Going from text to meaning: A small case study

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Outline

- What we are doing in general
- From-to phrases

  Different readings of ‘go from A to B’
  Lexical semantics
  Distinctions relevant to understand the readings
  Abstract Knowledge Representation: normalization
  Disambiguation and reasoning

- Conclusion

What we are doing

Building a bridge from natural language utterances to reasoning

Extend linguistic analysis with a level of Abstract Knowledge Representation (AKR)

- Normalizes linguistic expressions to a form that can be taken as input by reasoners (AKR0)

- Makes linguistically based inferences about e.g. time and space, who, what, where, when? (AKR)

AKR0-AKR

Contains all the information from the text (at this point - sentence) that is necessary for reasoning (depends on the reasoning task)

Same concept, same representation; different concept, different representation

Systematic translation to various reasoning systems possible

The Bridge pipeline

string

"A girl hopped."

LFG Parser

syntactic F-structure

```
PRED     'hop<[44:girl]>'
SUBJ     PRED   'girl'
         CHECK  [LEX-SOURCE countnoun-lex]
         NTYPE  [NSEM [COMMON count]
                 NSYN common]
         SPEC   [DET [PRED     'a'
                      DET-TYPE indef]]
      44 CASE nom, NUM sg, PERS 3
CHECK    [SUBCAT-FRAME V-SUBJ]
TNS-ASP  [MOOD indicative, PERF -_, PROG -_, TENSE past]
   104 CLAUSE-TYPE decl, PASSIVE -, VTYPE main
```

rewrite rules

Conceptual Structure:

subconcept(hop:7,[hop-1,hop-2,hop-3,hop-4,hop-5,hop-6])
role(sb,hop:7,girl:5)
subconcept(girl:5,[girl-1,female_child-1,daughter-1,girlfriend-2,girl-5])
role(cardinality_restriction,girl:5,sg)

Contextual Structure:

context(t)
top_context(t)
instantiable(girl:5,t)
instantiable(hop:7,t)

Temporal Structure:

trole(when,hop:7,interval(before,Now))

AKR (Abstract Knowledge Representation).

Focus: expressions of physical change

linguistic inferences of predicates that express dimensional change (vs. (abrupt) change of state);

expressed in from-to phrases (and measure phrases);

inferences limited to begin points and end points;

this seems a very narrow domain but ...

Some examples

- Liz went from Palo Alto to Austin.
- The road went from Palo Alto to Menlo Park.
- The temperature went from 30 degrees to 50 degrees.
- The room went from 30 to 50 degrees.
- The meeting went from 4 pm to 6 pm.

From-to phrases

Domain of the denotations of the *from-to* phrases taken in consideration

- space
- time
- scalar

- ignored- the temperature went from *low* to *high*

Ignored: cognitive, emotional, transfer-of-possession uses:

- He went from hope to despair
- The inheritance went from Liz to Bill.

Questions

- What inferences can we make ?
  - Linguistically based inferences: subsumption reasoning
- Which textual elements give rise to these inferences ?

Some examples

- Liz went from Palo Alto to Austin.

  Liz was in Palo Alto at some time and in Austin at a later time.

- The road went from Palo Alto to Menlo Park.

  A part of the road was in Palo Alto and another part in Menlo Park.

- The temperature went from 30 degrees to 50 degrees.
- The room went from 30 degrees to 50 degrees.
- The meeting sent from 4 pm to 6 pm.

Traditional Lexical Semantics representation

- Verb(Subject, from-oblique, to-oblique)
- Predicate(theme, source, destination)

The relation of the ‘theme’ to the predicate varies

- ‘theme’ refers to a whole that moves (1);

    1. Liz went from Palo Alto to Austin.

- there are ‘slices’ of the ‘theme’ that are in specific locations(2) or occur at specific times (5)

    2. The road went from Palo Alto to Menlo Park.

- the ‘theme’ is a function and the value of the function changes (3);

    3. The temperature went from 30 degrees to 50 degrees.

- the ‘theme’ is the container argument of the function whose value changes (4);

    4. The room went from 30 degrees to 50 degrees.

The mappings vary -

- space-time (1)
- space (2)
- (value of) temperature-undefined (3 & 4)
- time (5)
- ...

FrameNet:
Change position on a scale

Attribute [att] The Attribute is a scalar property that the Item possesses. Oil ROSE in price by 2%. The price of oil ROSE by 2%. [dimension]

Final_value [val2] The position on the scale where the Item ends up. Microsoft shares FELL to 7 5/8.

Initial_value [val1] The initial position on the scale from which the Item moves away. Microsoft shares FELL from 12 3/8 to 7 5/8.

Item [ite] The entity that has a position on the scale. I fear this service will DIMINISH in quality.

(Value_range [] A portion of the scale, typically identified by its end points, along which the values of the Attribute fluctuate. The patient's temperature FLUCTUATED between 28.5 and 29.5.)

FrameNet:
path_shape, motion_directional

- path
- goal
- source
- path_shape

No structured relation among these elements

statives = imagined movement

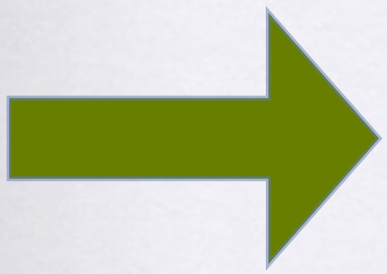
Main Inspiration

- Jackendoff (1995)The Proper Treatment of Measuring Out, Telicity, and Perhaps Even Quantification inEnglish, *NLLT*

- Gawron (2005-9)Paths and the Language of Change

Introducing some AKR-notation

The boy ate an apple before noon.



subconcept(boy-3,[boy-1,...])
subconcept(eat-4,[eat-1,...])
subconcept(noon-5,[noon-1])
subconcept(apple-6,[apple-1,...])
role(theme,eat-4,apple-6)
role(agent,eat-4,boy-3)
role(when,eat-4,Interval(before,Now))
role(when,eat-4,Interval(before,noon-5))

Introducing some AKR-notation

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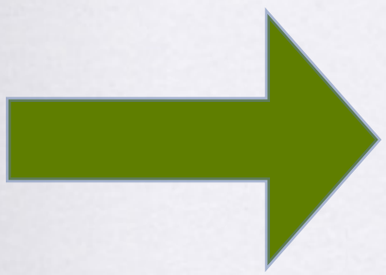

subconcept(boy-3,[boy-1,...])
subconcept(eat-4,[eat-1,...])
subconcept(noon-5,[noon-1])
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role(theme,eat-4,apple-6)
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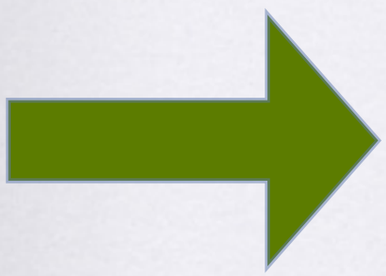


subconcept(boy-3,[boy-1,...])
subconcept(eat-4,[eat-1,...])
subconcept(apple-6,[apple-1,...])
role(Theme,eat-4,apple-6)
role(Agent,eat-4,boy-3)
role(when,eat-4,Interval(before,Now))
role(when,eat-4,Interval(before,noon-5))

Abstract Knowledge Representation-0 (normalizing the linguistic input)

Requirements for a good normalization

Get the right dependencies encoded

- Syntax-semantics mapping-

  from-phrases and to-phrases are independent units in the syntax. Is that the way we want to treat them in the AKR?

- What are the implicit parts of the meaning that need to be made explicit to allow further reasoning?

Two types of readings

From Monday to Friday the Bay Bridge will be unusable from Yerba Buena Island to Oakland.

extent reading (uncorrelated reading)

From May to September the Bay Bridge will be widened from 4 lanes to 6 lanes.

change reading (correlated reading)

Extent reading:
The road went from Palo Alto to Menlo Park

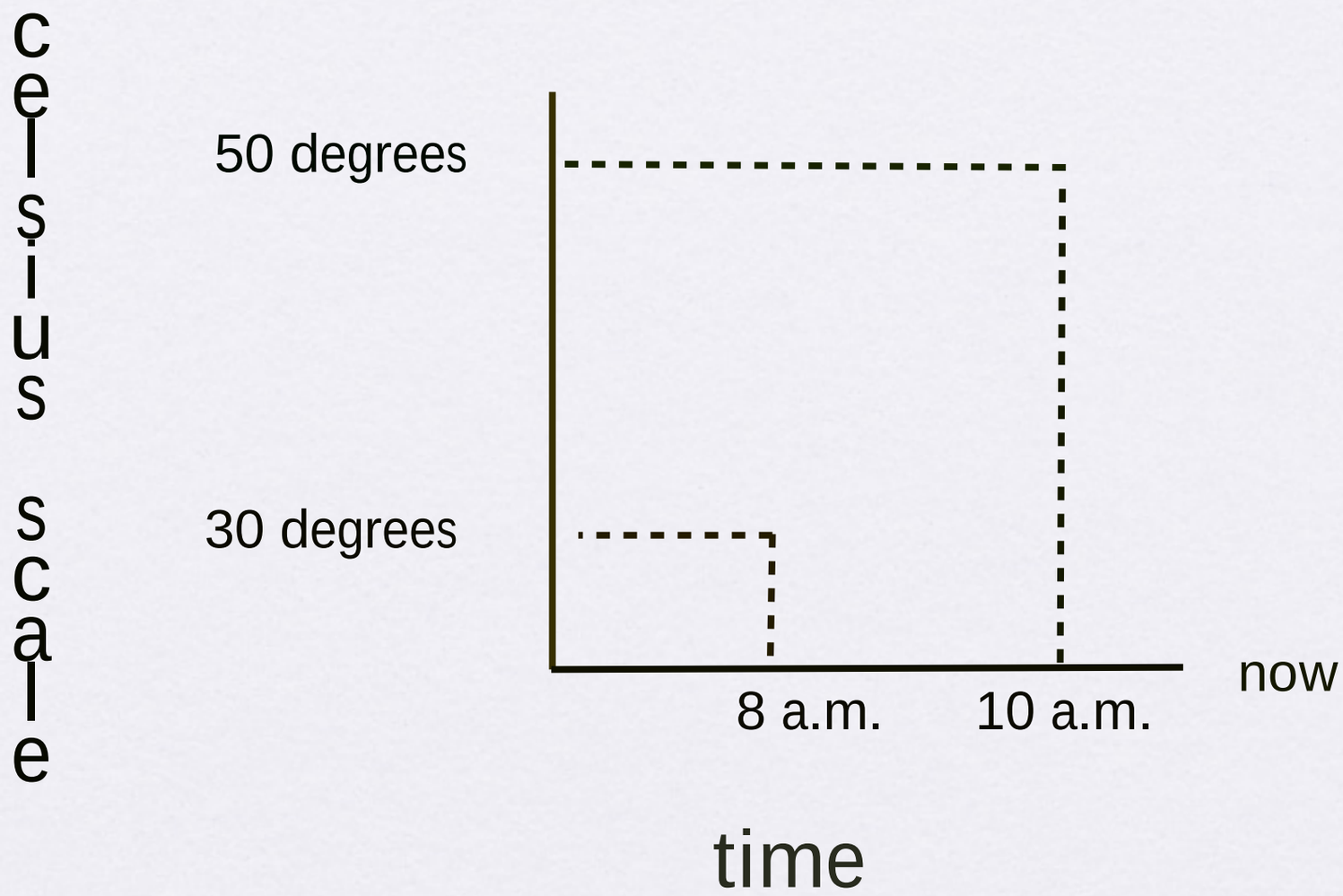
subconcept(go-4,[go#v#2])
subconcept(PA-2,[town#n#1])
subconcept(MP-3,[town#n#1])
subconcept(road-1,[road#n#2])
subconcept(path-5,[])
role(theme,go-4,road-1)
role(position,go-4,path-5)
role(dimension,path-5,loc)
role(initial,path-5,loc(-at-,PA-1))
role(final,path-5,loc(-at-,MP-2))
role(when,go-4,Interval(before,Now))
role(spatial-subpart,road-1,path-5)

Change reading:

The temperature went from 30 to 50 degrees from 8 a.m. to 10 a.m.

subconcept(go-5,[go#v#1])
subconcept(temperature-1,[temperature#n#2])
subconcept(path-4,[])
subconcept(path-7,[])
subconcept(from_to_span-11,[time_period#n#1])
role(theme,go-5,temperature-1)
role(scale,go-5,path-4)
role(dimension, path-4,temperature)
role(initial,path-4,temperature(-at-,30 degrees))
role(final,path-4,temperature(-at-,50 degrees))
role(initial,time(go-5),timepoint(-at-,8 a.m.))
role(final,time(go-5),timepoint(-at-,10 a.m.))
role(temporallyEquals,time(go-5),from_to_span-11)
role(when,go-5,Interval(before,Now))
path-map(function(temperature,?),time(go-5),path-4,)

The temperature went from 30 to 50 degrees for 8 a.m. to 10 a.m.



The room went from 30 to 50 degrees

subconcept(go-5,[go#v#1])
subconcept(temperature-1,[temperature#n#2])
subconcept(room-8,[room#n#4])
subconcept(path-4,[])
subconcept(path-7,[])
role(theme,go-5,room-8)
role(scale,go-5,path-4)
role(dimension, path-4,temperature)
role(initial,path-4,temperature(-at-,30 degrees))
role(final,path-4,temperature(-at-,50 degrees))
role(when,go-5,Interval(before,Now))
path-map(function(temperature,room-8),time(go-5),path-4,)

Liz went from Palo Alto to Austin

subconcept(Liz-1,[female#n#2])
subconcept(PA-2,[town#n#1])
subconcept(Austin-3,[town#n#1])
subconcept(go-4,[go#v#2])
role(theme,go-4,Liz-1)
role(source,go-4,PA-2)
role(destination, go-4,Austin-3)
role(when,go-4,Interval(before,Now))

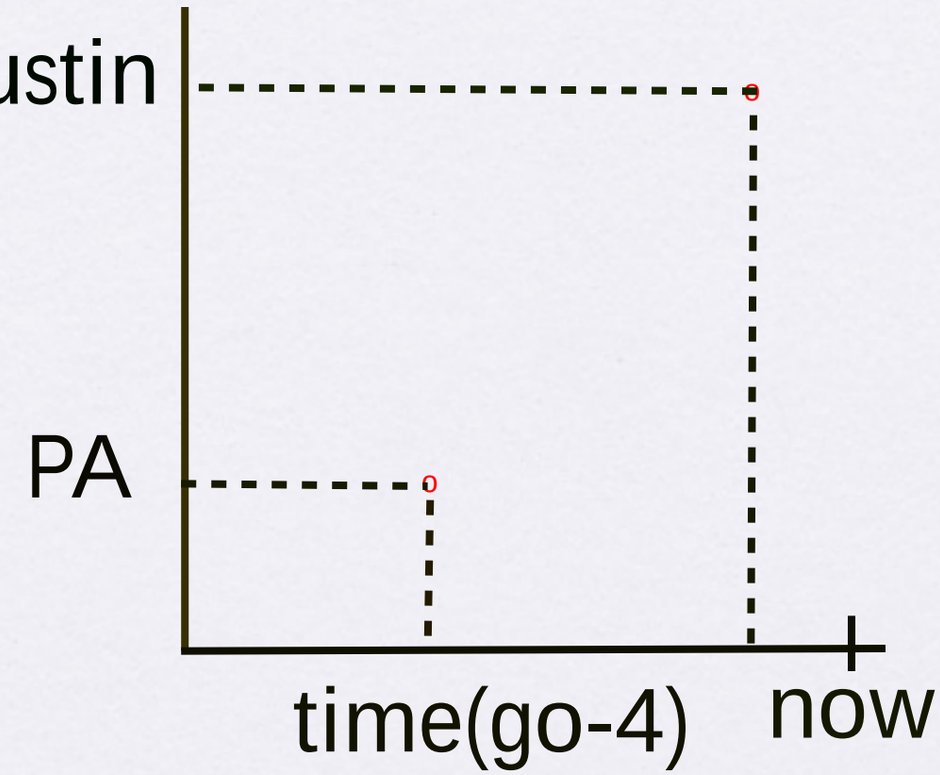
Liz went from Palo Alto to Austin

subconcept(Liz-1,[female#n#2])
subconcept(PA-2,[location#n#1])
subconcept(Austin-3,[location#n#1])
subconcept(go-4,[go#v#2])
subconcept(path-5,[])
role(theme,go-4,Liz--1)
role(mpath,go--4,path-5)
role(dimension,path-5,loc)
role(initial,path-5,loc(-at-,PA-2)
role(final,path-5,loc(-at-,Austin-3)
role(when,go-4,interval(before,Now))
path-map(function(location,Liz-1),time(go-4), path-5)

The AKR representation creates a path, which in this case has the role of a *movement* path. *From* and *to* are analyzed as initial and final roles with a *loc(ation)* argument and there is *function* that explicitly relates the location and the time.

Liz went from Palo Alto to Austin

subconcept(Liz-1,[female#n#2])
subconcept(go-4,[go#v#2])
subconcept(PA-2,[town#n#1])
subconcept(Austin-3,[town#n#1])
subconcept(path-5,[])
role(theme,go-4,Liz-1)
role(mpath,go-4,path-5)
role(dimension,path-5,loc)
role(initial,path-5,loc(-at-,PA-1))
role(final,path-5,loc(-at-,Austin-2))
role(when,go-4,Interval(before,Now))
path-map(function(loc,Liz-1),time(go-4),path-5,)



The meeting went from 3 pm to 5 pm

subconcept(meeting-13, [meeting#n#3])
subconcept(go-12,[go#v#3])
subconcept(from_to_span-11,[time_period#n#1])
role(theme, go-12,meeting-13)
role(time, go-12,from_to_span-11)
role(initial,from_to_span-11,timepoint(-at-,3 p.m.))
role(final,from_to_span-11,timepoint(-at-,5 p.m.))
role(when,go-12, Interval(beforeNow))

Extending the scope to degree achievements

- The road widens from PA to MP
- The road widens from 2m to 4m
- The road widens from 2m to 4m from PA to MP
- The road widened/narrowed from 3 pm to 5pm

The road widens from PA to MP

subconcept(widen-13,[widen#v#1])
polarity(positive, widen-13)
subconcept(PA-8,[town#n#1])
subconcept(MP-9,[town#n#1])
subconcept(road-1,[road#n#2])
subconcept(path-4,[])
subconcept(path-7,[])
role(theme,widen-13,road-1)
role(scale,widen-13,path-4)
role(dimension,path-4,width)
role(position,widen-13,path-7)
role(initial,path-7,loc(-at-,PA-8)
role(final,path-7,loc(-at-,MP-9)
role(spatial-subpart,road-1,path-7)
role(when, widen-13, interval(includes,Now)
path-map(function(width,path-7),path-7,path-4,)

The road widens from 2m to 4m

subconcept([widen-13,[widen#v#1])
polarity(positive, widen-13)
subconcept(road-1,[road#n#2])
subconcept(path-7,[])
subconcept(path-4,[])
role(theme,widen-13,road-1)
role(scale,widen-13,path-4)
role(dimension(path-4, width)
role(dimension(path-7,loc)
role(initial,path-4,width(-at-,2m))
role(final,path-4,width(-at-,4m))
role(position,widen-13,path-7)
role(spatial-subpart,road-1,path-7)
role(when,widen-13,interval(includes,Now))
path-map(function(width,road-1),path-7,path-4)

The road widened from 2 to 4 m from PA to MP

subconcept(widen-13,[widen#v#1])
role(polarity,widen-13,positive)
subconcept(PA-8,[town#n#1])
subconcept(MP-9,[town#n#1])
subconcept(road-1,[road#n#2])
subconcept(path-4,[])
subconcept(path-7,[])
role(theme,widen-13,road-1)
role(scale,widen-13,path-4)
role(position,widen-13,path-7)
role(dimension,path-4,width)
role(initial,path-7,loc(-at-,PA-8)
role(final,path-7,loc(-at-,MP-9)
role(initial,path-4,spacepoint(-at-,2m)
role(final,path-4,spacepoint(-at-,4m)
role(spatial-subpart,road-1,path-7)
role(when,widen-5,Interval(before,Now))
path-map(function(width,path-7),path-7,path-4)

- From May to September the road widened from 2 to 4 meters from PA to MP.

Difference with FrameNet

- FrameNet: scalars <--> ‘movement’ (real or imaginary)

- Our analysis: extent (one-dimensional) <--> change (functional)

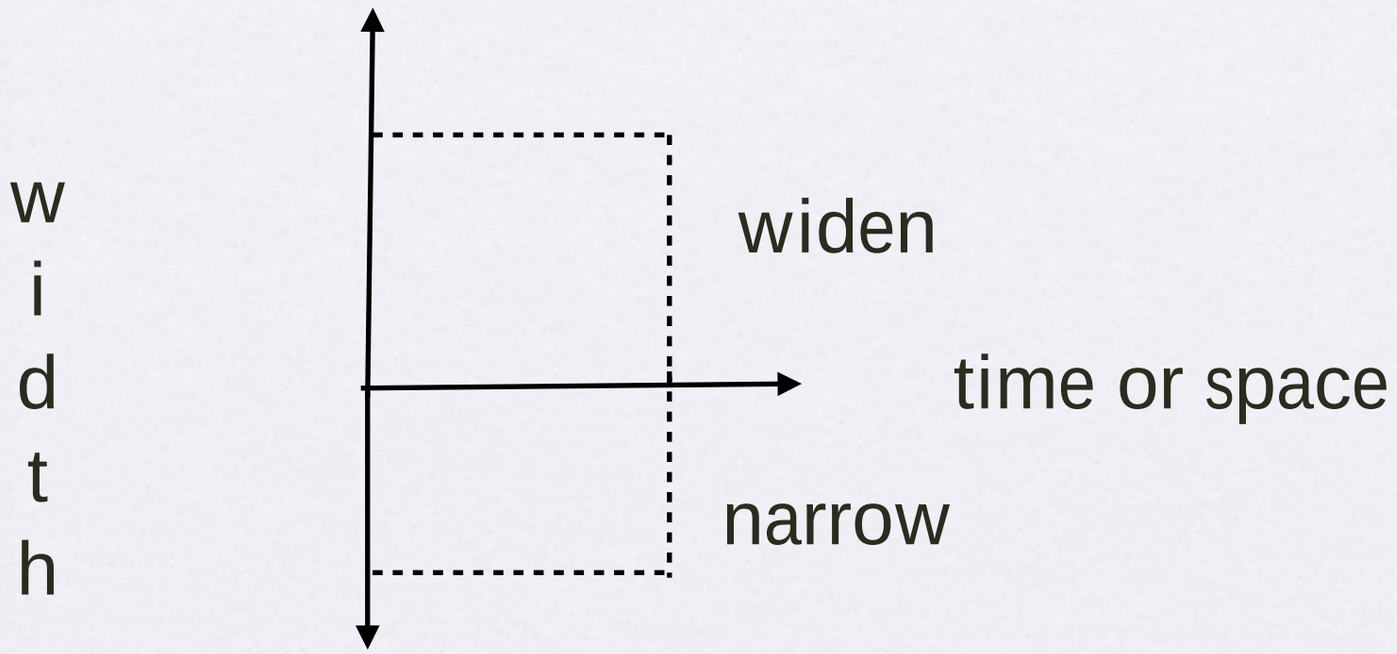
Ambiguities or underspecification of verb meanings?

- FrameNet: three different entries for ‘rise’

- but the interpretation depends on the meaning of the arguments (or adjuncts)

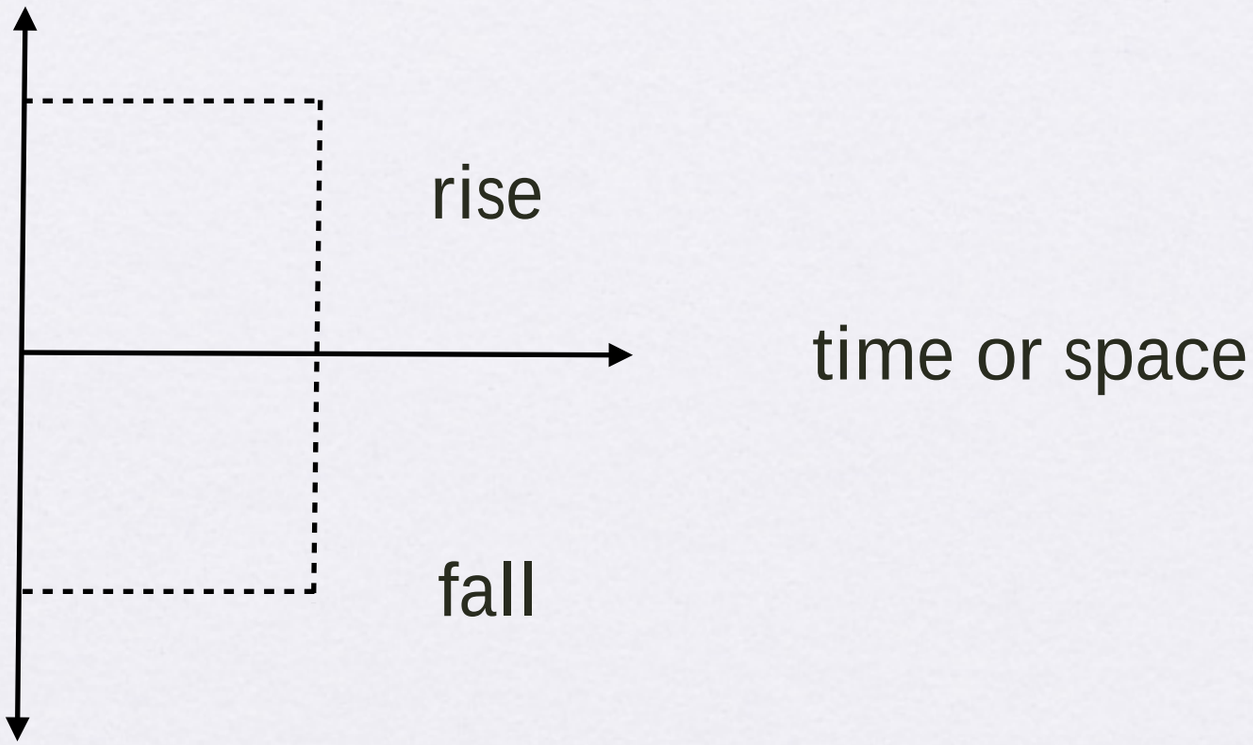
- underspecified core meaning for ‘rise’

Meaning of widen and narrow



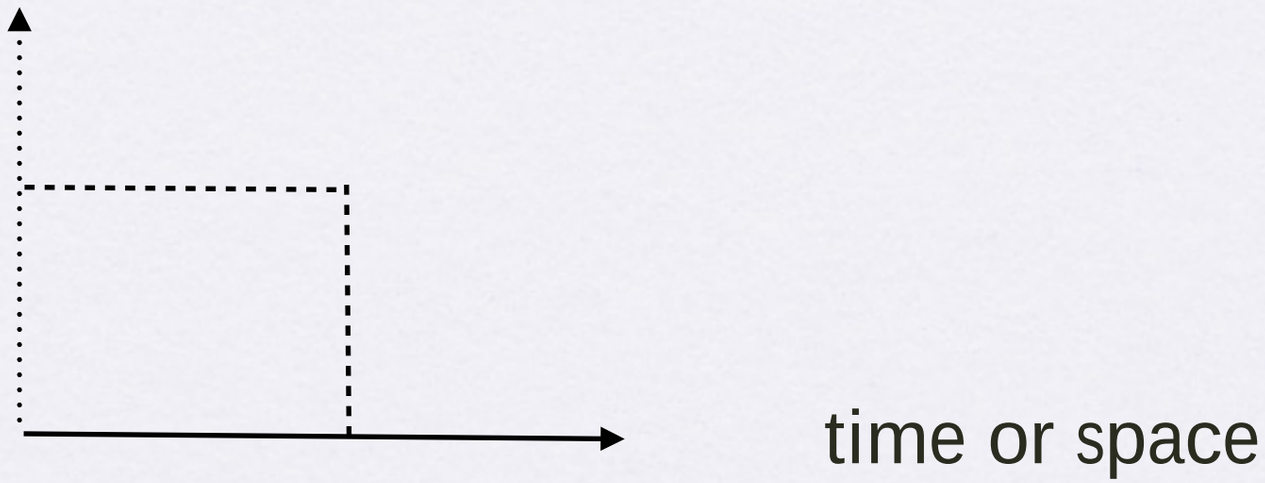
widen: dim: width, cor:+, pol:+
narrow: dim: width, cor:+, pol:-

Meaning of rise and fall



rise: cor:+, pol:+
fall: cor:+, pol:-

Meaning of go



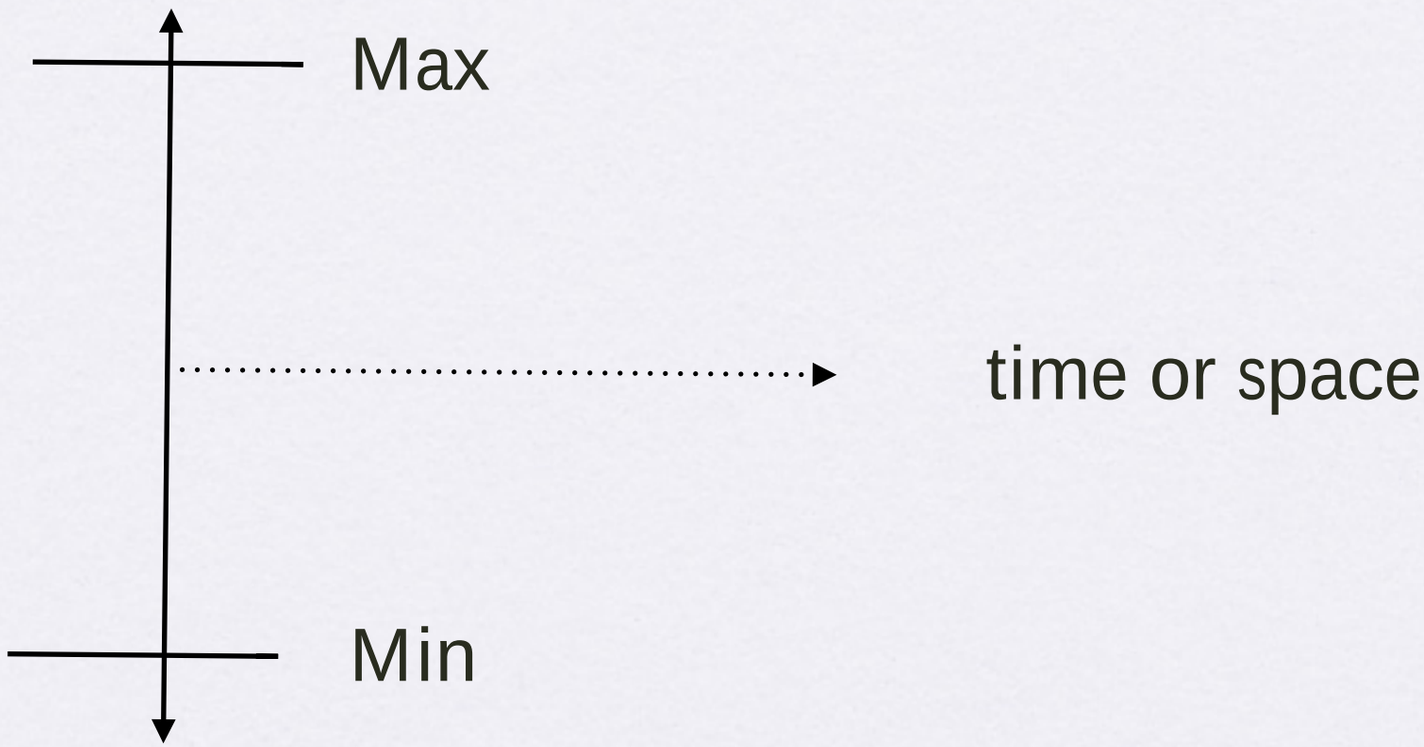
go: cor:+/-
- if stative, + if progressive

Partial meaning of
run of the mill statives (be-unusable)

time or space

be-unusable: cor:-

Meaning of range



The temperature ranged from 30 to 40 degrees.

Reasoning: Linguistic part

Inferences

- correlated/non correlated (‘change’)
  - path-map(function(dimension)path x, path y) --> correlated
  - ~path-map(function(dimension)path x, path y) --> non-correlated
- change over time or space
  - path-map/role(overlap) --> stationary (change over space or no change)
- movement = correlated time and space

Some generalities about path-maps with from-to

- When there is a mpath, there is an understood temporal path (physical necessity)

- When there is a position role, there is no temporal path, but there can be change over a locational domain.

- When there is a scalar path, there can be a temporal path or a spatial path that is its domain (eventive and stative readings)

Disambiguation

How do we know which interpretation is the right one for a given sentence?

- Dimensions: time, space, temperature, ...
- Modalities: mpath(+movement), position, scales
- Polarity:-/+
- Path characteristics: initial,final; given by *from* and *to*

Are there syntax-semantics correlates we can rely on?

- Positions and movement paths are referential --> they are expressed by proper names or by NP with a specifier

- Exceptions:

  - He ran from where I put to ball to where the field ends.

  - His tattoo goes from head to toe.

  - The path meanders from mountain to mountain.

Verb meanings

Manner of motion verbs (not all of them)

Liz/the road/the temperature went/crawled/moved/meandered/... from X to Y

- the verb does not contribute to the distinctions we are interested in.
- Both extent and change readings

Verbs of inherent directed motion

Liz/the road/the temperature descended/climbed/ascended/fell/plunged/rose/ tumbled from X to Y

- the verb contributes the polarity of dimension.
- Change reading, change can be along a locational or temporal axis

Degree achievements

The road/the crack/?Liz/*the temperature widened/narrowed

- verb indicates the dimension (and polarity)
- Change reading, change can be along locational or temporal axis

Tools to help make the relevant distinctions

- Ontologies/gazetteers
- Co-occurrence patterns
- Annotation
- Reasoning

Trying to distinguish …

- The road went from PA to MP
- Eric went from PA to MP
  - Eric went from Stanford to MIT
  - He went from village to village
- The meeting went from 5 to 6 pm
- All the rest is ‘other’

Wikipedia and NYT□
with Raphael Hoffmann (Univ. of Washington)

- Parsed with Stanford Dependency Parser
- Annotation categories

A1a : locative extent

A1b : locative movement

A1c : locative movement (institutions)

A1d : locative movement (undefined places)

B : all other went-from-to phrases

C : different grammatical construction

Characterizing the content NPs

- Subjects for stative reading: + spatial extent
  - Common nouns for geographical/spatial features: tunnel, road, rail road, network, border, …
  - Names of roads: A85, Tinnos Line, …
  - Common nouns for objects with spatial extension: suppressor, staircase, …
- Subject for dynamic readings: + moveable
  - Person names: Peter IV, Dharendra Bahadur Rasalli, …
  - Common nouns for persons or groups: trader, army, …
  - Moveable objects: ball, painting, …
  - Events: parade, expedition, …

This railroad went from Chicago to Oelwein, Iowa.

The suppressor, 2 inches in diameter, went all the way from the back of the barrel to well beyond the muzzle (the suppressor makes up half the overall length of the rifle), providing a very large volume of space to contain the gases produced by firing.

Somewhat off-center of the dance floor, there was a narrow metal spiral staircase with clear plastic arms that went up from the dance floor to the balcony above where people could watch the dancers below.

John and Cosmas went from Damascus to Jerusalem, where both became monks in the Lavra (monastery) of St. Sabbas the Sanctified near that city.

The camel caravans went from Kyakhta across Inner Mongolia to a Great Wall gate at Kalgan.

The ball went from Starks to Anthony Mason to Oakley, but Oakley was called for a charging foul with 17 seconds to play, setting up Miller's shot.

Categories

common nouns

- connector
- vehicle
- object
- person
- event
- body part
- landmark
- building part
- institution
- noun
- spatial
- date

pronouns

- non person: it
- person: I, you, we
- pronoun: they
- spatial: there, here
- anaphoric: next, (an)other

names

- connector
- landmark
- vehicle
- person
- institution

- some of these categories will not be found in standard ontologies:
  - they are motivated by the problem at hand
  - standard ontologies don’t go very far

Three step approach:

Normalization

Disambiguation

Reasoning

Conclusions

- from-to phrases, even in the physical domain, are multi-dimensional; change is not always temporal (Gawron);

- the interpretation of from-to phrases often requires a functional mapping between two paths and one or both of these paths can be syntactically unexpressed;

- movement predicates and degree achievements share functional path-maps that relate the various axes of change;

- the interpretations are dependent on lexical information that often is not readily available.

Thank You

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Defaults?

- The road widened. ➪ spatial?
- They widened the road. ➪ temporal?
- The room cooled. ➪ over time (but- the room cooled from the front to the back)
- The sky darkened.

Thanks!

Lexical annotations

	dimension	polarity	path-role	function
widen	width	+	scale	
narrow	width	-	scale	
walk	spatial	n	path	
rise		+	scale	
meter	spatial	n	scale	
degree		n	scale	
go		n		
road	spatial	n	position	
Liz		n	path	
temperature				yes

- widen: dim: width, cor:+, pol:+, scalar:+
- narrow: dim: width, cor:+, pol:+
- rise: cor:+, pol:+, scalar:+
- fall: cor:+, pol:-, scalar:+
- go: cor:+/-
- be-unusable: cor:-
- range: cor:-, pol: -, scalar:+
- from: cor:+/-, initial
- to: cor:+/-, final
- between: cor:-
- The road widens from PA to MP --> cor:+ pol:+
- The road widened from 3 to 5 pm --> cor:+ pol:+
- The road widens between PA and MP --> cor:-, pol:+
- The road goes from PA to MP --> cor:- : pragmatically/reasoning determined by nature of the road
- Eric went from PA to MP --> cor:+
- The road goes between PA and MP --> cor:-
- The Eric went between PA and MP --> cor:?
- The road is unusable between PA and MP: cor:-
- The road is unusable from PA to MP --> cor:-
- The width of the road ranges from x to y --> cor:-

from/to

- from: dir:+/- , initial
- to: dir:+/-, final

How far do we want to go with the mapping between AKR0 and AKR?

Not too far-

The room cooled from 20 to 10 degrees from 3 to 5 pm.
Was the temperature of the room 15 degrees between 3 and 5 pm?
The road widened from 2 to 4 lanes.
Was the width of the road 3 lanes?

	continuous	polarity
widen	no	increasing
cool	yes	decreasing
narrow	no	decreasing

Better left to ‘real theorem provers’;
Experiments with SNARK

functional nouns

- temperature(value,time,place,unit))

- The temperature went from 30 to 50 degrees (F/C)
  default: ambient
- The room went from 30 to 50 degrees
- The temperature rose/went up
- *The room went up.
- The room cooled

  - height,width,length,weight,depth,breadth,...

  - pressure: atmosphere, blood, ...

  - speed,acceleration,

- price(value,time,(place),commercial-good,unit), tax, rent, mortgage rate, ...
    - The price of gold went from $800 to $900 per ounce
    - Gold went up/rose
    - The price went up. (needs context, no default)
    - ?Houses/books went up/??The house went up (ok: in value)

- test score(value,time,(place),intellectualproduct, unit)
- The scores went from 600 to 800 points.
- ?The students went from 600 to 800 points.
- *The exams went from 600 to 800 points.
- The proficiency went from 600 to 800 points.
- *The students rose.
- The proficiency rose

- His blood pressure went from 130/70 to 160/90.

- *His blood went from 130/70 to 160/90.

- The pressure rose.

- *The blood rose.

- speed(value,time,movingthing,unit)
- The car went from 60 to 90 m/h
- The speed went from 60 to 90 m/h
- The speed increased/rose
- *The car rose.
- The car accelerated

- appreciate
  - The price of the house appreciated (from 1 to 2 million)
  - The house appreciated in price (from 1 to 2 million)
  - *The temperature of the room appreciated
- balloon
  - ?The price of the house ballooned (from 1 to 2 million)
  - *The house ballooned in price (better:from 1 to 2 million)
  - *The temperature of the room ballooned
- climb
  - The price of the house climbed (from 1 to 2 million)
  - The house climbed in price (from 1 to 2 million)
  - The temperature of the room climbed (from 30 to 50 degrees)
  - ?The room climbed in temperature (from 30 to 50 degrees)
- decline
  - The price of the house declined (from 2 to 1 million)
  - The house declined in price (from 2 to 1 million)
  - ?The temperature of the room declined
  - *The room declined in temperature
- decrease
  - The price of the house decreased (from 2 to 1 million)
  - The house decreased in price (from 2 to 1 million)
  - The temperature of the room decreased (from 50 to 30 degrees)
  - *?The room decreased in temperature (from 50 to 30 degrees)
- depreciate
  - The price of the house depreciated (from 2 to 1 million)
  - The house depreciated in price (from 2 to 1 million)
  - *The temperature of the room depreciated (from 50 to 30 degrees)

- appreciate
  - *The width of the house appreciated (from 1 to 2 meters)
  - *The house appreciated in width (from 1 to 2 meters)
- balloon
  - ?The width of the house ballooned (from 1 to 2 meters)
  - ?The house ballooned in width (better:from 1 to 2 meters)
- climb
  - *The width of the house climbed (from 1 to 2 meters)
  - *The house climbed in width (from 1 to 2 meters)
- decline
  - ?The width of the house declined (from 2 to 1 meters)
  - ?The house declined in width (from 2 to 1 meters)
- decrease
  - The width of the house decreased (from 2 to 1 meters)
  - The house decreased in width (from 2 to 1 meters)
- depreciate
  - *The width of the house depreciated (from 2 to 1 meters)
  - *The house depreciated in width (from 2 to 1 meters)

- differ
- diminish
  - The price of the house diminished (from 2 to 1 million)
  - The house diminished in price (from 2 to 1 million)
  - ?The temperature of the room diminished (from 50 to 30 degrees)
  - *The room diminished in temperature (from 50 to 30 degrees)
- drop
  - The price of the house dropped (from 2 to 1 million)
  - The house dropped in price (from 2 to 1 million)
  - The temperature of the room dropped (from 50 to 30 degrees)
  - ?The room dropped in temperature (from 50 to 30 degrees)
- fall
  - The price of the house fell (from 2 to 1 million)
  - The house fell in price (from 2 to 1 million)
  - The temperature of the room fell (from 50 to 30 degrees)
  - *?The room fell in temperature (from 50 to 30 degrees)
- fluctuate
- gain
  - *The price of the house gained (from 1 to 2 million)
  - The house gained in price (from 1 to 2 million)
  - *The temperature of the room gained (from 30 to 50 degrees)
  - *The house gained in temperature (from 30 to 50 degrees)

- differ
  - The width of the houses differed (from 2 to 1 meters)
  - The houses differed in width (from 2 to 1 meters)
- diminish
  - ??The width of the house diminished (from 2 to 1 meters)
  - ??The house diminished in width (from 2 to 1 meters)
- drop
  - ?The width of the house dropped (from 2 to 1 meters)
  - ?The house dropped in width (from 2 to 1 meters)
- fall
  - ?The width of the house fell (from 2 to 1 meters)
  - ?The house fell in width (from 2 to 1 meters)
- fluctuate
  - The width of the houses fluctuated (from 2 to 1 meters)
  - The houses fluctuated in width (from 2 to 1 meters)
- gain
  - *The width of the house gained (from 1 to 2 meters)
  - The house gained in width (from 1 to 2 meters)

- grow
  - The price of the house grew (from 1 to 2 million)
  - The house grew in price (from 1 to 2 million)
  - ?The temperature of the room grew (from 30 to 50 degrees)
  - *The room grew in temperature (from 30 to 50 degrees)
- increase
  - The price of the house increased (from 1 to 2 million)
  - The house increased in price (from 1 to 2 million)
  - ?The temperature of the room increased (better:from 30 to 50 degrees)
  - *The room increased in temperature (from 30 to 50 degrees)
- jump
  - The price of the house jumped (from 1 to 2 million)
  - ?The house jumped in price (better: from 1 to 2 million)
  - ?The temperature of the room jumped (better:from 30 to 50 degrees)
  - *The room jumped in temperature (from 30 to 50 degrees)
- mushroom
- plummet
  - The price of the house plummeted (from 2 to 1 million)
  - ?The house plummeted in price (better:from 2 to 1 million)
  - ?The temperature of the room plummeted (from 50 to 30 degrees)
  - *The room plummeted in temperature (from 50 to 30 degrees)

- grow
  - ?The width of the house grew (from 1 to 2 meters)
  - The house grew in width (from 1 to 2 meters)
- increase
  - The width of the house increased (from 1 to 2 meters)
  - The house increased in width (from 1 to 2 meters)
- jump
  - ?The width of the house jumped (from 1 to 2 meters)
  - ?The house jumped in width (better: from 1 to 2 meters)
- mushroom
- plummet
  - ?The width of the house plummeted (from 2 to 1 meters)
  - ?The house plummeted in width (better:from 2 to 1 meters)

- plunge
  - The price of the house plunged (from 2 to 1 million)
  - ?The house plunged in price (better:from 2 to 1 million)
  - The temperature of the room plunged (from 50 to 30 degrees)
  - *The room plunged in temperature (from 50 to 30 degrees)
- rocket
  - The price of the house rocketed (from 1 to 2 million)
  - ?The house rocketed in price (better:from 1 to 2 million)
  - ?The temperature of the room rocketed (from 30 to 50 degrees)
  - *The room rocketed in temperature (from 30 to 50 degrees)
- rise
  - The price of the house rose (from 1 to 2 million)
  - The house rose in price (from 1 to 2 million)
  - The temperature of the room rose (from 30 to 50 degrees)
  - *?The room rose in temperature (from 30 to 50 degrees)
- skyrocket
- soar
  - The price of the house soared (from 1 to 2 million)
  - ?The house soared in price (from 1 to 2 million)
  - The temperature of the room soared (from 30 to 50 degrees)
  - *?The room soared in temperature (from 30 to 50 degrees)
- surge
  - The price of the house surged (from 1 to 2 million)
  - ?The house surged in price (from 1 to 2 million)
  - The temperature of the room surged (from 30 to 50 degrees)
  - *?The room surged in temperature (from 30 to 50 degrees)
- tumble
  - The price of the house tumbled (from 2 to 1 million)
  - ?The house tumbled in price (from 2 to 1 million)
  - The temperature of the room tumbled (from 50 to 30 degrees)
  - *The room tumbled in temperature (from 50 to 30 degrees)
- vary

- plunge
  - ?The width of the house plunged (from 2 to 1 meters)
  - ?The house plunged in width (better:from 2 to 1 meters)
- rocket
  - ?The width of the house rocketed (from 1 to 2 meters)
  - ?The house rocketed in width (better:from 1 to 2 meters)
- rise
  - *The width of the house rose (from 1 to 2 meters)
  - *The house rose in width (from 1 to 2 meters)
- skyrocket
- soar
  - ?The width of the house soared (from 1 to 2 meters)
  - ?The house soared in width (from 1 to 2 meters)
- surge
  - ?The width of the house surged (from 1 to 2 meters)
  - ?The house surged in width (from 1 to 2 meters)
- tumble
  - ?The width of the house tumbled (from 2 to 1 meters)
  - ?The house tumbled in width (from 2 to 1 meters)
- vary
  - The width of the house varied (from 2 to 1 meters)
  - The house varied in width (from 2 to 1 meters)

Thanks

Measure phrases

- The classes we have been talking about, can take measure phrases as well as for-to complements (except for *go*- *The price went 5 dollars)).

- This is not true across the board- *I mailed/posted/ sent it 5 miles.

The meeting went from 3 pm to 5 pm

AKR0

subconcept(meeting-13, [meeting#n#3])
subconcept(go-12,[go#v#3])
subconcept(from_to_span-11,[time_period#n#1])
role(theme, meeting-13, go-12)
role(time, go-12, from_to_span-11)
role(initial,from_to_span-11,timepoint(-at-,3 p.m.))
role(final,from_to_span-11,timepoint(-at-,5 p.m.))
role(theme,meeting-13,start-3)

- role(time,start-3,timepoint(-at-,3 p.m.))
- role(time,end-4,timepoint(-at-,3 p.m.))
- role(simultaneous,start-3,timepoint(-at-,3 p.m.))
- role(simultaneous,end-4,timepoint(-at-,5 p.m.))
- role(theme,meeting-13,end-4)

role(when,go-12,Interval(beforeNow))

AKR

role(meet,start-3,go-12)
role(meet,go-12,end-4)
role(disjoint,timepoint(-at-,3 p.m.),timepoint(-at-,5 p.m.))

The meeting went from 3 pm to 5 pm

subconcept(meeting-13, [meeting-3])
subconcept(go-12,[go-3])
subconcept(from_to_span-11,[time_period-1])
role(theme, meeting-13, go-12)
role(time, go-12, from_to_span-11)
role(initial,from_to_span-11,timepoint(-at-,3 p.m.))
role(final,from_to_span-11,timepoint(-at-,5 p.m.))
role(theme,meeting-13,start-3)

- role(time,start-3,timepoint(-at-,3 p.m.)) # scaffolding
- role(time,end-4,timepoint(-at-,3 p.m.)) # scaffolding
- trole(simultaneous, start-3, timepoint(-at-,3 p.m.))
- trole(simultaneous, end-4, timepoint(-at-,5 p.m.))
- role(theme,meeting-13, end-4)
- trole(meet, start-3, go-12)
- trole(meet, go-12, end-4)
- trole(disjoint, timepoint(-at-,3 p.m.), timepoint(-at-, 5 p.m.))

John walked 3 miles

subconcept(walk-13,[walk-2])
subconcept(John-3,[male-2])
subconcept(path-5,[])
role(theme,walk-13,John-3)
role(scale,walk-13,path-5)
role(extent,path-5,measure(3,miles))
trole(before,walk-13, Now)
path-map(function(distance, walk-13), path-5, time (walk-13))