

The background of the slide is a collage of numerous small, rectangular white cards scattered across a light gray surface. Each card has a single word printed on it in a black, sans-serif font. The words are oriented in various directions, some horizontally, some vertically, and some at angles. Visible words include 'moment', 'sing', 'him', 'it', 'those', 'see', 'stare', 'through', 'prod', 'may', 'for', 'spring', 'go', 'pull', 'and', 'pingue', 'ke', 'whisper', 'may', 'for', 'spring', 'go', 'pull', 'and', 'pingue', 'ke', 'whisper', 'may', 'for', 'spring', 'go', 'pull', 'and', 'pingue', 'ke', 'whisper'.

Struggling with English Prepositional Verbs

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**The aliens will
destroy Earth
unless we**



**accept
meet
obey**

**agree to
accede to
conform to
yield to
give in to**

**comply with
cooperate with
go along with**

their demands.

English Prepositional Verbs

1. ~~High-level~~ Vague definition
 - Advantages of a CxG framework
2. Wanted: a simple and reproducible criterion
3. Ideas

PrepVs in English

(*CGEL*, ch. 4)

- **Verb**+**preposition** combinations where the selection of the preposition is **idiomatic**:

come across refer to decide on look at look for

- ▶ Syntactically: [**V** [_{PP} **P** Obj]]
- Distinguished from **verb-particle constructions** like *wake up, make out, pull off*
 - ▶ [V Part Obj] ↔ [V Obj Part]
 - ▶ particle can be analyzed as an intransitive preposition

PrepVs + CxG

- Prepositional verbs are **idiomatic**—knowing how to use them correctly involves a mix of lexically-specific and general-syntactic knowledge.
- Construction Grammar hypothesizes **continuity between lexicon and grammar**. Lexical items, highly productive syntactic patterns, and idiomatic patterns are described as form-function mappings (constructions) at different levels of abstraction.

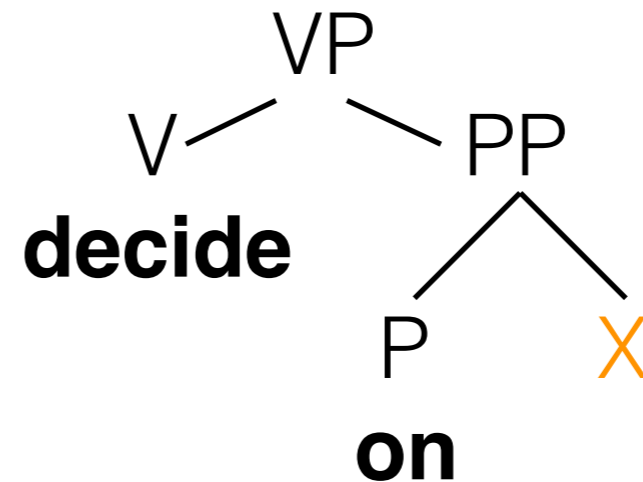
PrepV constructions

(Chang 2011)

meaning

(Agent) CHOOSE Theme

form



decide on construction

Limited productivity

- Not just look at: glance at, stare at, take a gander at
- Not just look for: search for, hunt for, turn the house upside down for...
- agree/accede/yield/give in to
- depend/rely/count on
- Even decide on 'choose' (considered "frozen" by Chang) has a close relative, settle on

Limited productivity

- In CxG, we can account for these as a productive V+P construction that is schematic with respect to the particular verb.
- (Or: a sense of the preposition that is limited to certain classes of verbs)

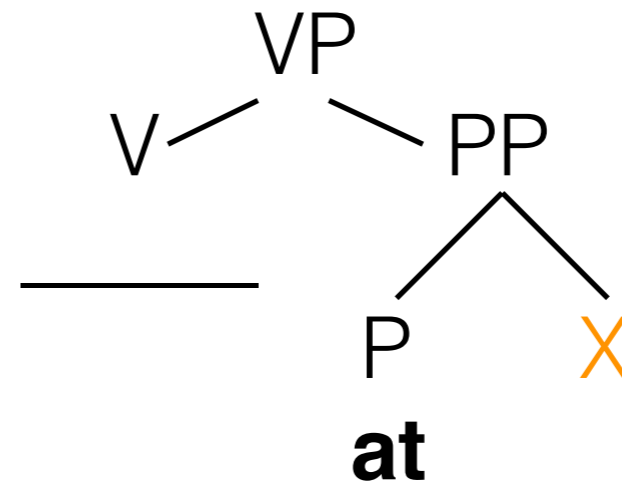
PrepV constructions

(Chang 2011)

meaning

(Experiencer) LOOK Theme

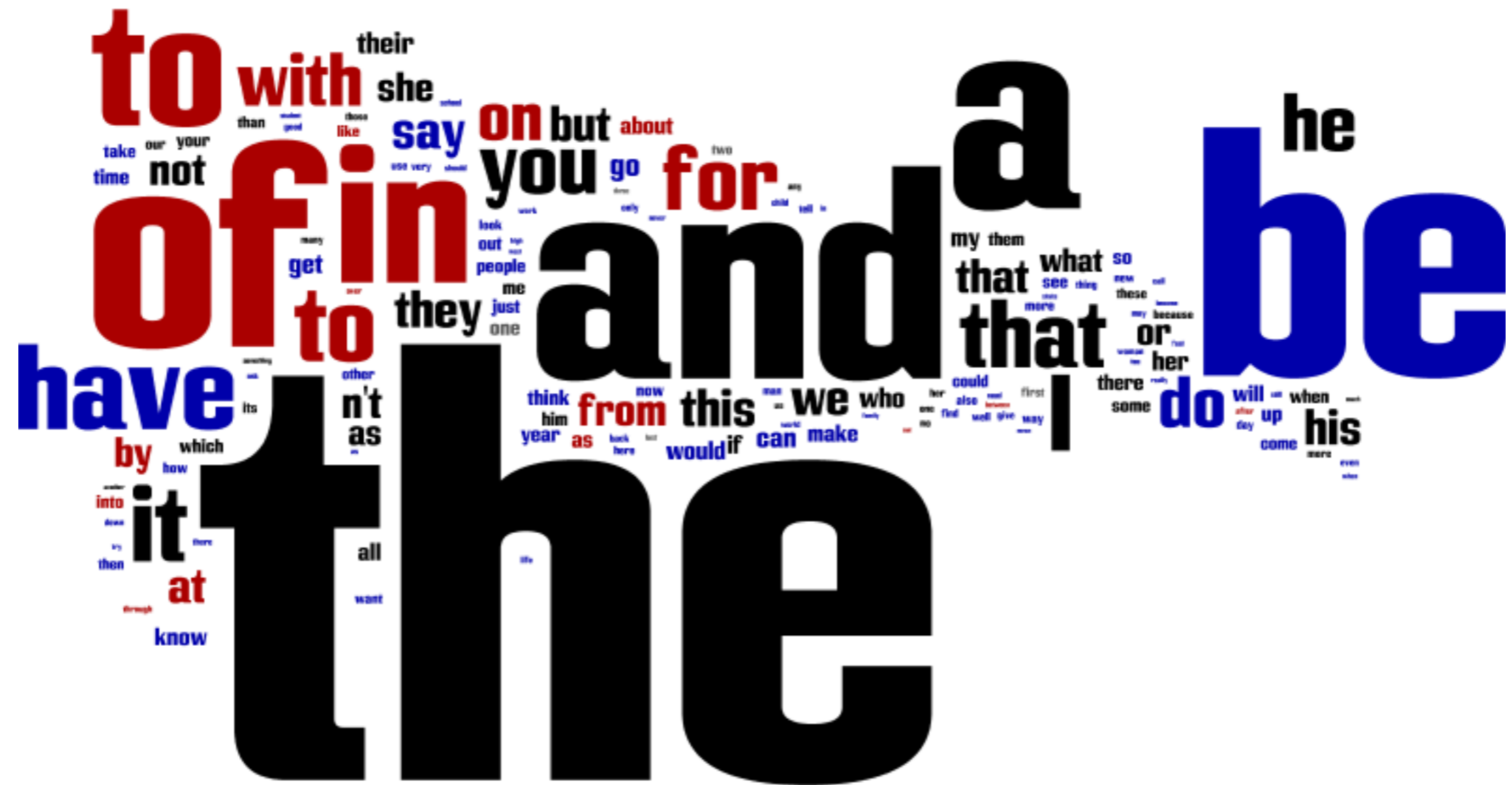
form



<intentional_visual_perception> at construction:
look/glance/peer/... at

English Prepositional Verbs

1. ~~High-level~~ Vague definition
 - ▶ Advantages of a CxG framework
2. Wanted: a simple and reproducible criterion
 - ▶ Failure of purely syntactic tests
 - ▶ Challenge of partial productivity
3. Ideas



based on COCA list of 5000 most frequent English words

Corpus annotation for NLP

- For applications like machine translation, we want the system to **choose or interpret the verb and preposition in combination** (for PrepVs).
- To support this, we want to build a **semantic analyzer for preposition meanings**. And we want it to indicate where that meaning is tied to the verb.
- In order to build a statistical (machine learning) analyzer, we need a manually annotated **corpus**.
- In order to annotate a corpus, we need an **annotation scheme** that is **simple**, **reproducible**, and **broad-coverage**.

Central question

- In order to annotate a corpus, we need an **annotation scheme** that is **simple**, **reproducible**, and **broad-coverage**.

How do we decide which verb+preposition combinations should count as prepositional verbs?

- Or: multiple subphenomena?

Syntactic tests

- Despite many attempts to characterize the category of prepositional verbs by syntactic tests, different tests give **conflicting and intuitively unsatisfying results** (Tseng 2000, reviewing Kruisinga, Quirk et al., etc.).
 - E.g., **prepositional passive** test over- and under-predicts
 - Vestergaard (1977): clusters of tests support 5 degrees of preposition attachment

- In practice, these tests can be **difficult to apply**:

She disagreed with my observation

→ ??My observation was disagreed with (by her)

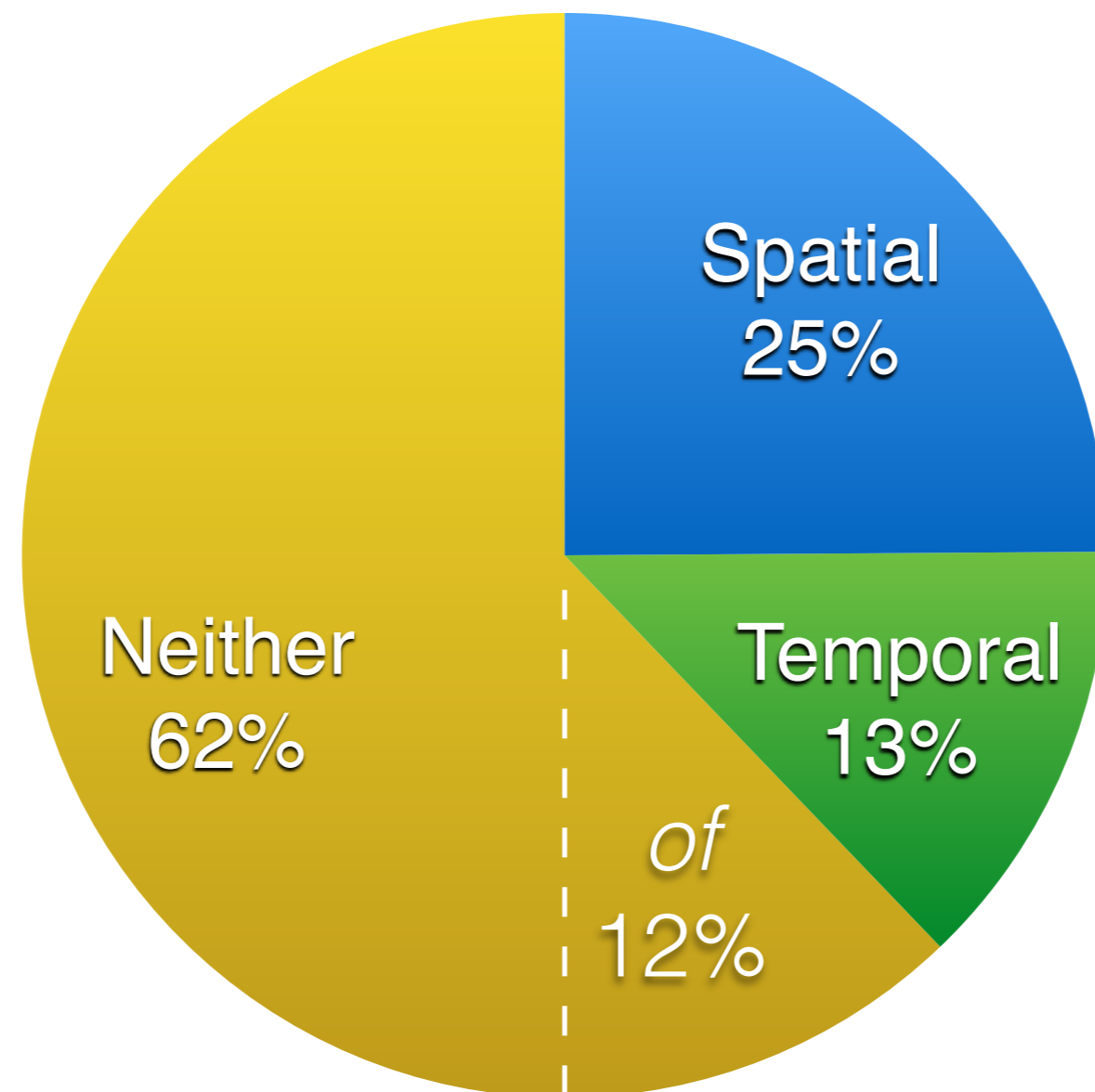
I talked to a manager → ??A manager was talked to (by me)

Studies of preposition semantics

- **Polysemy networks** for *over* (e.g., Brugman 1981, Lakoff 1987, Dewell 1994, Tyler & Evans 2003, Deane 2005) and *other English prepositions* (Lindstromberg 1998/2010)
- **Cognitive Grammar** (Zelinsky-Wibbelt 1993)
- Many other studies focusing on **spatial** and **temporal** usages
- **The Preposition Project** (fine-grained sense resource; Litkowski & Hargraves 2005)

Distribution in our corpus


N = 4073



semantic distribution of all prepositions (not just verb-headed)

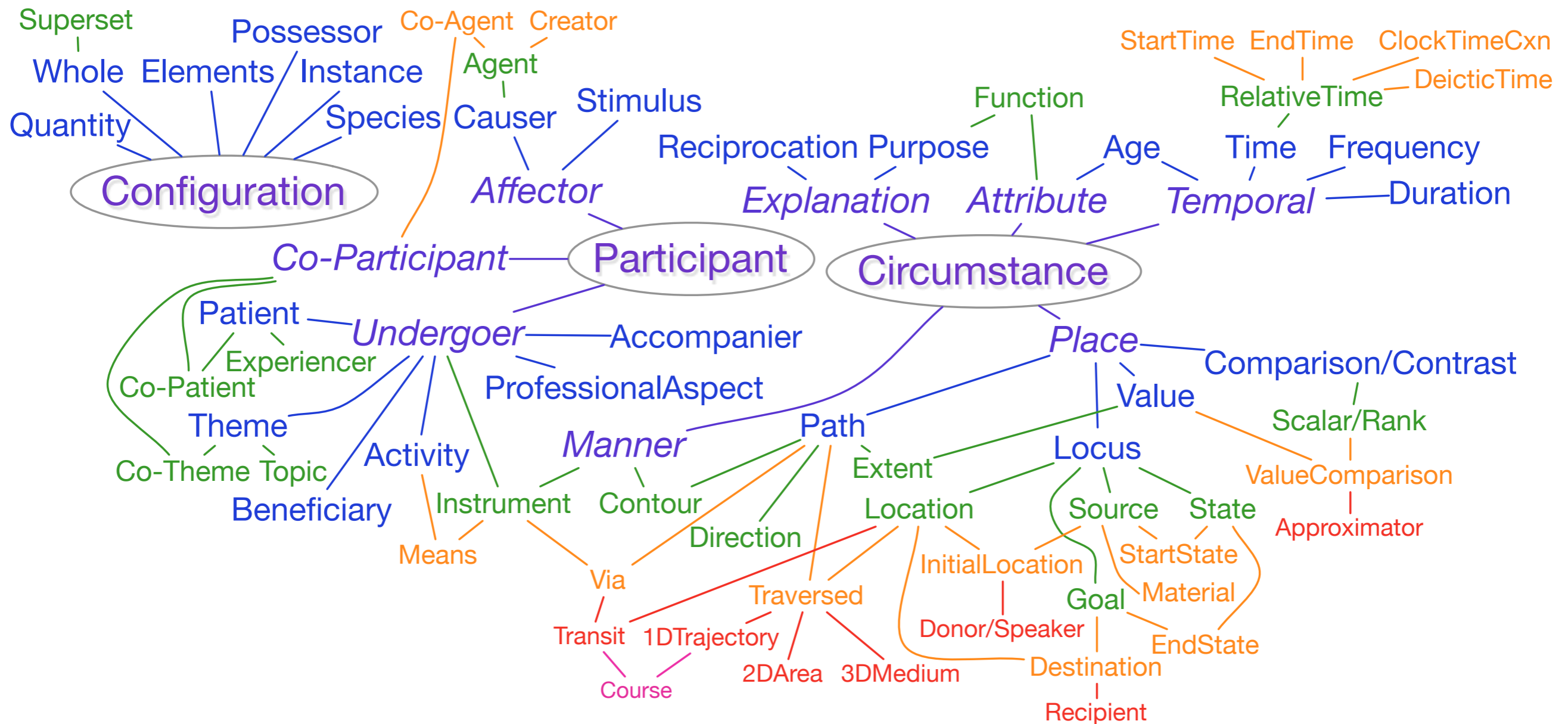
Corpus examples

Dr. Obina told me that his office closed ^{TIME} **at** noon and
that I should call him ^{TIME} **on** Monday .

I had been a patient ^{POSSESSOR} **of** Dr. Olbina ^{DURATION} **for** 9 years and
had ^{QUANTITY} **spent** thousands **of** dollars ^{THEME} **on** crowns etc .


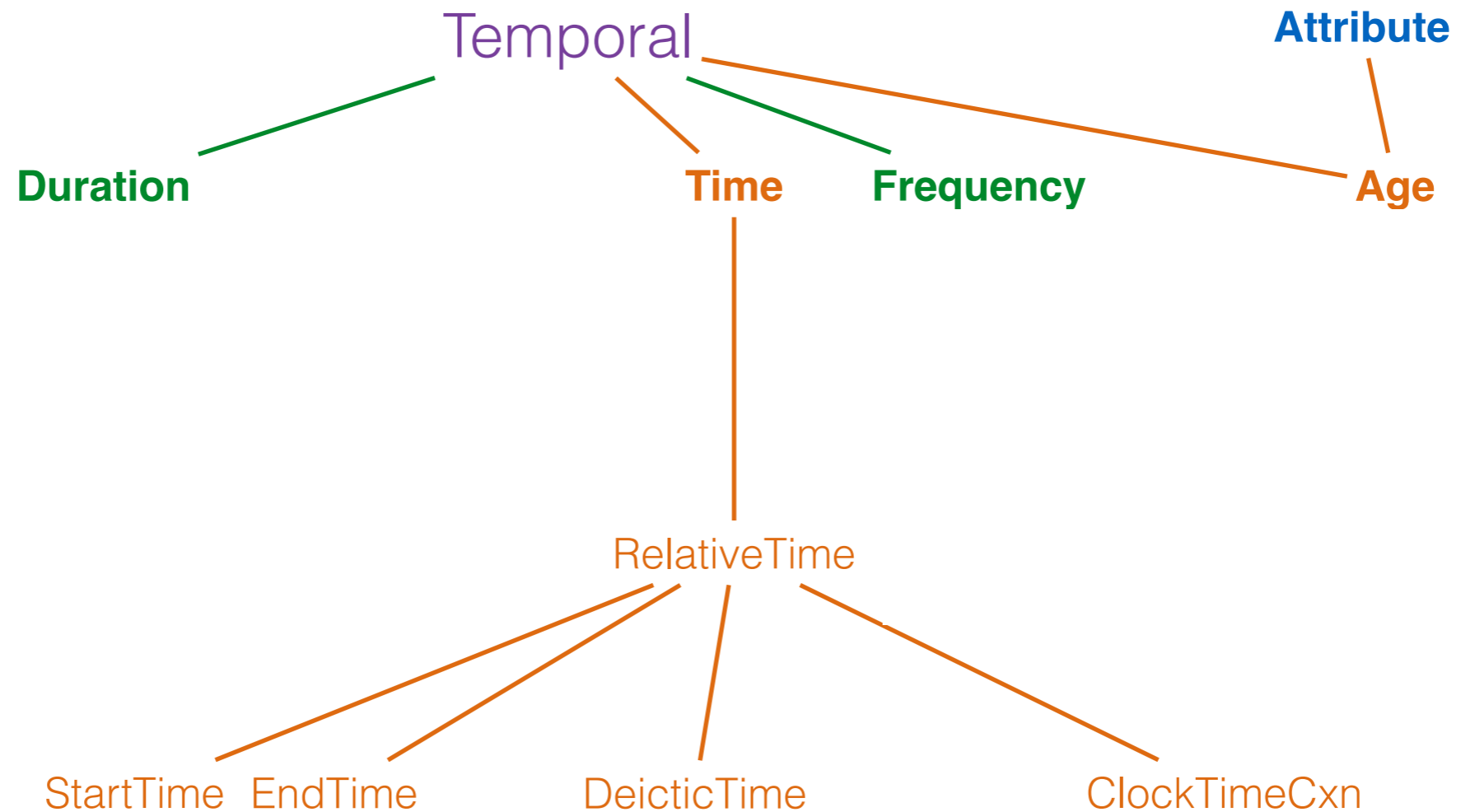
Preposition Supersenses

(Schneider et al. 2015)

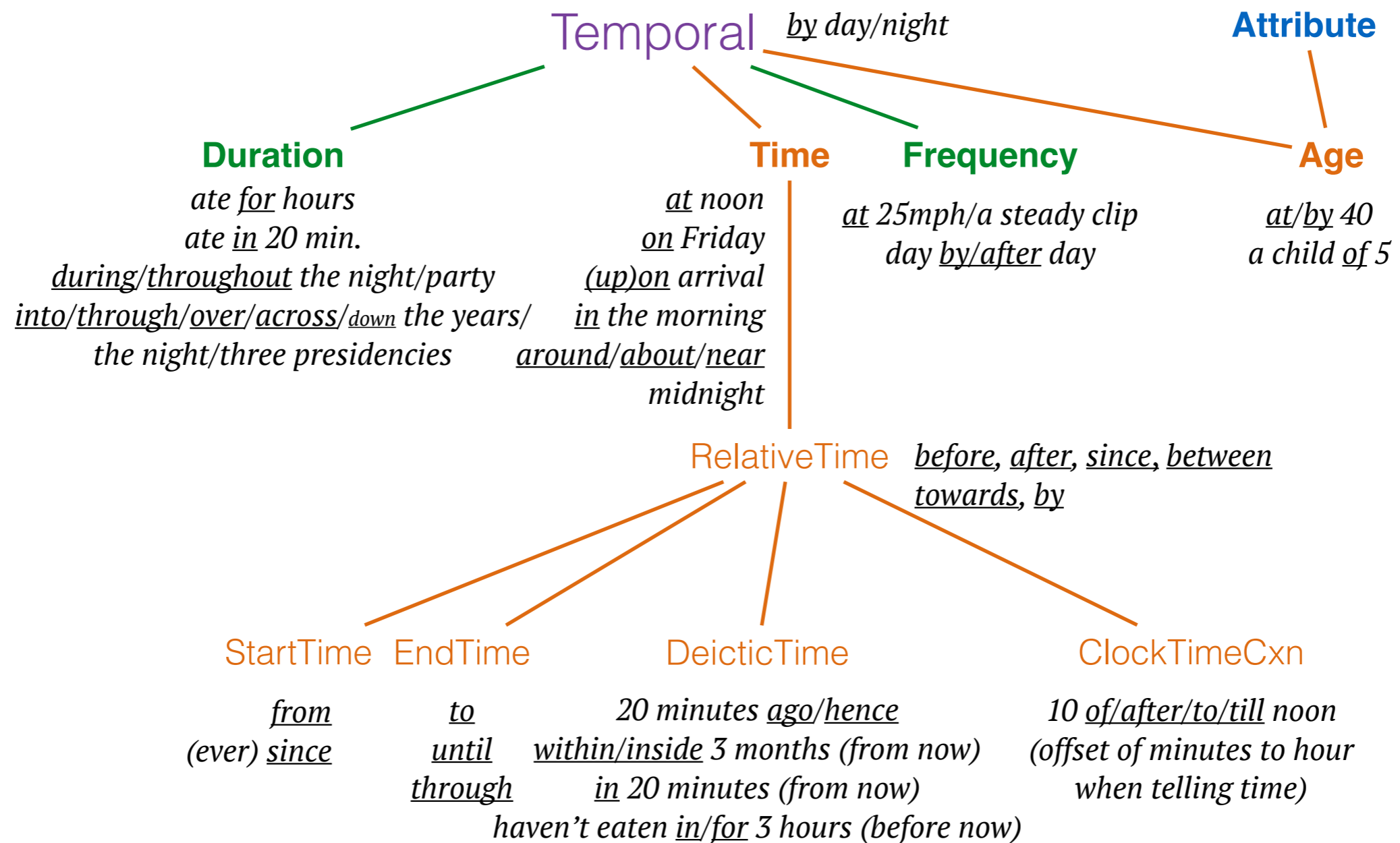


<http://tiny.cc/prepwiki>

Preposition Supersenses



Preposition Supersenses



Another sentence

Pay extra attention **to** the appetizers - the next time I go there I 'm planning **on** ordered a few instead of an entree .

Limited productivity

- Not just look at: glance at, stare at, take a gander at
- Not just look for: search for, hunt for, turn the house upside down for...
- agree/accede/yield/give in to
- depend/rely/count on
- Even decide on 'choose' (considered "frozen" by Chang) has a close relative, settle on

Limited productivity

- **How limited** does it have to be to count as a prepositional verb?
- What about
 - talk/speak/lecture/... **to**?
 - talk/speak/chat/... **with**?
 - meet/play/dine/... **with**?
- Maybe we want to call these “case-marking”, but not verb-specific, preposition functions?

English Prepositional Verbs

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 - ▶ Advantages of a CxG framework
2. Wanted: a simple and reproducible criterion
 - ▶ Failure of purely syntactic tests
 - ▶ Challenge of partial productivity
3. Ideas
 - ▶ Integral vs. nonintegral distinction
 - ▶ Argument/adjunct distinction
 - ▶ Frame semantics

“Integral” prepositions

- Our current approach takes a narrow view of “semantically inseparable”. Conservative test of omissibility:

In response to a declarative sentence with the verb+preposition combination, is there a natural way to **query the circumstances** of the verbal event **using the verb, but not the preposition**?

- | | |
|--|--|
| — I <u>came across</u> a nice restaurant. | — We <u>decided on</u> a restaurant. |
| — #When did you come? | — How long did it take you to decide? |
| — I know I can <u>rely on</u> that restaurant. | — I went to <u>look for</u> a nice restaurant. |
| — *Why can you rely? | — Where did you look? |

“Integral” prepositions

- If the preposition is required (not omissible in the question), we say it is **integral** to the verb.
 - In many such cases, the verb is polysemous and would have another reading without the preposition (e.g. *come* in *come across*)
 - Preliminary study: Two judges applied the test to verb-preposition pairs previously marked as multiword expressions.
Agreed on 69/77 = 90%.
- Related to (but simpler and narrower than) a test proposed by Tseng (2000), adapted from one in Quirk et al. (1985)
- Details: <https://github.com/nschneid/nanni/wiki/Prepositional-Verb-Annotation-Guidelines>

Sample of decisions

Integral (28 total)

- belong to
- come from 'be born at'
- come with 'characteristically include'
- consist of
- count on
- deal with (counterpart or problem)
- fall for (hoax)
- get away with 'get by with'
- keep from
- make up for 'compensate for; balance out'
- put up with
- refer to (resource)

Nonintegral (48 total)

- | | |
|---------------------|-----------------------------------|
| • argue with | • meet with 'have a meeting with' |
| • ask for 'request' | • nibble on |
| • beware of | • pay for |
| • bother with | • plan on |
| • buy from | • reek of |
| • care about | • save from |
| • check on | • suck at (activity) |
| • compliment on | • talk to |
| • cope with | • talk with |
| • disagree with | • treat s.o. to s.t. |
| • enroll in | • wait for |
| • introduce to | • work on |
| • listen to | • work with |
| • look at | • yell at |
| • look for 'search' | |

Perception_active

FrameNet

framenet.icsi.berkeley.edu

Definition:

This frame contains perception words whose perceivers intentionally direct their attention to some entity or phenomenon in order to have a perceptual experience. For this reason we call the perceiver role in this frame **Perceiver_agentive**.

She **GAZED** upon him fondly.

Comparing the Perception_active frame to the Perception_experience frame, we note that for some modalities there are different lexical items in each frame. For instance, whereas Perception_active contains the verb phrase look at, Perception_experience contains see. For other sense modalities, we find the same lexical item in both frames. To illustrate, consider the verb smell. This first sentence exemplifies the Perception_active use of the verb smell:

SMELL this to see if it's fresh. **CNI**

This second sentence exemplifies its Perception_experience sense:

I **SMELL** something rotten.

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She **GAZED** upon him **longly**.

Comparing the Perception_active frame to the Perception_experience frame, we note that for some modalities there are different lexical items in the two frames. For example, the verb **smell** is in the Perception_experience frame but not in the Perception_active frame. For other sense modalities, we find the same lexical item in both frames. To illustrate, consider the verb **see**. The first sentence exemplifies the Perception_active use of the verb **see**:

SMELL this to see if it's fresh. **ONI**

This second sentence exemplifies its Perception_experience sense:

I **SMELL** something rotten.

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Comparing the Perception_active frame to the Perception_experience frame, we note that for some modalities there are different lexical items that can be used to express the same meaning.

Perception_experience contains see. For other sense modalities, we find the same lexical item in both frames. To illustrate, consider the verb smell. The first sentence exemplifies the Perception_active use of the verb smell:

I **SMELL** this to see if it's fresh. **ONI**

This second sentence exemplifies its Perception_experience sense:

I **SMELL** something rotten.

...perception words whose perceivers intentionally direct their attention to some entity or phenomenon...

FEs:

Core:

Perceiver_agentive [per]

Semantic Type: Sentient

The **Perceiver_agentive** performs some action in order to have a perceptual experience.

It is expressed as an External Argument:

The waiter **SMELLED** the milk to see if it was fresh.

Phenomenon [Phen]

Phenomenon indicates the entity or phenomenon to which the **Perceiver_agentive** directs his or her attention in order to have a perceptual experience. Typically, it is expressed as an Object with verbs.

The waiter **SMELLED** **the milk** to see if it was fresh.

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Definition:

This frame contains perception words whose perceivers intentionally direct their attention to some entity or phenomenon in order to have a perceptual experience. For this reason we call the perceiver role in this frame **Perceiver_agentive**.

She **GAZED** upon him **intently**.

Comparing the Perception_active frame to the Perception_experience frame, we note that for some modalities there are different lexical items.

Perception_experience contains: For other sense modalities, we find the same lexical item in both frames. To illustrate, consider the verb **SMELL**. The first sentence exemplifies the Perception_active use of the verb **SMELL**.

SMELL this to see if it's fresh. **ONI**

This second

I **SMELL**

...perception words whose perceivers intentionally direct their attention to some entity or phenomenon...

Lexical Units:

(most use **at** to mark the Phenomenon!)

admire.v, attend.v, eavesdrop.v, eye.v, feel.v, gape.v, gawk.v, gaze.n, gaze.v, glance.n, glance.v, look.v, observation.n, observe.v, palpate.v, peek.n, peek.v, peep.v, peer.v, savour.v, smell.v, sniff.n, stare.n, stare.v, taste.n, taste.v, view.v, watch.v

FEs:

Core:

Perceiver_agentive [per]

Semantic Type: Sentient

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The waiter **SMELLED** **the milk** to see if it was fresh.

Arguments vs. Adjuncts

- Perhaps the literature on the **argument/adjunct distinction** will be helpful to characterize verb+preposition combinations.
- ***Hypothesis:*** Adjunct-marking prepositions never belong to a prepositional verb.
- But how do we know which PPs are adjuncts?

put it [on the shelf]?

boo him [off the stage]?

yell [at your mother]?

set off [for college]?

Arguments vs. Adjuncts

- Unfortunately, though there are clear **prototypes** of arguments vs. adjuncts, the distinction is fraught. (Literature review: Hwang 2011)
 - Syntactic and/or semantic?
 - Binary, or more than 2 kinds?
- Goldberg (2006, pp. 42–43) suggests that a phrase can be an argument (or not) w.r.t. the **verb**, and w.r.t. the **argument structure construction** (ASC).
 - Does this account for limited productivity? (When do prepositions qualify as part of an ASC?)

FrameNet

- FrameNet makes a 3-way semantic coreness distinction: **core**, **peripheral**, **extra-thematic**. Roughly:
 - **core** = conceptually necessary to understand a scene (may be expressed overtly, or implicit)
 - **peripheral** = minor characteristics within a scene (time, place, manner, etc.)
 - **extra-thematic** = extrinsic to the scene itself—assumed to have been introduced constructionally (e.g., frequency of repeated event)
- Determining coreness of a role crucially depends on the definition of the frame (and how specific it is).

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Comparing the Perception_active frame to the Perception_experience frame, we note that for some modalities there are different lexical items in each frame. For instance, whereas Perception_active contains the verb phrase look at, Perception_experience contains see. For other sense modalities, we find the same lexical item in both frames. To illustrate, consider the verb smell. This first sentence exemplifies the Perception_active use of the verb smell:

SMELL this to see if it's fresh. **CNI**

This second sentence exemplifies its Perception_experience sense:

I **SMELL** something rotten.

Lexical Units:

FEs: *admire.v, attend.v, eavesdrop.v, eye.v, feel.v, gape.v, gawk.v, gaze.n, gaze.v, glance.n, glance.v, look.v, observation.n, observe.v, palpate.v, peek.n, peek.v, peep.v, peer.v, savour.v, smell.v, sniff.v, stare.n, stare.v, taste.n, taste.v, view.v, watch.v*

Core:

Perceiver_agentive [per]

Semantic Type: Sentient

The **Perceiver_agentive** performs some action in order to have a perceptual experience.

It is expressed as an External Argument:

The waiter **SMELLED** the milk to see if it was fresh.

Phenomenon [Phen]

Phenomenon indicates the entity or phenomenon to which the **Perceiver_agentive** directs his or her attention in order to have a perceptual experience. Typically, it is expressed as an Object with verbs.

The waiter **SMELLED** the milk to see if it was fresh.

Non-Core:

Depictive [State]

State is used for predicate expressions that apply to the **Phenomenon**, providing some information about the state it is in while the perceiver's attention is directed to it:

The detective **WATCHED** the suspect **fleeing**.

Pat **TASTED** the cookie dough **raw**.

Duration [Dur]

Semantic Type: Duration

This FE identifies the **Duration** of time for which the Perception takes place.

I **WATCH** them **for quite a while** .

Expected_entity [exp]

An entity or state-of-affairs that the **Perceiver_agentive** hopes, fears, or expects to find within the **Phenomenon**.

WATCH **for little errors with hand position**.

While Bertha was n't looking, he carefully **SMELT** the soup **for any trace of the poison**.

Ground [Ground]

Ground is the perceptual background against which the **Phenomenon** is experienced by the **Perceiver_agentive**.

Kim **LOOKED** at the cloud **against the blue sky**.

Location_of_protagonist [Loc]

This FE is the position of the Perceiver during the act of perception. Typically, it is expressed in a from-PP.

We **WATCHED** the parade **from the roof**.

Maybe “prepositional verb” conflates several things

- **Integral** prepositions: come across
- **Verb-selected** prepositions: comply with
- **Frame-selected** prepositions: look at, depend on
- **Core-marking** prepositions: Co-Agent with
- A semantically-motivated alternative to Vestergaard?



Open question

- Can we identify (beyond integral/nonintegral distinction) clear subcategories of prepositional verbs?
- With broad coverage
- Without relying on
 - fuzzy tests,
 - complex and incomplete resources like FrameNet, or
 - a full account of argument structure constructions?

(Unsatisfying) conclusions

- Verb+preposition combinations can be idiomatic, but difficult to cleanly separate them
- Seems related to the argument/adjunct distinction, but that is similarly difficult to pin down
- Maybe there are several kinds of verb+preposition idiomaticity
 - Preliminary test for narrow category of “integral” prepositions
- We need a better understanding of “ordinary” preposition meanings and compositionality (argument structure, frame semantics) to recognize the extraordinary!
 - Not limited to verb-headed prepositions

Thanks

- Fellow preposition-wranglers: Jena Hwang, Meredith Green, Martha Palmer (University of Colorado at Boulder) & Vivek Srikumar (University of Utah)
- Everyone who helped with annotation and pilot annotation of preposition supersenses: Carnegie Mellon University & CU Boulder
- Michael Ellsworth (Berkeley FrameNet), Ken Litkowski, Orin Hargraves, colleagues at Edinburgh

Syntactic tests

- Several attempts to formulate syntactic tests to distinguish prepositional vs. non-prepositional verbs. (Kruisinga, Quirk et al., etc. reviewed in Tseng 2000 and dismissed as inadequate; also Vestergaard 1977, who ultimately proposed 5 degrees of PP attachment). Most famous test is the **prepositional passive**:

✓ The pardons were **decided on** by the president

✓ *The restaurant was **eaten at** by many guests

✗ *Several parts are **consisted of** by their plan;

✗ I had the feeling I was being **walked behind** (Tseng 2000)

- In practice, these tests can be difficult to apply:

She disagreed with my observation

→ ??My observation was disagreed with (by her)

I talked to a manager → ??A manager was talked to (by me)