Thematic Roles in Linguistics

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Outline

- Fillmore – Cases
  - useful generalizations, fewer sense distinctions,
- Jackendoff – Lexical Conceptual Structure
  - Thematic roles are defined by the predicates they are arguments to
- Dowty – Proto-typical Agents and Patients
  - A bag of “agentive” entailments
- Levin – Verb classes based on syntax
  - syntactic behavior is a reflection of the underlying semantics

Lexical Conceptual Structures,

Ray Jackendoff

- Decomposition into primitive semantic predicates – Thematic Relations
- Thematic roles inherit their meaning from the relations they are in

Semantic Decomposition

- Markers

  $\begin{bmatrix} \text{HORSE} \\ \text{RED} \end{bmatrix}$ *the red horse*

- Functions

  SEE(x,y) *the man saw the (red) horse*

  SEE(x,HORSE)

  SEE(THE MAN,THE HORSE)

  SEE(X1, Y1)

Five Semantic Functions

- GO
- BE
- STAY
- LET
- CAUSE

GO – Change of location

The train traveled from Detroit to Cincinatti.

The hawk flew from its nest to the ground.

An apple fell from the tree to the ground.

The coffee filtered from the funnel into the cup.

GO (x,y,z)

THROUGH THE AIR/DOWNWARD

THEME **GOES** FROM SOURCE, TO GOAL

Full representation

[event GOPOSIT

([$_{thing}$ John],

[$_{path}$ FROM ([place AT (Denver)])],

[$_{path}$ TO ([place AT (San Francisco)])])

[MANNER: Drivingly]]

Satellite framed vs. Verb framed motion verbs – *basis of LCS Interlingua*

Verb-framed: French, Spanish

GO (Theme,Source,**Goal**)

Manner

Traverse the lake by swimming

- Satellite-framed: English

GO (Theme,Source,Goal)

Manner

Swim across the lake.

Mapping from Syntax to Semantics

/flaj/

+ V

+ [NP^1____ (from NP^2) (to NP^3)]

GO (NP^1,NP^2,NP^3)

THROUGH THE AIR

BE – Stationary location

Max is in Africa.

The vine clung to the wall.

The dog is on the left of the cat.

The circle contains/surrounds the dot?

BE(x,y)

THEME IS AT LOCATION

BE (THE DOG, LEFT OF (THE CAT))

STAY – Durational stationary location

The bacteria stayed in his body.

Stanley remained in Africa.

Bill kept the book on the shelf.

STAY(x,y)

THEME IS AT LOCATION for a duration

STAY (STANLEY, AFRICA) (for two years)

Locational modes: POSIT, POSS, ID

The train traveled from Detroit to Cincinatti.

[GO (x,y,z)
  POSIT]

Harry gave the book to the library.

[GO (x,y,z)
  POSS]

The book belonged to the library..

[BE (x,z)
  POSS]

Locational modes: POSIT, POSS, ID

The bacteria stayed in his body.

[STAY (x,z)
  POSIT]

The library kept the book.

[STAY (x,z)
  POSS]

Locational modes: POSIT, POSS, ID

**The coach changed from a handsome young man to a pumpkin.*

$[GO_{IDENT}\ (x,y,z)]$

Princess Mia changed from an ugly duckling into a swan.

$[GO_{IDENT}\ (x,y,z)]$

Universal grammar?

Causation and Permission

CAUSE and LET

The rock fell from the roof to the ground.

$[GO_{POSIT}\ (x,y,z)]$

Linda lowered the rock from the roof to the ground.

$[CAUSE\ (a,\ GO_{POSIT}\ (x,y,z))]$

Linda dropped the rock from the roof to the ground.

$[LET\ (a,\ GO_{POSIT}\ (x,y,z))]$

INSTRUMENTS

Linda lowered the rock from the roof to the ground with a cable.

$$\left[\begin{array}{l} \text{CAUSE}(a, \text{GO}_{\text{POSIT}}(x,y,z)) \\ \text{Inst: } i \end{array}\right]$$

Instruments only occur with causation.

CAUSE always has an *event* second argument.

Dollie caused Martin to be happy.

Lexical Conceptual Structure

concept	POSIT	POSS	IDENT
GO	go	receive	become
motional	fall	inherit	change
BE	be	have	be
punctual	contain	own	seem
STAY	stay	keep	stay
durational	remain		remain
CAUSE(a,GO)	bring, take	obtain, give	make,elect
CAUSE(a,STAY)	keep, hold	keep, retain	keep
LET(a,GO)	drop,release	accept, fritter	
LET(a,BE)	leave, allow	permit	leave

Rules of inference

CAUSE(a, event) -> event.

Issues

- Ducks vs. Geese?
- Abstract concepts?

Thematic Proto-Roles and Argument Selection, *David Dowty*

- Role definitions have to be determined verb by verb, and with respect to the other roles

  - Thanks to Michael Mulyar for slides

Context of Dowty's work

- Thematic relations
  - (Gruber 1965, Jackendoff 1972)
- Traditional thematic roles types include:
  - Agent, Patient, Goal, Source, Theme, Experiencer, Instrument
- "Argument-Indexing View": thematic roles objects at syntax-semantics interface, determining a syntactic derivation or the linking relations.

Problems with Thematic Role Types

- Fragmentation: Cruse (1973) subdivides Agent into four types.
- Ambiguity: Andrews (1985) is Extent, an adjunct or a core argument?
- Symmetric stative predicates: e.g. “This is similar to that” Distinct roles or not?
- Searching for a Generalization: What is a Thematic Role?

Proto-Roles

- Event-dependent Proto-roles introduced
- Prototypes based on shared entailments
- Grammatical relations such as subject related to observed (empirical) classification of participants
- Typology of grammatical relations
- Proto-Agent
- Proto-Patient

Proto-Agent

- Properties
  - Volitional involvement in event or state
  - Sentience (and/or perception)
  - Causing an event or change of state in another participant
  - Movement (relative to position of another participant)
  - (exists independently of event named)

    *may be discourse pragmatic

Proto-Patient

- Properties:
  - Undergoes change of state
  - Incremental theme
  - Causally affected by another participant
  - Stationary relative to movement of another participant
  - (does not exist independently of the event, or at all) *may be discourse pragmatic

Argument Selection Principle

- For 2 or 3 place predicates
- Based on empirical count (total of entailments for each role).
  - Greatest number of Proto-Agent entailments → Subject;
  - greatest number of Proto-Patient entailments → Direct Object.
- Alternation predicted if number of entailments for each role similar (non-discreteness).

Worked Example: Psychological Predicates

Examples:

Experiencer Subject	Stimulus Subject
x likes y	*y pleases x*
x fears y	*y frightens x*

Describes “almost the same” relation

Experiencer: sentient (P-Agent)

Stimulus: causes emotional reaction (P-Agent)

Number of proto-entailments same; but for stimulus subject verbs, experiencer also undergoes change of state (P-Patient) and is therefore lexicalized as the patient.

Diathesis Alternations

Alternations:

- Spray / Load
- Hit / Break

Non-alternating:

- Swat / Dash
- Fill / Cover

Spray / Load Alternation

Example:

Mary loaded the hay onto the truck.
Mary loaded the truck with hay.

Mary sprayed the paint onto the wall.
Mary sprayed the wall with paint.

- Analyzed via proto-roles, not e.g. as a theme / location alternation.
- Direct object analyzed as an Incremental Theme, i.e. either of two non-subject arguments qualifies as incremental theme. This accounts for alternating behavior.

Hit / Break Alternation

John hit the fence with a stick.

John hit the stick against a fence.

John broke the fence with a stick.

John broke the stick against the fence.

- Radical change in meaning associated with *break* but not *hit*.
- Explained via proto-roles (change of state for direct object with break class).

Fill / Cover

Fill / Cover are non-alternating:

Bill filled the tank (with water).

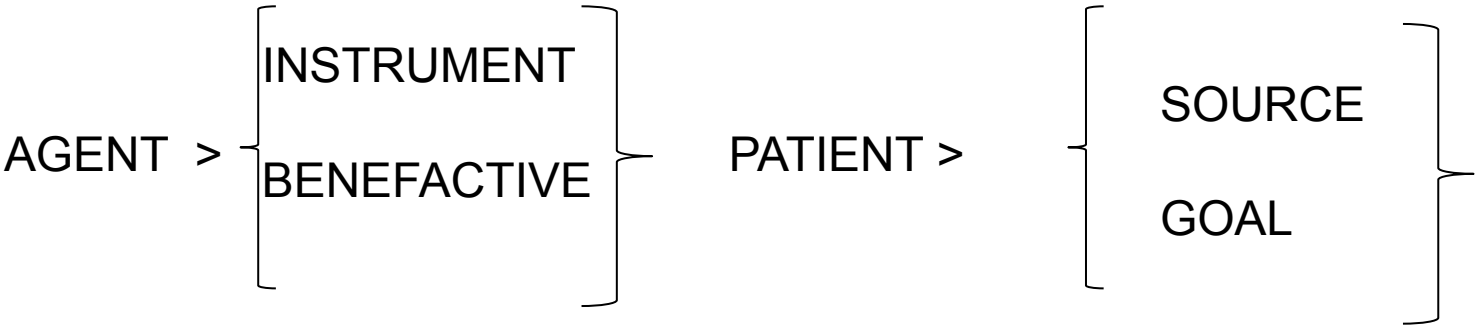
**Bill filled water (into the tank).*

Bill covered the ground (with a tarpaulin).

**Bill covered a tarpaulin (over the ground).*

- Only goal lexicalizes as incremental theme (direct object).

Dowty's Hierarchy (English)

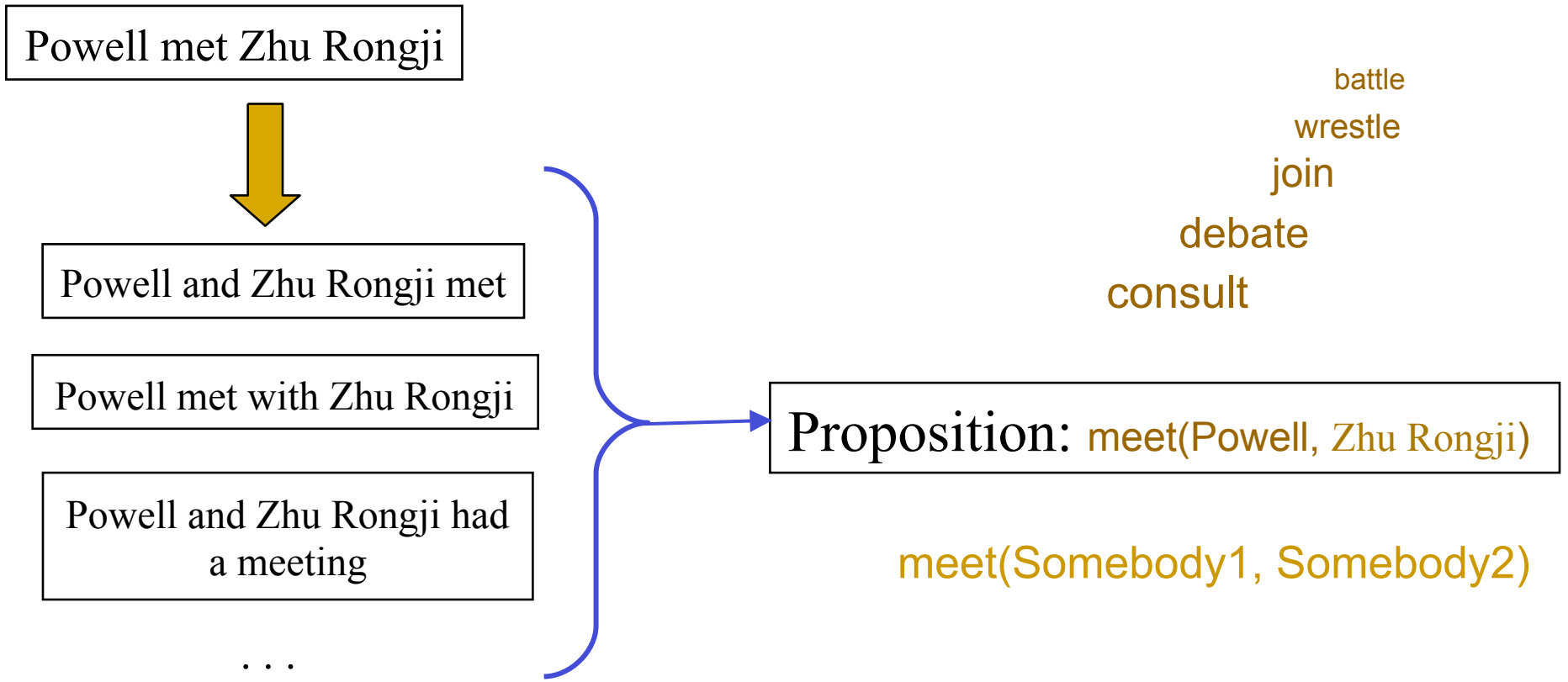


Conclusion

- Dowty argues for Proto-Roles based on linguistic and cognitive observations.
- Three main areas of analysis: symmetric predicates, diathesis alternations, unaccusativity
- Objections: Are P-roles empirical (*hit* class)? Are P-roles event dependent (possibly in need of revision, e.g. something like p-patients named by event vs. p-patients defined by event)?

Motivation: From Sentences to Propositions

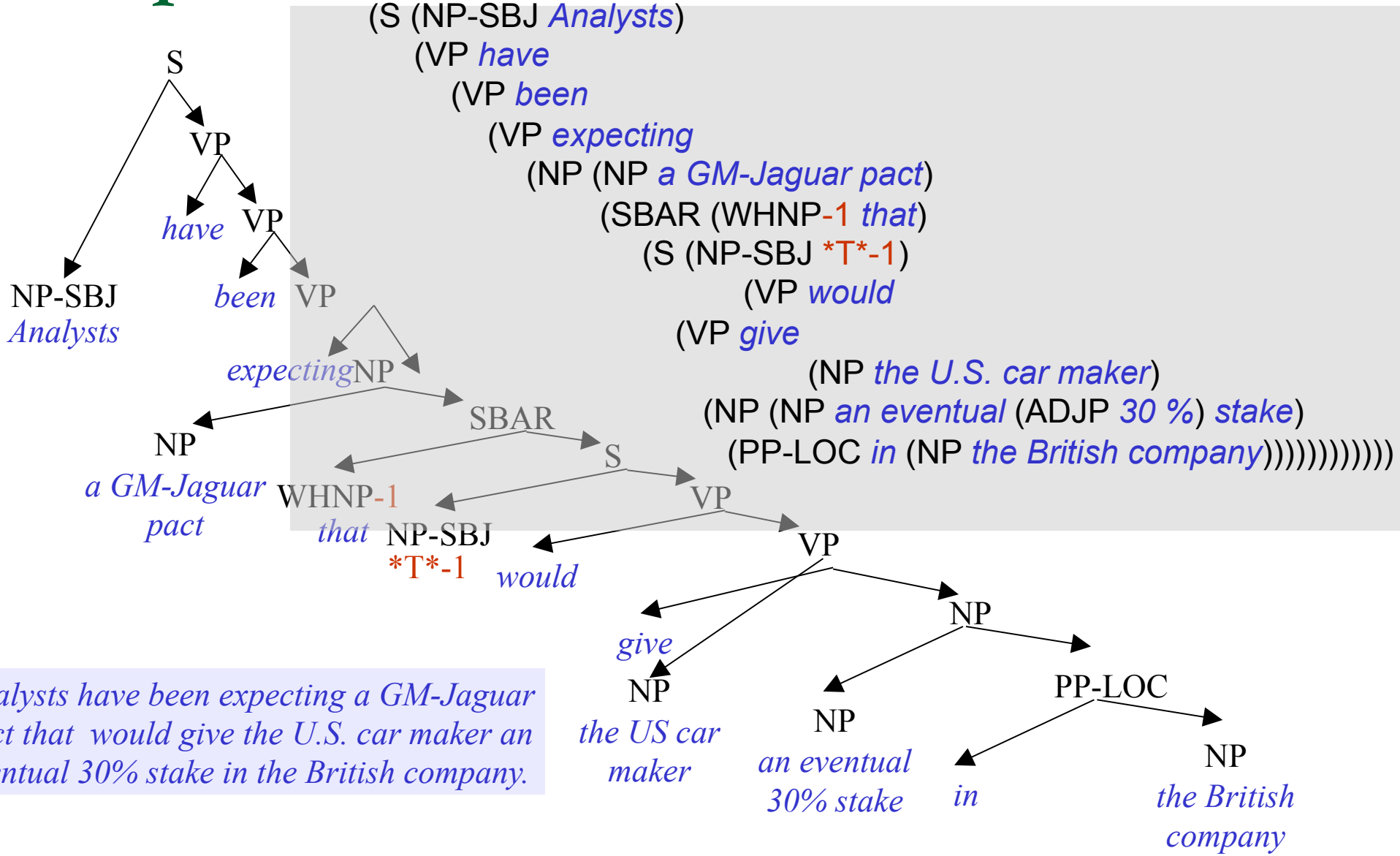
Who did what to whom, when, where and how?



When Powell met Zhu Rongji on Thursday they discussed the return of the spy plane.

meet(Powell, Zhu) discuss([Powell, Zhu], return(X, plane))

PropBank - A TreeBanked Sentence



Analysts have been expecting a GM-Jaguar pact that would give the U.S. car maker an eventual 30% stake in the British company.

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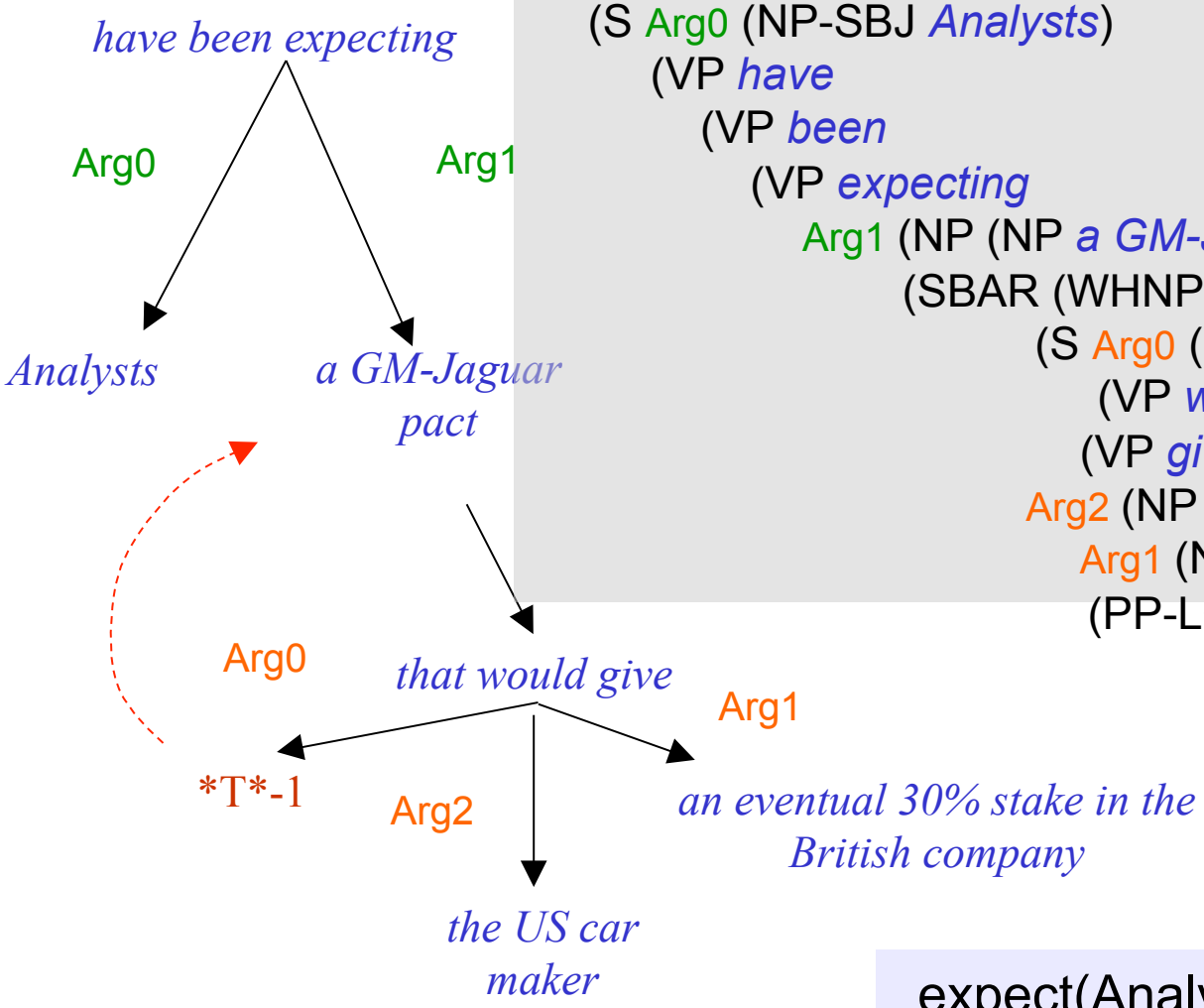
The same sentence, PropBanked



(S Arg0 (NP-SBJ *Analysts*)
(VP *have*
(VP *been*
(VP *expecting*
Arg1 (NP (NP *a GM-Jaguar pact*)
(SBAR (WHNP-1 *that*)
(S Arg0 (NP-SBJ *T*-1)
(VP *would*
(VP *give*
Arg2 (NP *the U.S. car maker*)
Arg1 (NP (NP *an eventual* (ADJP *30 %*) *stake*)
(PP-LOC *in* (NP *the British company*))))))))))))

expect(Analysts, GM-J pact)
give(GM-J pact, US car maker, 30% stake)

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PropBank roles – based on Dowty

- PropBank Frame for *break*:

Frameset **break.01** “break, cause to not be whole":
Arg0: breaker
Arg1: thing broken
Arg2: instrument
Arg3: pieces

- Why numbered arguments?
  - Lack of consensus concerning semantic role labels
  - Numbers correspond to verb-specific labels
  - Arg0 – Proto-Agent, and Arg1 – Proto-Patient, (Dowty, 1991)
  - Args 2-5 are highly variable and overloaded – poor performance

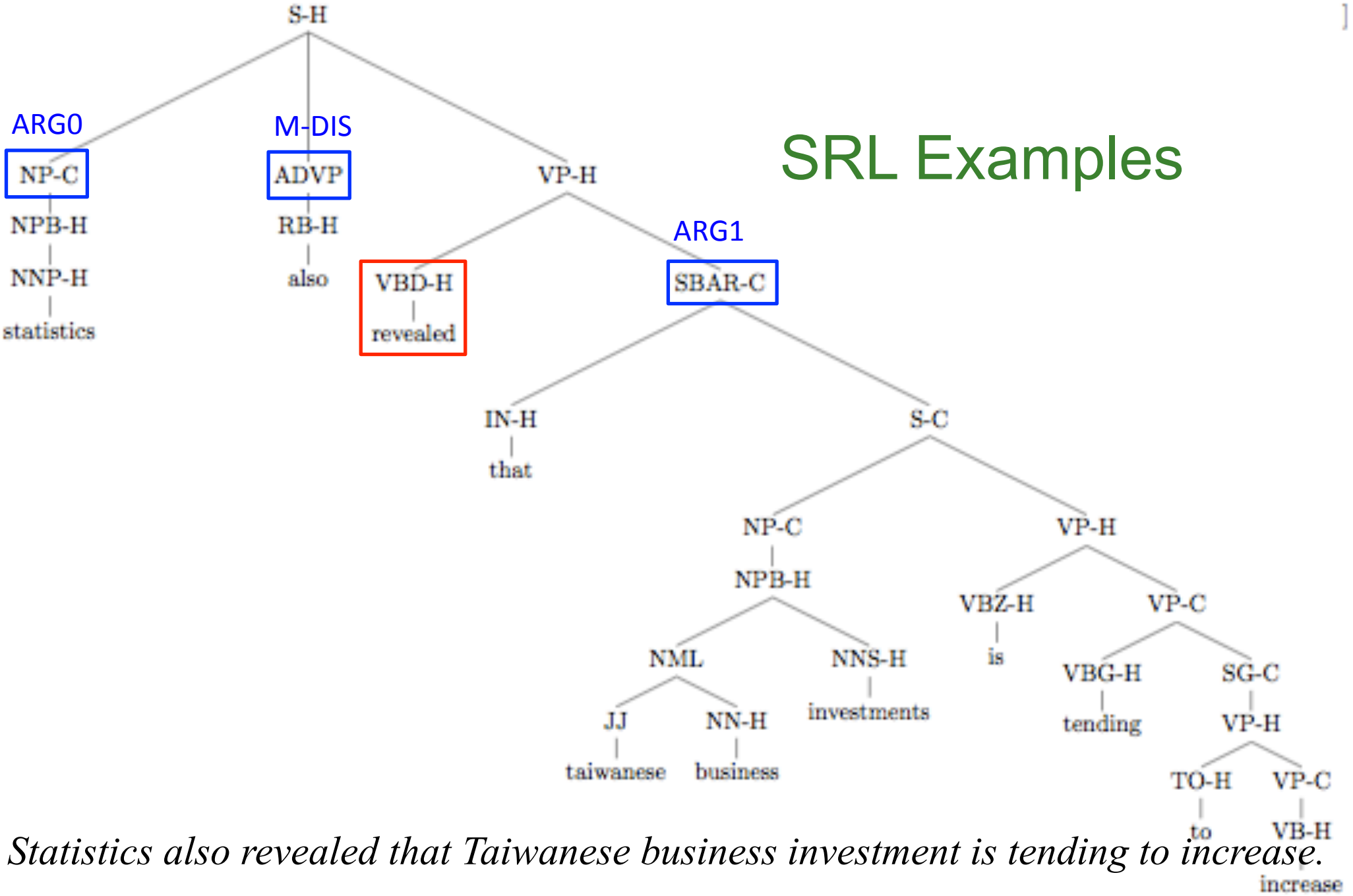
Consistent argument labels across different syntactic realizations

- Uuuuuusually…
  - Arg0 = agent, experiencer
  - Arg1 = patient, theme
  - Arg2 = benefactive / instrument / attribute / end state
  - Arg3 = start point / benefactive / instrument / attribute
  - Arg4 = end point

Function tags for modifiers

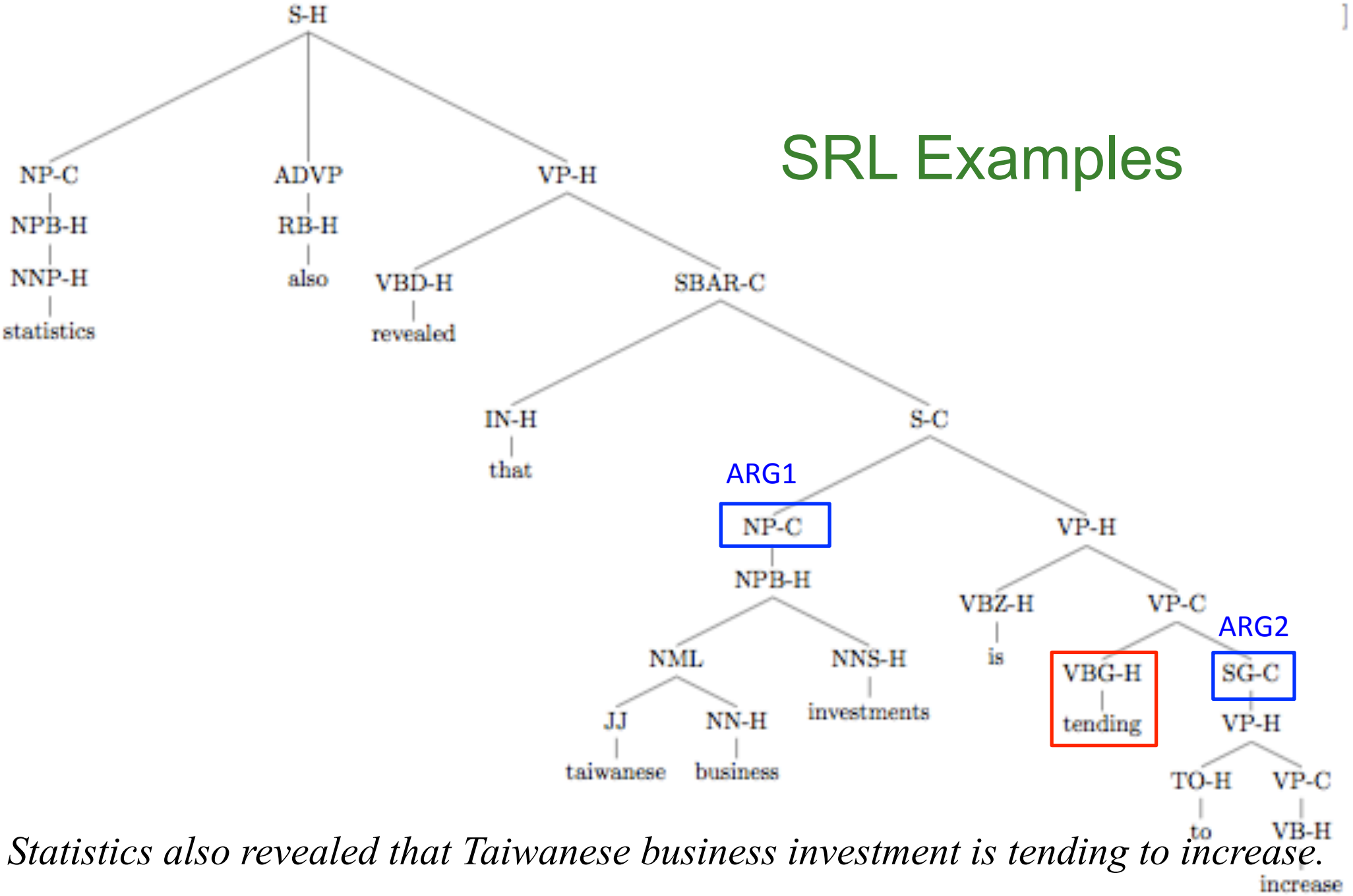
- Variety of ArgM's:
  - TMP - when? *yesterday, 5pm on Saturday, recently*
  - LOC - where? *in the living room, on the newspaper*
  - DIR - where to/from? *down, from Antartica*
  - MNR - how? *quickly, with much enthusiasm*
  - PRP/CAU -why? *because … , so that …*
  - REC - himself, themselves, each other
  - GOL - end point of motion, transfer verbs? *To the floor, to Judy*
  - ADV - hodge-podge, miscellaneous, "nothing-fits!"
  - PRD - this argument refers to or modifies another: *…ate the meat raw*

SRL Examples



Statistics also revealed that Taiwanese business investment is tending to increase.

SRL Examples



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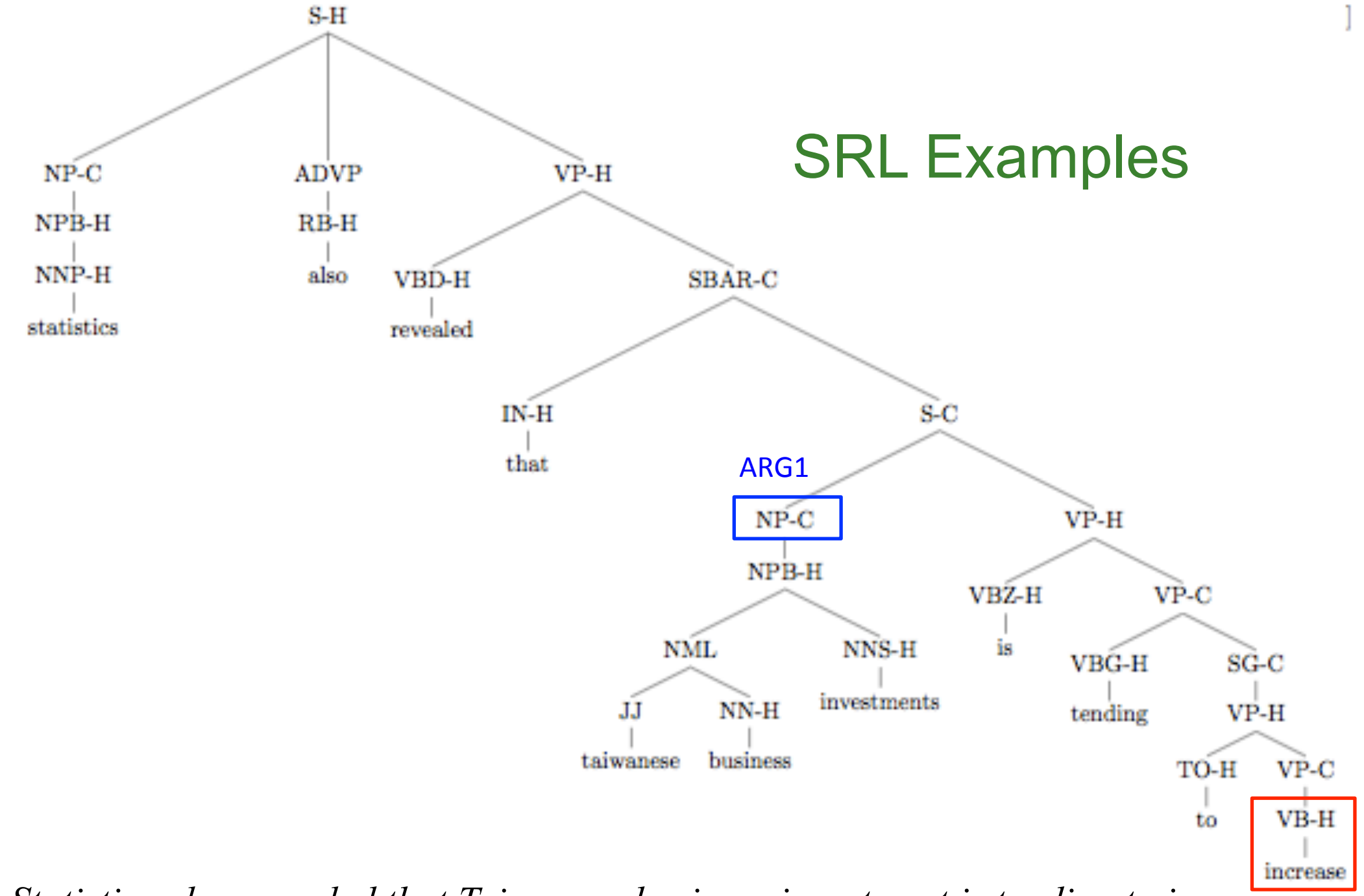

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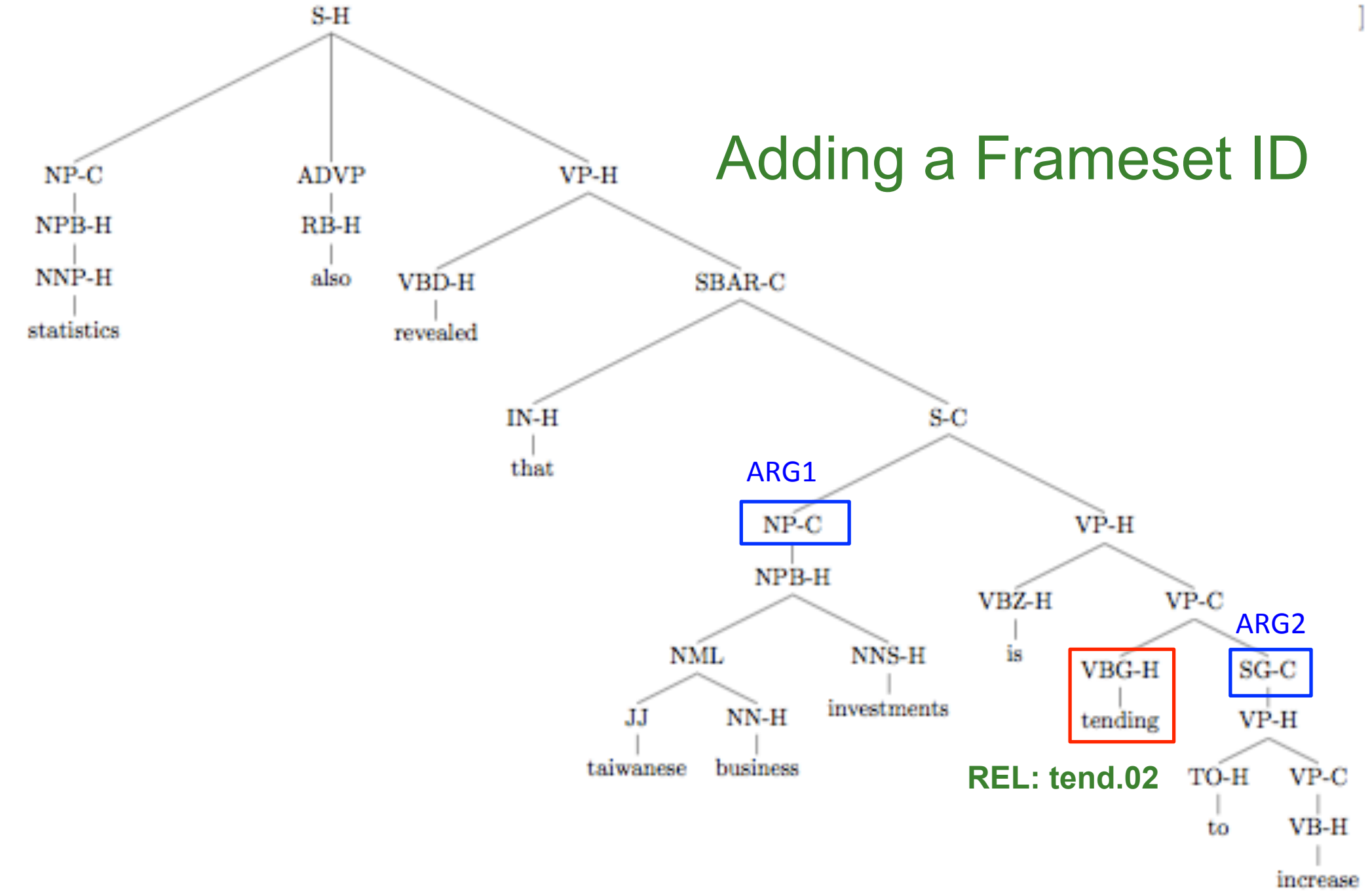
Adding a Frameset ID



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Why do we need Frameset ID's?

PropBank Frames Files: **tend.01** , *care for*

Roles:

Arg0: tender

Arg1: thing tended (to)

Example: *John* *tends* *to the needs of his patrons.*

Arg0:	*John*
REL:	*tend*
Arg1:	*the needs of his patrons*

Sense distinctions in PropBank – coarse-grained

PropBank - Frames Files: tend.02, *have a tendency*

Roles:

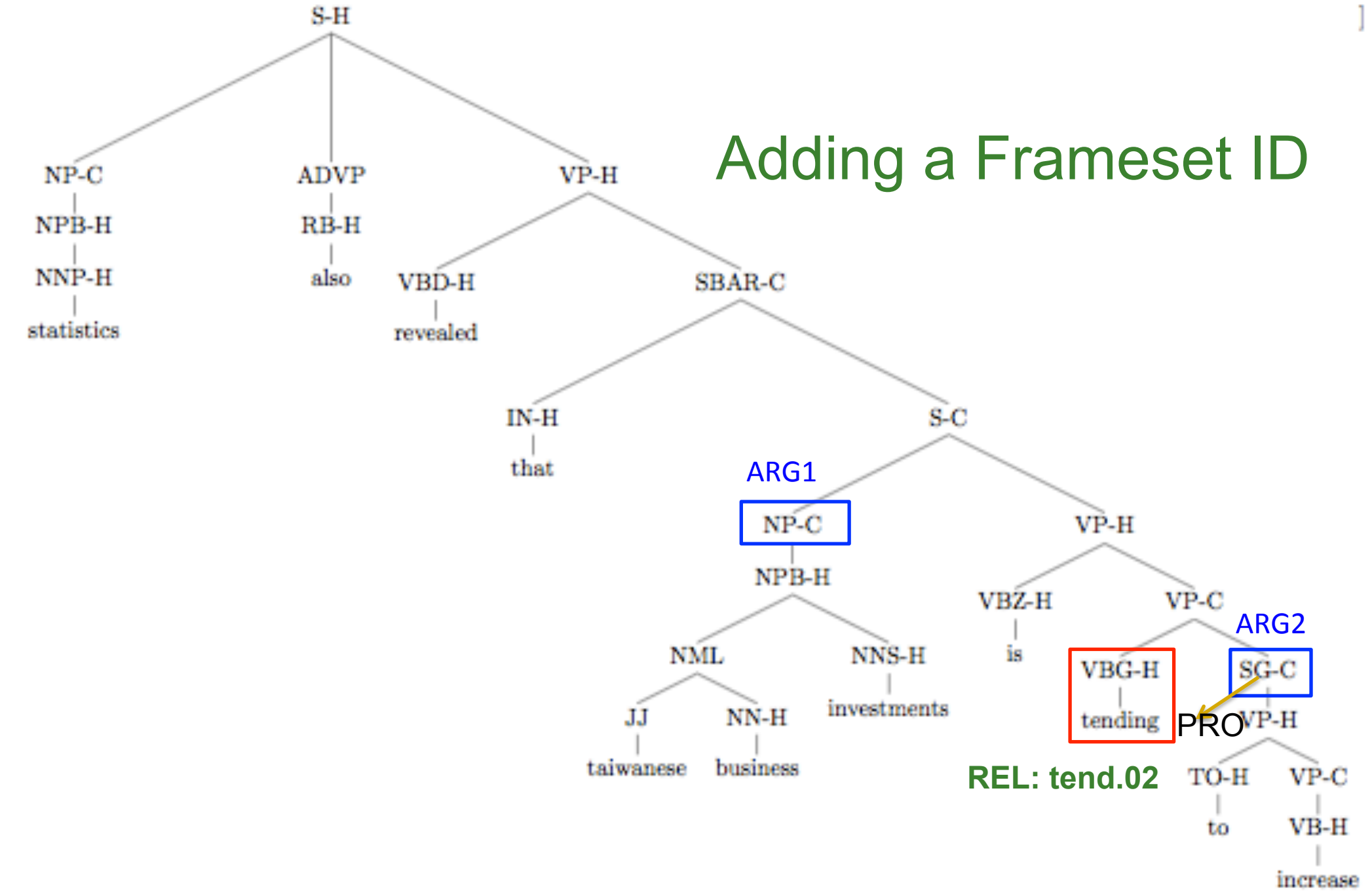
Arg1: Theme

Arg2: Attribute

Example: *The cost, or premium,* tends *to get fat in times of crisis.*

Arg1:	*The cost, or premium*
REL:	*tend*
Arg2:	*to get fat in times of crisis.*

Adding a Frameset ID



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Actual data for *leave*

Leave .01 “move away from” Arg0 rel Arg1 Arg3
Leave .02 “give” Arg0 rel Arg1 Arg2

sub-ARG0 obj-ARG1 44
sub-ARG0 20
sub-ARG0 NP-ARG1-with obj-ARG2 17
sub-ARG0 sub-ARG2 ADJP-ARG3-PRD 10
sub-ARG0 sub-ARG1 ADJP-ARG3-PRD 6
sub-ARG0 sub-ARG1 VP-ARG3-PRD 5
NP-ARG1-with obj-ARG2 4
obj-ARG1 3
sub-ARG0 sub-ARG2 VP-ARG3-PRD 3