Processing VP anaphora

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Online incremental processing vs. construction of sentence meanings

The philosophical conception of underlined sentence meanings that are

- constructed compositionally in the semantics, and are
- subsequently adjusted to contextual or background information

is hard to fit to empirical observation about the incrementality of language comprehension.

Empirical observation rather suggest that language comprehension integrates information from linguistic utterances with information that is antecedently or concurrently available from other sources, as soon as the information becomes available to the processor.

The classic division of labour

Compositional sentence contents :
propositions
(truth conditions)

SEMANTICS

Contexts → Utterance meanings

PRAGMATICS

Frege

Wenn mit dem *Tempus praesens* eine Zeitangabe gemacht werden soll, muß man wissen, wann der Satz ausgesprochen worden ist, um den Gedanken richtig zu erfassen. Dann ist also die Zeit des Sprechens Teil des Gedankenausdrucks.

(Der Gedanke, 1918)

Did he mean that, in order to capture the proposition, we must integrate knowledge from the utterance context?

David Kaplan integrates contextual information into the semantics

Character: Contexts → Contents
sentence   *propositions*
meaning

Content: Worlds → {0,1}
proposition

This accounts for contextual saturation of explicit variables - typically for indexicals, like *I, you, here, now, etc.*

… but there is more to context dependence

Immediate context influence

Suppose we apply Kaplan's conception not to sentence meanings, but to meanings of smaller constituents - ultimately lexical items - as they become available consecutively during sentence processing.

We would then not any longer compute sentence meanings from lexical meanings, but sentence denotations from denotations of sentence constituents;

and context dependence is taken into account not at sentence level, but immediately, during processing.

Evidence from sentence processing would support such a conception.

Online incremental processing (1)

Marslen Wilson & Tyler (1982)

context

(1) As Philip was walking back from the shop he saw an old woman trip and fall flat on her face.

foregrounding

(2) She seemed unable to get up again.

target		probe
(3)	a. Philip ran towards...	
	b. He ran towards...	him/her/..
	c. Running towards...	

Online incremental processing (2)
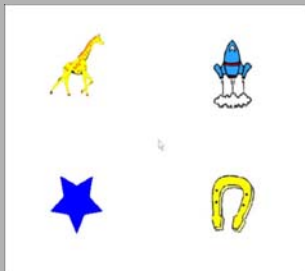
Mean naming latencies (msec):

	subj antec foregrounded		
anaphor	app	inap	delta
rep. name	379	427	48
pronoun	382	432	50
zero	381	417	36

=> reference of names, pronouns, zero is processed instantly and equally fast, and context is already taken into account.
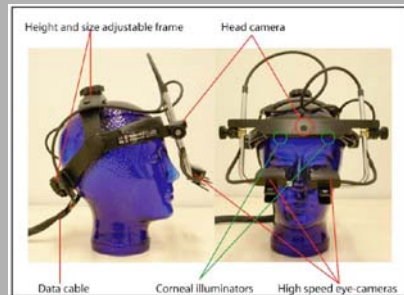
Visual world (1)

Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995

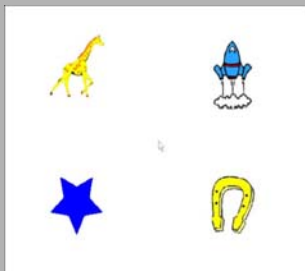*click on the blue rocket*

Visual world (2)

The headband is fitted to the subject's head and adjusted until the eyes are visible to both eye-cameras and corneal illuminators (green circles). The head camera receives a signal from 4 infrared markers attached to the corners of the display monitor.

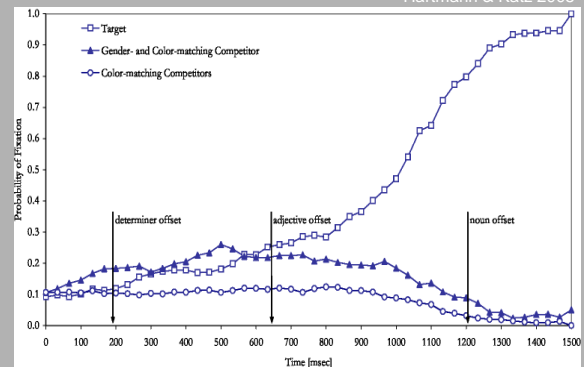(Figure from Tichanek (2004).

Visual world (3)

Hartmann & Katz 2005

Klicken Sie auf die blaue Rakete.

[click on ...] followed by a def. article, adjective, and noun
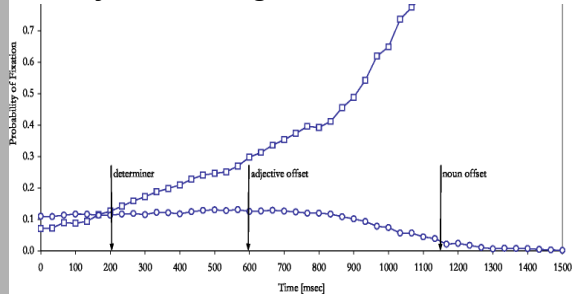
Visual world (4)

Hartmann & Katz 2005

Visual world (5)

subjects decide about reference as soon as they have enough information

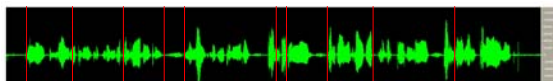## Eye tracking for reference resolution (1)

Heute ist Markt im Dorf. Die Marktfrau streitet sich mit dem Arbeiter. Sie sagt jetzt gerade, dass er ihr nun das neue Fahrrad zurückgeben soll, das er sich geliehen hat.
It's market day in the village. The market woman is qibbling with the worker. She's just saying that he should give the new bike back that he das borrowed.
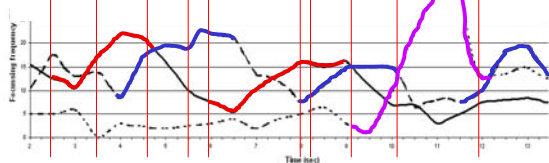
Eye tracking for reference resolution (2)

Die Marktfrau streitet sich mit dem Arbeiter Sie sagt jetzt gerade daß er ihr nun das neue Fahrrad zurückgeben soll das er sich geliehen hat

Immediate evaluation

The experimental evidence shows that referential expressions are resolved to the utterance context immediately, i.e., before sentence meanings are computed.

Should this not also be the case for unsaturated expressions, like VPs, Vs, etc.?

Anticipation effects, as in the Karabanov e.a. experiment, seem to suggest this.

So we need to look at contextual denotations of unsaturated expressions….

Considerations of VP anaphora may help here.

VP anaphora

Peter is working, and so is Fred.

Peter is working, and Fred _____ too.

Peter is working, and Fred is _____ too.

What are the relevant identity conditions between source and target?

In what terms are they defined?

surface expressions?

meanings?

LF-expressions?

denotations !

What are the contextual denotations of VPs?

Where is Fred?
(1)   *He's working.*

$$\text{WORK}_i(\text{fred}) \rightarrow \varphi \, (\text{LOCATION}(\text{fred}))$$

How can Fred afford these expensive holidays?
(2)   *He's working.*

$$\text{WORK}_k(\text{fred}) \rightarrow \psi \, (\text{WEALTH}(\text{fred}))$$

The lexical meaning of **work**, or a denotation that is determined solely by the lexical meaning, is clearly insufficient.

What are the contextual denotations of VPs?

The variation is inferentially and hence *truth-conditionally relevant*.

Nothing follows about Fred's location when
> *Fred is working*

is an answer to
> *How can Fred afford these expensive holidays?*

The variation is *stable within the utterance context*.

> *Fred is working and so is Pete.*

cannot be interpreted as, e.g.,

> *Fred is in his office and Pete can afford expensive holidays.*

What is this variation a variation of ?

- not of lexical meanings (characters)
  (because the variation is productive and correlates with variation in the context)

  | character: context → content |

- but of semantic values (contents)

I call these contextual values of predicate expressions *Contextual Concepts* (CCs)

Cf. Frege's idea that the values of "predicates" are concepts.

What is this variation a variation of ?

CCs are the contextual denotations of predicate expressions

> They are truth functions that are defined for all arguments in the intended context

CCs are linguistically real.

> They define the required notion of identity in
>
> - VP anaphora, VP ellipsis, coordination, question-answer coherence
>
> - they define units of counting

VP anaphora, VP ellipsis, Coordination

> *Fred is working and so is Pete.*
> *Fred is working, and Pete too.*
> *Fred is working and Pete is working.*
>
> + Q-A relations

Counting

> (talking of Fred, Pete, and a few others):
> *I wonder how many of them are working?*

This is NOT identity of meaning, but identity of semantic value:

> *Fred is working for **her**, and so is Pete.*

the referent of *her* must be the same for Pete and Fred and forms part of the specification of the CC ascribed to both Pete and Fred.

Denotations of VPs

[Last night at John's.]
a. Peter said he was a fool.
b. Peter saw his sister.
c. Peter defended himself.

a. $\lambda x [\![say]\!](x, [\![fool]\!](y))$
b. $\lambda x [\![see]\!](x, [\![sister\_of]\!](y))$
c. $\lambda x [\![defend]\!](x,x)$

lexical compos. VP denotations

a'. $\lambda x [\![say]\!](x,[\![fool]\!](x))$
b'. $\lambda x [\![see]\!](x,[\![sister\_of]\!](x))$
c'. $\lambda x [\![defend]\!](x,x)$

pronouns bound by abstractor

a''. $\lambda x [\![say]\!](x,[\![fool'([\![john]\!])$
b''. $\lambda x [\![see]\!](x,[\![sister\_of]\!]([\![john]\!]))$

pronouns referentially resolved

a'''. $\lambda x [\![say]\!](x,[\![fool'([\![peter]\!]))$
b'''. $\lambda x [\![see]\!](x,[\![sister\_of]\!]([\![peter]\!]))$
c'''. $\lambda x [\![defend]\!](x,[\![peter]\!])$

pronouns resolved by inference

CCs are contextual VP interpretations

VP anaphora: "sloppy" and strict

[Last night at John's.]

> Peter said he was a fool, and so did Fred.

a. Peter said Peter was a fool and Fred said Fred was a fool
   $\lambda x.[\![say]\!](x, [\![fool]\!](x)) ([\![peter]\!])$ $\lambda x.[\![say]\!](x, [\![fool]\!](x) ([\![fred]\!])$

b. Peter said Peter was a fool and Fred said Peter was a fool
   $\lambda x.[\![say]\!](x, [\![fool]\!]([\![peter]\!])) ([\![peter]\!])$ $\lambda x.[\![say]\!](x, [\![fool]\!]([\![peter]\!]) ([\![fred]\!])$

c. Peter said John was a fool and Fred said John was a fool
   $\lambda x.[\![say]\!](x, [\![fool]\!]([\![john]\!])) ([\![peter]\!])$ $\lambda x.[\![say]\!](x, [\![fool]\!]([\![john]\!]) ([\![fred]\!])$

=> strict identity of CCs in all cases

CCs

Ontologies represent *sorts (types)* of entities. These entities may be things (saturated) or properties (unsaturated), abstract or concrete.
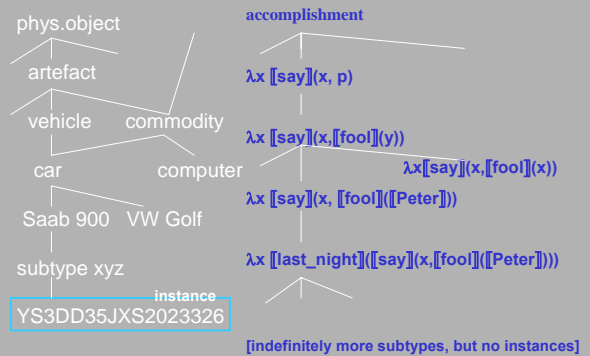
Individual concrete entities are *instances* of these sorts (tokens of these types). They can be distinguished, additionally, by their names, like elements of one set.

***Representations of sorts* are always fully specified (their identity is given by their representation)**

Representations of instances may be incomplete: We may simply not know (or not be interested in) all the sorts, which an instance is an instance of or all its attributes.

- ***Discourse referents are things: instances or sorts;***
- ***CCs are sorts.***

CCs in an ontological subsumption hierarchy

phys.object

accomplishment

artefact

$\lambda x \; [\![say]\!](x, p)$

vehicle   commodity

$\lambda x \; [\![say]\!](x,[\![fool]\!](y))$

car   computer

$\lambda x[\![say]\!](x,[\![fool]\!](x))$

$\lambda x \; [\![say]\!](x, [\![fool]\!]([\![Peter]\!]))$

Saab 900   VW Golf

subtype xyz

$\lambda x \; [\![last\_night]\!]([\![say]\!](x,[\![fool]\!]([\![Peter]\!])))$

instance

YS3DD35JXS2023326

[indefinitely more subtypes, but no instances]

Conclusions

- There is reasonable experimental evidence for immediate evaluation of referential expressions to the intended context.

- There are some indications that immediate contextual evaluation may not be restricted to referential expressions but that also unsaturated expressions are evaluated immediately.

- I am proposing Contextual Concepts as contextual semantic values of unsaturated expressions.

- CCs provide the identity conditions for VP anaphora.