Introduction to Psycholinguistics

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SS 2006

Overview

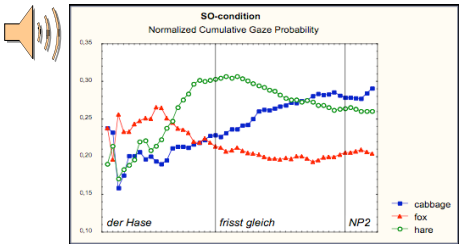
- PART I
  - ⇨ Situated spoken sentence comprehension
    - Evidence from eye-tracking
- PART II
  - ⇨ The Coordinated Interplay Account (CIA)
  - ⇨ Computational modelling of the eye-tracking findings

Theories of sentence comprehension

- Psycholinguistic theories of sentence comprehension
  - ⇨ Have largely been informed by findings from reading studies
  - ⇨ Account for influence of linguistic and world knowledge

  e.g., Frazier & Clifton, 1996; MacDonald et al., 1994, Townsend & Bever, 2001; Tanenhaus & Trueswell, 1994
- Little consideration of
  - ⇨ The role of immediate scenes for theory formation
  - ⇨ The integration of scene, linguistic/world knowledge, and utterance
- For comprehension of scene-related utterances
  - ⇨ Characterizing the online interplay between language comprehension, the use of linguistic and world knowledge, and scene processing

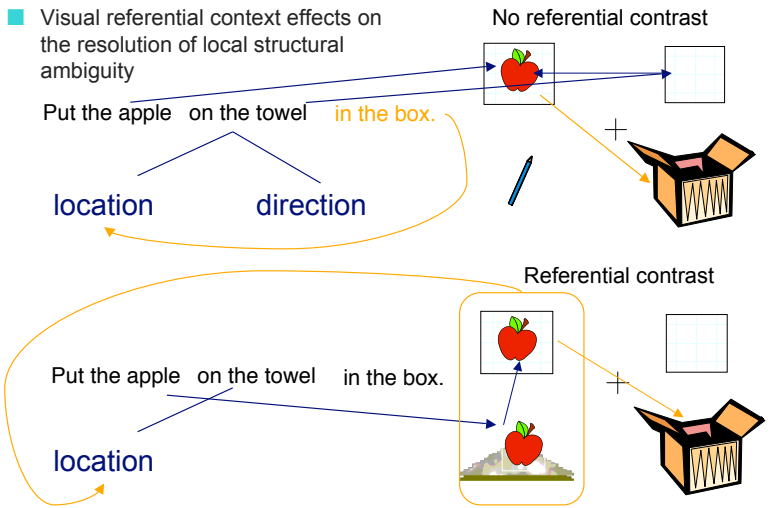
Eye tracking in scenes



- Attention to objects in the scene is closely time-locked to comprehension
  - ⇨ Makes it possible to use eye-tracking in scenes during utterance presentation to investigate spoken comprehension
  - ⇨ Permits us to examine use of scene information for comprehension

Tanenhaus et al., 1995, *Science*

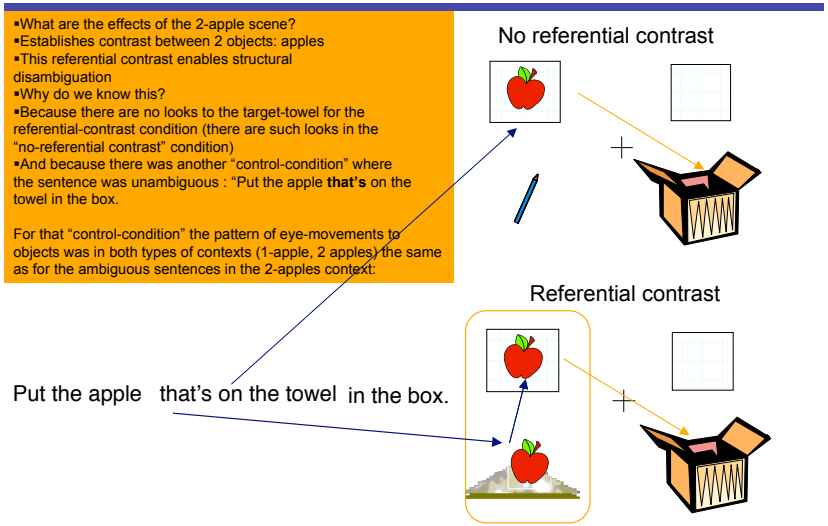
- Visual referential context effects on the resolution of local structural ambiguity



Tanenhaus et al., 1995, *Science*

- What are the effects of the 2-apple scene?
- Establishes contrast between 2 objects: apples
- This referential contrast enables structural disambiguation
- Why do we know this?
- Because there are no looks to the target-towel for the referential-contrast condition (there are such looks in the "no-referential contrast" condition)
- And because there was another "control-condition" where the sentence was unambiguous : "Put the apple **that's** on the towel in the box.

For that "control-condition" the pattern of eye-movements to objects was in both types of contexts (1-apple, 2 apples) the same as for the ambiguous sentences in the 2-apples context:

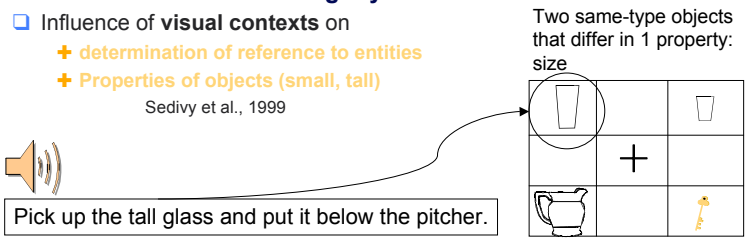


Incremental semantic interpretation

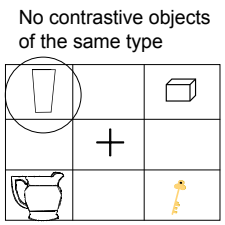
More visual referential ambiguity

- Influence of **visual contexts** on
  - + determination of reference to entities
  - + Properties of objects (small, tall)

Sedivy et al., 1999

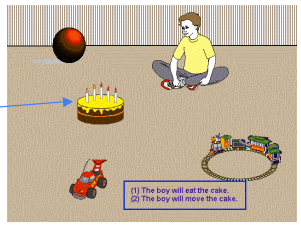


- More rapid looks to the tall glass before hearing "glass" in the contrastive than non-contrastive condition



Anticipatory eye-movements

- Anticipatory eye-movements: eye-movements to an object in a scene before it has been named
- Do verb selectional restrictions allow anticipation of as yet unmentioned postverbal argument/ its referent in the scene
  - Verb selectional restrictions: *eat* can take only edible objects as arguments
- What is anticipated?
- Why is an object anticipated?
- "The boy will move the cake."
  - train, ball, toy car and cake can be moved
- "The boy will eat the cake."
  - highly restrictive: only the cake is edible



Kamide et al., 2003

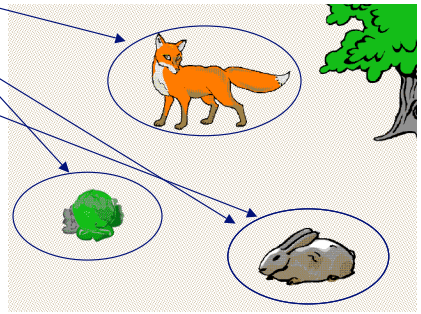
- Case-marking and world-knowledge (Kamide et al., 2003)

Der Hase frisst gleich den Kohl.

Den Hasen frisst gleich der Fuchs.

▪Why is there a postverbal adverb?
▪Adv is filler word to permit observing people's expectations through their eye-movements

Which is the interesting condition? "Der Hase" or "Den Hasen"? Why?



- Task: comprehension + occasional questions
- Which comprehension processes occur when people hear NP1 + verb?
  - Compositional integration of case-marking and verb plausibility
  - Thematic role-assignment
- Where people looked and which comprehension processes took place was influenced rapidly by
  - **Linguistic / world knowledge**: case-marking + verb plausibility

Summary visual world studies

- What are the differences between the Kamide et al., 2003 and the Tanenhaus studies?
  - Type of sentence
    - KA: "Der Hase/Den Hasen" unambiguous sentences
    - TA: sentences are structurally ambiguous
  - Comprehension processes
    - KA: incremental thematic interpretation
    - TA: structural disambiguation
  - The time course of eye-movements in relation to comprehension
    - KA: "Der Hase/Den Hasen frisst" anticipatory looks to likely object before object is named
    - TA: incremental; looks to object after word is mentioned
  - Implications for time-course of spoken comprehension use of scene information
    - Incremental, and sometimes even predictive
    - Rapid use of linguistic knowledge and information from a visual referential context
  - What is the decisive information in understanding the sentences in each of the studies?
    - Der Hase/Den Hasen: case-marking + verb plausibility; *scene* is a constant factor!
    - 1 Apple/ 2 Apples: visual referential contrast/ no referential contrast; *sentence* is constant factor

Summary visual worlds studies

- Which kinds of information may influence spoken sentence comprehension ?
- Incremental use of
  - Linguistic knowledge
    - Verb selectional restrictions
    - Scalar adjectives
    - Case-marking + verb plausibility
  - Visual scene information
    - Properties of objects (size, shape, texture)
    - Referential contrast between objects
    - … ? … well, how about events?
- What comprehension processes do the various types of information influence?
  - Referential visual contrast: structural disambiguation } identify scene objects
  - Adjectives: incremental semantic interpretation
  - Case-marking&verb plausibility: thematic role-assignment

The role of enriched scenes

- Influence of other types of information in scenes
  - ⇨ E.g., depicted events?
- Use of depicted events for comprehension
  - ⇨ Rapid and incremental?

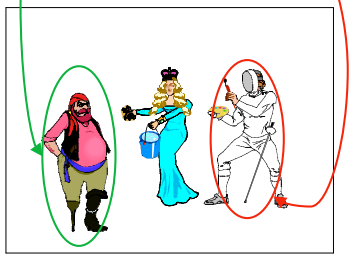
Depicted events

Knoeferle et al., 2005, *Cognition*

- German SVO/OVS sentences
  - ⇨ Initial structural and role ambiguity

SVO Die Prinzessin wäscht offensichtlich den Piraten.
The princess (amb.) washes apparently the pirate (obj).

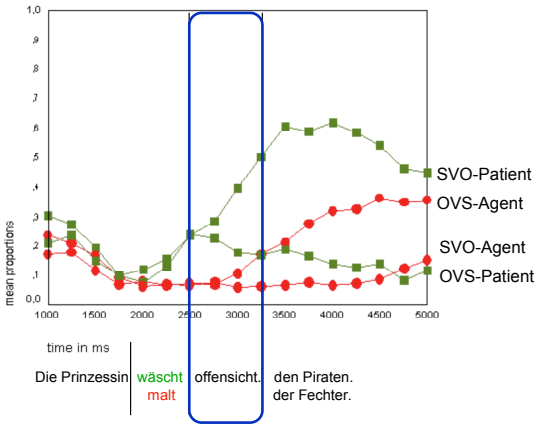
OVS Die Prinzessin malt offensichtlich der Fechter.
The princess (amb.) paints apparently the fencer (subj).



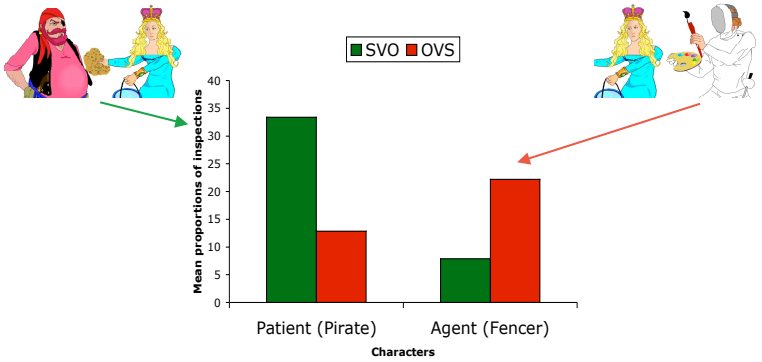
What we measure

- Eye movements to entities in the scene as the utterance unfolds
- Colour bitmaps to map X/Y coordinates of fixations onto entities
- Entities are coded for their role (ambiguous, agent, patient)

Time-course of scene influence



Shortly after the verb



SVO: Die Prinzessin (agent/amb.) wäscht offensichtlich…
OVS: Die Prinzessin (patient/amb.) malt offensichtlich…

Summary depicted events

- Influence of other types of information in scenes
  - ⇨ Depicted events
- Time-course of scene influence on comprehension
  - ⇨ Rapid and verb-mediated

Discussion

Influence of **structure in visual contexts** on **structural disambiguation**

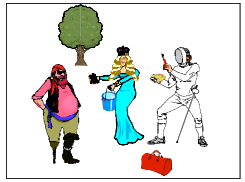
In previous studies scenes only contained **things**

⇨ **Contrast between things**

Tanenhaus et al., 1995

In our studies scenes contained **events**

⇨ **Depicted actions & role relations**



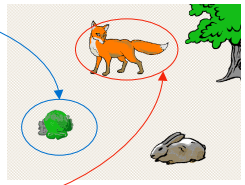
Discussion

Previous research

⇨ **world knowledge** & **case-marking** ⇒ anticipation of thematic roles

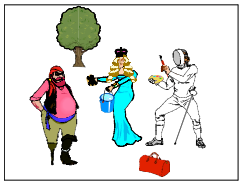
Kamide et al., 2003; Scheepers et al., 2003

Der Hase (subj)	**frisst** gleich	den Kohl.	
The hare (subj)	*eats soon*	*the cabbage.*	
Den Hasen (obj)	**frisst** gleich	der Fuchs.	
The hare (subj)	*eats soon*	*the fox.*	



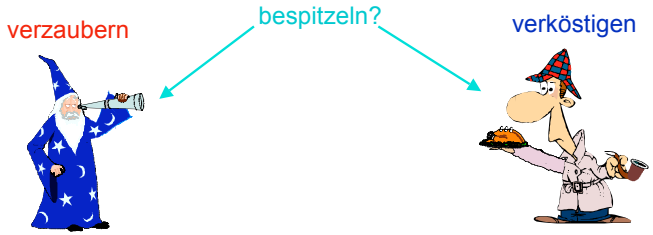
⇨ **Role information** from the **immediate scene**

⇒ incremental thematic role assignment



Depicted events versus thematic knowledge

- Importance of scene information (depicted events)
  - ⇨ Relative to linguistic and world knowledge



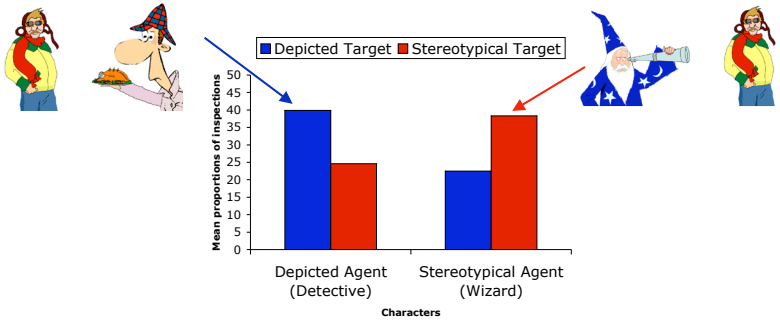
Stored thematic knowledge **or** depicted

- Each agent (detective, wizard) is uniquely identified

Depicted Den Piloten verköstigt gleich der Detektiv.
The pilot (obj) serves-food-to soon the detective (subj).

Stored Den Piloten verzaubert gleich der Zauberer.
The pilot (obj) jinxes soon the wizard (subj).

Shortly after the verb



Depicted Target: Den Piloten (patient) *verköstigt* gleich …
The pilot (patient) serves-food to soon …

Stereotypical Target: Den Piloten (patient) *verzaubert* gleich …
The pilot (patient) jinxes soon …

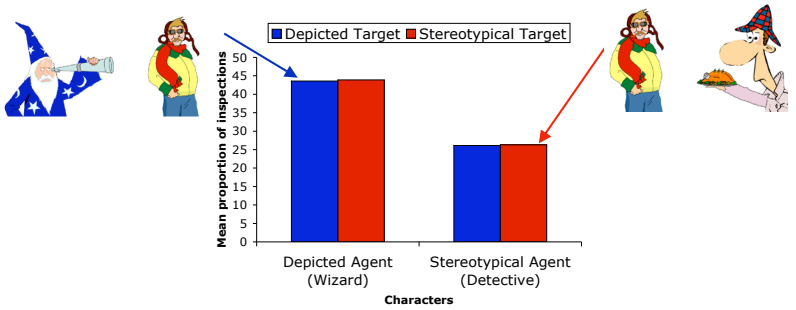
Stored thematic knowledge **versus** depicted

- Both agents (detective, wizard) identified by the verb

Depicted Den Piloten bespitzelt gleich der Zauberer.
The pilot (obj) spies-on soon the wizard (subj).

Stored Den Piloten bespitzelt gleich der Detektiv.
The pilot (obj) spies-on soon the detective (subj).

Shortly after the verb



Depicted Target: Den Piloten (patient) *bespitzelt* gleich …
The pilot (patient) spies-on soon …

Stereotypical Target: Den Piloten (patient) *bespitzelt* gleich …
The pilot (patient) spies-on soon …

Conclusions and interim summary of findings

- Rapid use of visual referential context for disambiguation
- Rapid use of contrastive properties of same-type objects for semantic interpretation
- Rapid use of verb selectional restrictions
- Rapid use of case-marking, verb meaning, and world knowledge
- Verb-mediated use of depicted events for thematic role assignment and structural disambiguation
- Greater relative priority of non-stereotypical depicted events over stereotypical thematic role knowledge

Coordinated Interplay Account (CIA)

- Two key steps in situated utterance comprehension
  - ⇨ Utterance comprehension guides attention in the scene
    - Establishing reference to objects and events

      Tanenhaus et al., 1995
    - Anticipating likely referents

      Altmann & Kamide, 1999
  - ⇨ Once the utterance has identified the most likely object or event, and attention has shifted to it, the attended scene information then rapidly influences utterance comprehension

    Knoeferle et al., 2005; Knoeferle & Crocker, 2006
- Close time-lock between comprehension and attention involves
  - ⇨ Strategy of first checking the scene
  - ⇨ Greater relative priority of immediately depicted events

Predictions of the CIA

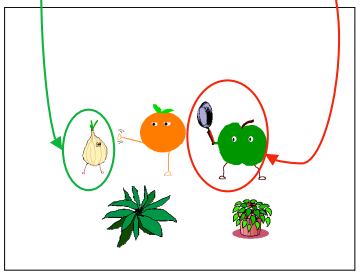
- Temporal-coordination hypothesis
  - ⇨ For early versus late identification of relevant scene events, we would expect a temporal difference in disambiguation
- The priority of depicted events
  - ⇨ When scenes are not immediately present
  - ⇨ When events are absent, but characters (and their affordances) are present

Experiment 4

Knoeferle, accepted

- Ambiguous SVO versus OVS sentences

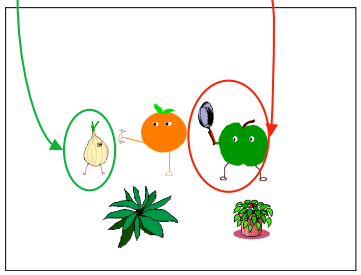
SVO	Die Frau Orange	tritt	in diesem Moment	den Sir Zwiebel.
	The Ms Orange (amb.)	kicks	currently	the Sir Onion (object).
OVS	Die Frau Orange	schlägt	in diesem Moment	der Sir Apfel.
	The Ms Orange (amb.)	hits	currently	the Sir Apple (subject).



Experiment 4

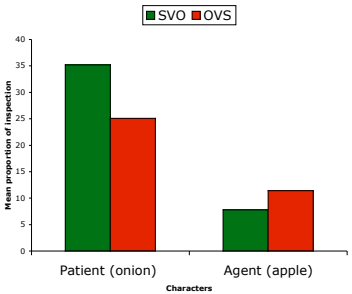
- Unambiguous SVO versus OVS sentences

SVO	Der Herr Orange	tritt	in diesem Moment	den Sir Zwiebel.
	The Mr Orange (amb.)	kicks	currently	the Sir Onion (object).
OVS	Den Herrn Orange	schlägt	in diesem Moment	der Sir Apfel.
	The Mr Orange (amb.)	hits	currently	the Sir Apple (subject).

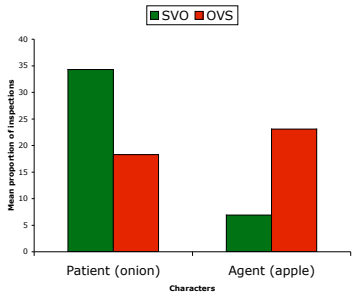


Verb region

Initially ambiguous

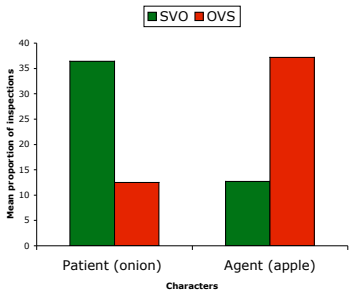


Unambiguous - early influence



Shortly after the verb

Initially ambiguous



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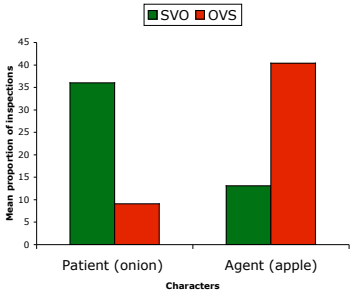
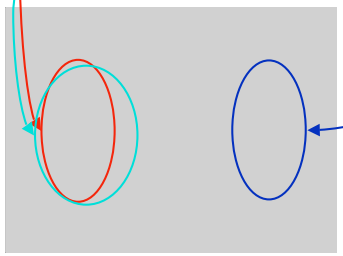


Predictions of the CIA

- Experiment 4: Temporal-coordination hypothesis
  - ⇨ For early versus late identification of relevant scene events, we would expect a temporal difference in disambiguation
- Experiments 5 and 6: The priority of depicted events
  - ⇨ Experiment 5: Scenes are not immediately present
  - ⇨ Experiment 6: Events are absent, but characters (and their affordances) are present

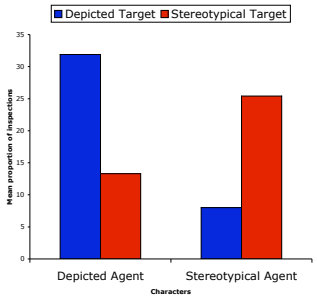
Experiment 5 - blank screen

Depicted	Den Piloten	verköstigt	gleich	der Detektiv.
	The pilot (obj)	*serves-food-to*	*soon*	*the detective (subj).*
Stored	Den Piloten	verzaubert	gleich	der Zauberer.
	The pilot (obj)	*jinxes*	*soon*	*the wizard (subj).*
Amb.	Den Piloten	bespitzelt	gleich	der Zauberer /Detektiv.
	The pilot (obj)	*spies-on*	*soon*	*the wizard /detective (subj)*

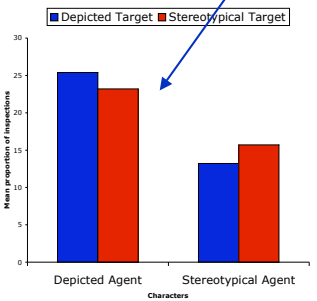


Results - blank screen

- Unique conditions



- Ambiguous conditions



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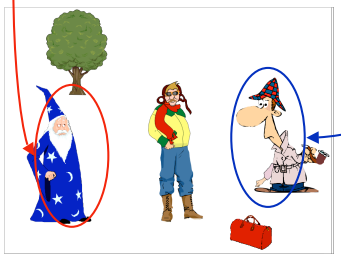
  - ⇨ Experiment 6: Events are absent, but characters (and their affordances) are present

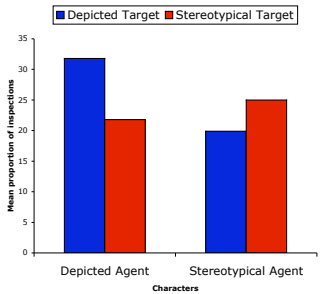
Experiment 6 - disappearing events

Depicted	Den Piloten	verköstigt	gleich	der Detektiv.
	The pilot (obj)	*serves-food-to*	*soon*	*the detective (subj).*
Stored	Den Piloten	verzaubert	gleich	der Zauberer.
	The pilot (obj)	*jinxes*	*soon*	*the wizard (subj).*
Amb.	Den Piloten	bespitzelt	gleich	der Zauberer /Detektiv.
	The pilot (obj)	*spies-on*	*soon*	*the wizard /detective (subj)*

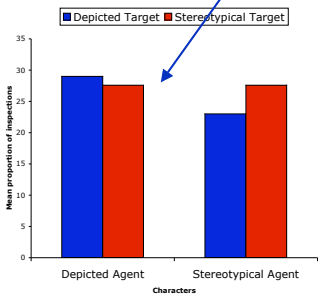


Results - disappearing events

- Unique conditions



- Ambiguous conditions



Depicted events with event-related potentials

- No scenes, written presentation
  - ⇨ Initially ambiguous German SVO versus OVS: P600
  - ⇨ Initially unambiguous German SVO versus OVS: no P600

e.g., Matzke et al., 2002

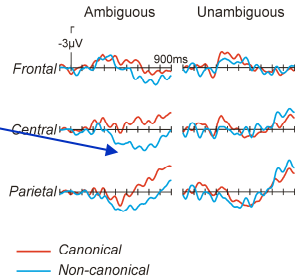
- With scenes, auditory presentation

Unamb.	SVO	Der Musiker	wäscht	offensichtlich	den Piraten.
		The musician(subj.)	*washes*	*apparently*	*the pirate (obj).*
	OVS	Den Musiker	malt	offensichtlich	der Fechter.
		The musician (obj.)	*paints*	*apparently*	*the fencer (subj).*

Results verb region

Knoeferle, Habets, Crocker & Münte, in prep.

- With scenes, P600 for ambiguous SVO/OVS



Summary ERPs

- Depicted events enable structural disambiguation of initially structurally ambiguous SVO/OVS utterances
  - ⇨ Corroborates eye-tracking findings on depicted events
  - ⇨ Implications for theories of sentence comprehension
    - Immediate syntactic revision through information from depicted events