference group.

Unusual Cases

- Compound phrases

  John and Mary got engaged. They make a cute couple.
  John and Mary went home. She was tired.

- Singular nouns with a plural meaning

  The focus group met for several hours. They were very intent.

- Part/whole relationships

  John bought a new car. A door was dented.

  Four of the five surviving workers have asbestos-related diseases, including three with recently diagnosed cancer.

Approach to coreference resolution

- Naively identify all referring phrases for resolution:
  - all Pronouns
  - all definite NPs
  - all Proper Nouns
- Filter things that look referential but, in fact, are not
  - e.g. geographic names, *the United State*
  - pleonastic “it”, e.g. *it’s 3:45 p.m., it was cold*
  - non-referential “it”, “they”, “there”
    - e.g. *it was essential, important, is understood,*
    - *they say,*
    - *there seems to be a mistake*

Identify Referent Candidates

- All noun phrases (both indef. and def.) are considered potential referent candidates.
- A referring phrase can also be a referent for a subsequent referring phrases,
  - e.g. He3 had 300 grams of plutonium 239 in his3 baggage.
  - The suspected smuggler3 & 4* denied that the materials were his4. (*chain)
- All potential candidates are collected in a table collecting feature info on each candidate.
- Problems:
  - chunking
    - e.g. the Chase Manhattan Bank of New York
  - nesting of NPs

Features

- Define features between a refering phrase and each candidate
  - Number agreement: plural, singular or neutral
    - He, she, it, etc. are singular, while we, us, they, them, etc. are plural and should match with singular or plural nouns, respectively
    - Exceptions: some plural or group nouns can be referred to by either it or they

      IBM announced a new product. They have been working on it …
  - Gender agreement:
    - Generally animate objects are referred to by either male pronouns (he, his) or female pronouns (she, hers)
    - Inanimate objects take neutral (it) gender
  - Person agreement:
    - First and second person pronouns are “I” and “you”
    - Third person pronouns must be used with nouns

More Features

- Binding constraints
  - Reflexive pronouns (himself, themselves) have constraints on which nouns in the same sentence can be referred to:
    John bought himself a new Ford. (John = himself)
    John bought him a new Ford. (John cannot = him)
- Recency
  - Entities situated closer to the referring phrase tend to be more salient than those further away
    - And pronouns can't go more than a few sentences away
- Grammatical role / Hobbs distance
  - Entities in a subject position are more likely than in the object position

Even more features

- Repeated mention
  - Entities that have been the focus of the discourse are more likely to be salient for a referring phrase
- Parallelism
  - There are strong preferences introduced by parallel constructs
    Long John Silver went with Jim. Billy Bones went with him.
    (him = Jim)
- Verb Semantics and selectional restrictions
  - Certain verbs take certain types of arguments and may prejudice the resolution of pronouns
    John parked his car in the garage after driving it around for hours.

Example: rules to assign gender info

- Assign gender to “masculine”,
  - if it is a pronoun “he, his, him”
  - if it contains markers like “Mr.”
  - if the first name belongs to a list of masculine names
- Same for “feminine” and “neuter” (except for latter use categories such as singular, geo names, company names, etc.)
- Else, assign “unknown”

Approaches

- Assign weights to the features and resolve the referring phrase to the candidate which achieves the highest score by summing over the weighted features
- Train a classifier over an annotated corpus to identify which candidates and referring phrases are in the same coreference group
  - Evaluation results (for example, Vincent Ng at ACL 2005) are on the order of F-measure of 70, with generally higher precision than recall
  - Evaluation typically uses the B-Cubed scorer introduced by Bagga and Baldwin, which compares coreference groups
  - Pronoun coreference resolution by itself is much higher scoring.

Example of an early CNLP Weighting Scheme

The system calculates a score for each candidate referent and picks the highest score as a resolution:

	Factors	(value of factors)		Weights
Total Score =	animacy	(1.0)	*	0.5 +
	Number	(1.0)	*	0.5 +
	gender	(1.0)	*	1.0 +
	recency	(0-1)	*	1.0 +
	head	(1.0)	*	2.0 +
	CNLPCatMatch	(-1.0 or 1.0)	*	1.0 +
	RepMention	(1-12)	*	0.1
	All Pro focus	(1.0)	*	0.5 (same sentence)
			*	0.2 (previous sentence)

etc...

Experimentally established a threshold for no resolution to avoid false alarms. (This scheme was later replaced by a classifier, using the same features.)