

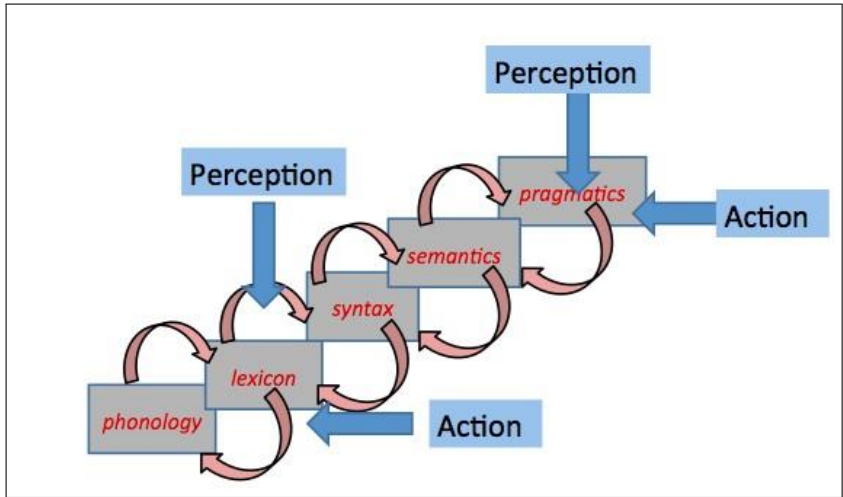
Comprehension of case in German children: Evidence against a maturational hypothesis

Duygu Özge, Jaklin Kornfilt, Katja Münster, Pia Knoeferle,
Aylin Küntay, and Jesse Snedeker

dozge@wjh.harvard.edu

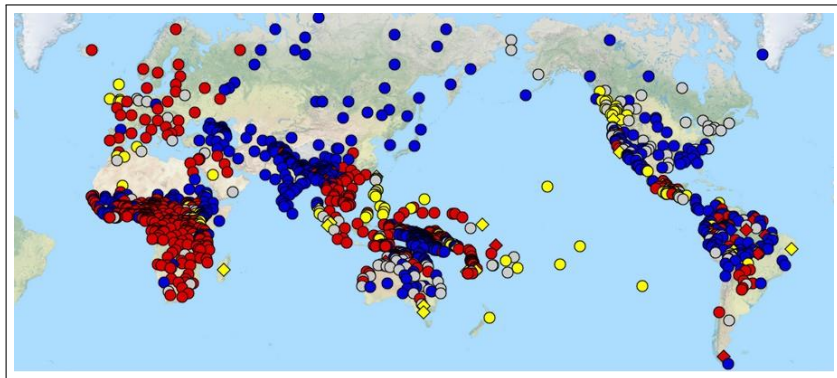
*28th Annual CUNY Conference on Human Sentence Processing,
University of Southern California
March 20, 2015*

21st century standard model of language processing



Word order variation

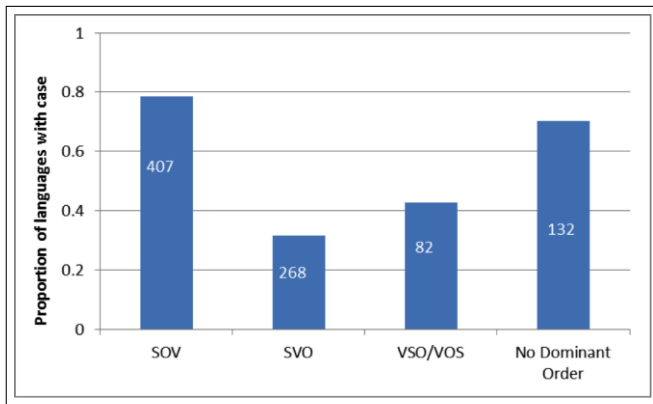
Dryer 2011, WALS



●	SOV	565
●	SVO	488
●	VSO	95
◆	VOS	25
◆	OVS	11
◆	OSV	4
○	No dominant order	189

Case marking is more common when the verb is late or order is variable

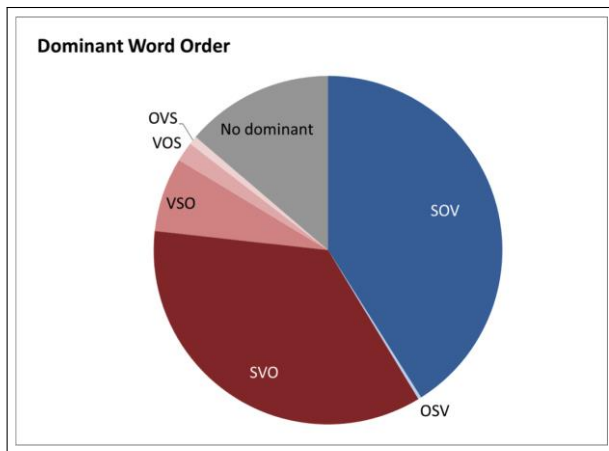
Dryer 2011, WALS



Two prototypes

Dryer 2011, WALS

- **Head-initial:** Strict order, early verb, limited case.
- **Head-final:** Flexible order, late verb, rich case.



English speakers use verbs to predict arguments

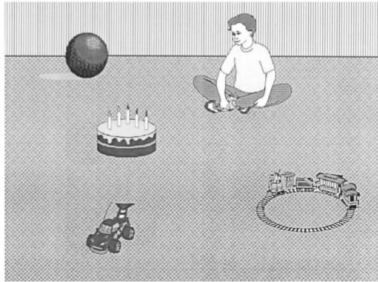
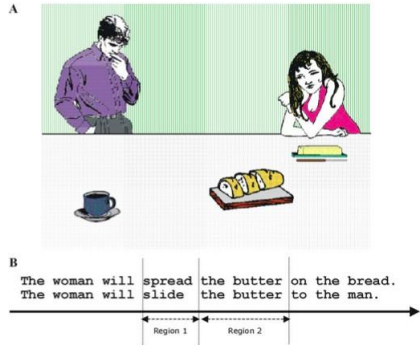


Fig. 1. Example scene used in Experiments 1 and 2 (Sections 2 and 3). Participants heard 'The boy will move the cake' or 'The boy will eat the cake' whilst viewing this scene.

Altmann & Kamide, 1999




Kamide, Altmann, & Haywood, 2003

Japanese adults use case predictively prior to the verb

Kamide, Altmann, & Haywood, 2003

A

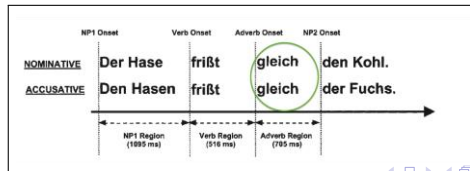
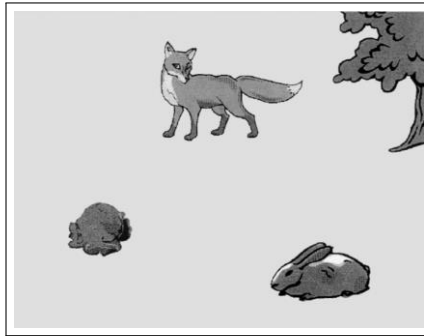


B

waitress-nom	customer-dat	merrily	hamburger-acc	bring.
ウェイトレスが	客に	楽し気に	ハンバーガーを	運ぶ。
		←-----→		
ウェイトレスが	客を	楽し気に	からかう。	
waitress-nom	customer-acc	merrily	tease.	

German adults use case predictively after the verb

Kamide, Scheepers, & Altmann, 2003



Moral:

Basis for thematic prediction varies cross-linguistically

- Head-initial languages (e.g., English, French)
 - Assign agent role to NP1
 - Predict upcoming arguments using verb
- Head-final languages (e.g., Turkish, Japanese)
 - Use case to integrate arguments into event representation
 - Predict verb using case markers and arguments

Do children use case predictively

- **Hypothesis 1: Case initially ignored**

- **Hypothesis 1a:** Relevant neural systems late to mature (Friederici et al. 2006; Friederici, 2011).
- **Hypothesis 1b:** Abstract syntax-semantics mappings acquired late (Tomasello, 1992; 2000; Pine et al., 1998; Savage, et al., 2003; Abbot-Smith & Tomasello, 2006; Boyd & Goldberg, 2012).

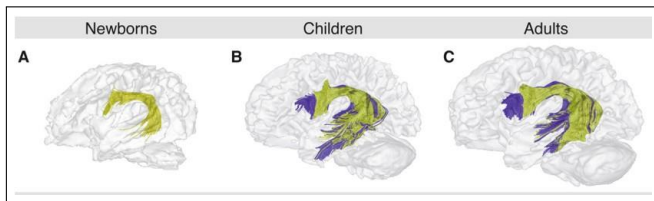
- **Hypothesis 2: Case used early when predictive**

- **Constraint satisfaction models** (MacWhinney, Pleh, & Bates, 1985; MacDonald et al. 1994; Tanenhaus, et al. 1995; Snedeker & Trueswell, 2004; Trueswell & Gleitman, 2007).
- **Early syntax-semantics mapping are abstract** (Pinker, 1984; 2007; Fisher, 2002; Gertner et al., 2006; Hartshorne & Snedeker, 2013; Hartshorne, O'Donnell, Sudo, Uruwashi, Lee, & Snedeker, under review).

Hypothesis 1a:

Late developing dorsal connections impair complex syntactic interpretation

- Dorsal fiber tracts connecting temporal cortex and Brodmann Area (BA) 44 develops as the brain matures (Pujol, et al., 2006; Perani et al., 2011).



- Function of late developing dorsal connections: processing complex syntax (Friederici et al. 2006; Friederici, 2011; 2012; Brauer et al., 2011; Knoll et al., 2013).
- As evidenced by: failure to interpret case and reliance on word order

Hypothesis 1b:

Abstract syntax-semantics mappings acquired late

- Children initially rely on narrow verb-based generalizations.
 - HUGGER hug HUGEE
- Early syntactic representations are wholistic constructions generalized from these verb islands.
- Children gradually extract features from constructions, order might be easier.
- **Supported by:** failure to interpret case and reliance on verb and word order.

(Tomasello, 1992; Tomasello, 2000; Savage, et al., 2003; Boyd & Goldberg, 2012)

Hypothesis 2:

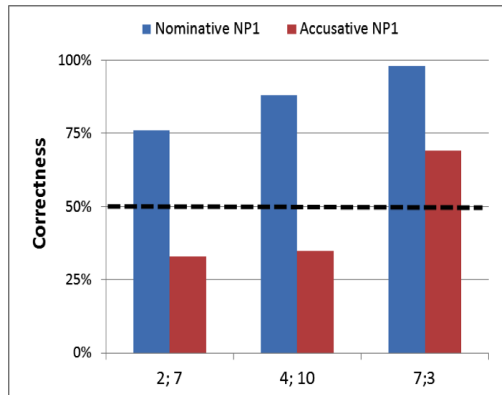
Case used early when predictive

- **Constraint-based parsing** (Tanenhaus, et al. 1995; Snedeker & Trueswell, 2004; Trueswell & Gleitman, 2007):
 - Highly predictive cues acquired early and used incrementally
 - Processing architecture like adults
- **Children break into language with:**
 - Abstract, compositional event representations (like adults)
 - Statistical learning abilities (for finding syntactic markers and classes)
 - Bias to expect clean mappings between semantics and syntax
(Pinker, 1984; 2007; Fisher, 2002; Gertner et al., 2006; Hartshorne & Snedeker, 2013; Hartshorne, O'Donnell, Sudo, Uruwashii, Lee, & Snedeker, under review)
- **Prediction:** incremental interpretation of case prior to the verb.

Evidence for late comprehension of German case

Dittmar, Abbot-Smith, Lieven, & Tomasello, 2008

Act-out and picture-selection with novel verbs



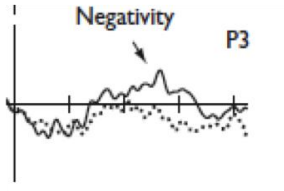
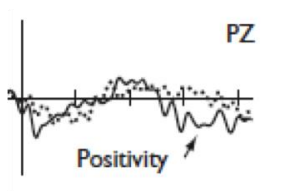
Similar results
for known
verbs Lidner
(2003)

"German children [may] pass through a stage in which they rely solely on word order and ignore case marking when these cues conflict." (p.1162)

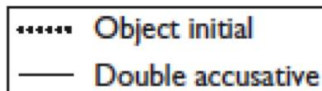
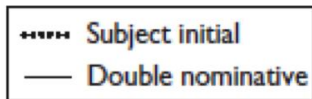
Evidence for late comprehension of German case, ERP

Schipke, Friederici, & Oberecker, 2012

From 3-6 years:



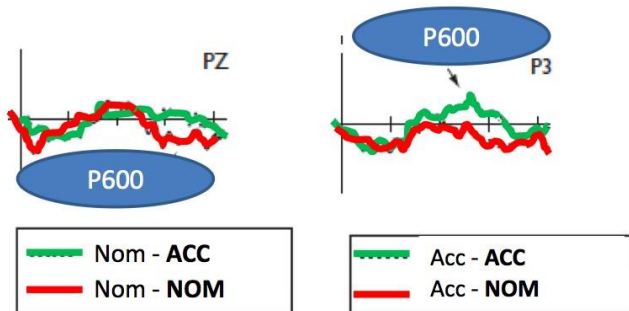
4;6 years



Evidence for late comprehension of German case, ERP

Schipke, Friederici, & Oberecker, 2012

From 3-6 years:



4;6 years

Nominative NP2 generates P600 regardless of NP1 case

Evidence for late comprehension of German case, fMRI

Knoll, Obleser, Schipke, Friederici & Brauer, 2012

- Adults and precocious 6 year olds have more LIFG activation for OVS sentences than SVO.
- Typical 6 year olds do not.

Do Turkish-speaking children interpret case incrementally?

Özge, Küntay, & Snedeker, 2013

Aim: Do Turkish-speaking children interpret case incrementally independent of the verb?

Participants: 20 monolingual Turkish-speaking children (aged: 4;0-5;0).

Task: Visual-world eye-tracking task modeled on Kamide, Scheepers, & Altmann (2003).

Items: Verb-final sentences in two orders (SOV, OSV).

Stimuli

Nominative Condition (SOV)



SOV

Tavşan birazdan şurada-ki havuç-u yi-yecek.
rabbit-NOM shortly that-Rel carrot-ACC eat-FUT-3sg

'The rabbit will shortly eat the carrot over there.'

Stimuli

Accusative Condition (OSV)



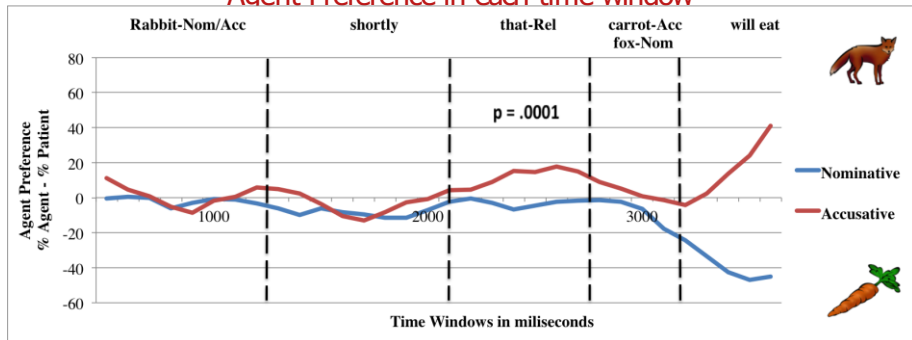
OSV:

Tavşan-ı birazdan şurada-ki tilki yi-yecek.
rabbit-ACC shortly thatRel fox-NOM eat-FUT-3sg

'The fox over there will shortly eat the rabbit.'

Turkish kids interpret case predictively, prior to verb

Agent Preference in each time window



- Predictive looks **before** the verb, during the **Modifier Region**.

What about German-speaking children?

- Previous findings suggest they will fail.
- Case may be less useful cue in German:
 - Less transparent case than Turkish and often ambiguous
 - German word order less variable
 - Not a typical verb-final language

Present Study

Interpretation of case marking in German

Aim: Do German-speaking children use case to predict the role of the upcoming argument independent of the verb?

Participants: 20 monolingual German-speaking children (aged: 4;0-5;0).

Task: Visual-world task similar to Turkish study.

Items: Verb-final sentences with masculine nouns; no embedded clauses.

Stimuli

Nominative Condition (SOV)



SOV:

Der Hase wird **im nächsten Moment** den Kohl aufspüren.
 rabbit-NOM will **shortly** Cabbage-ACC find-FUT-3sg
 'The rabbit will shortly find the cabbage.'

Stimuli

Accusative Condition (OSV)



OSV:

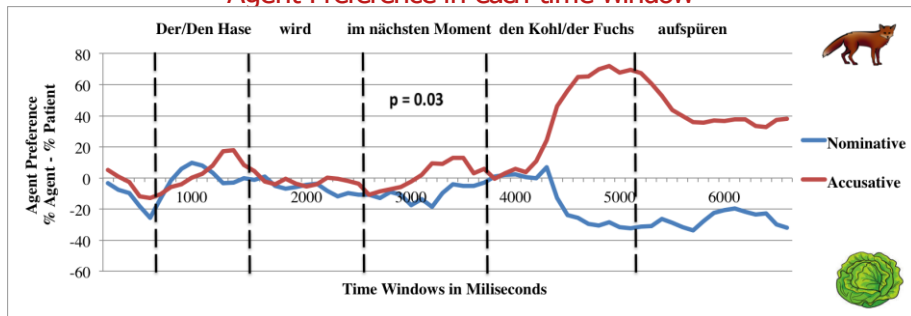
Den Hasen wird **im nächsten Moment** der Fuchs aufspüren.

rabbit-ACC will **shortly** fox-NOM find-FUT-3sg

'The fox will shortly find the rabbit.'

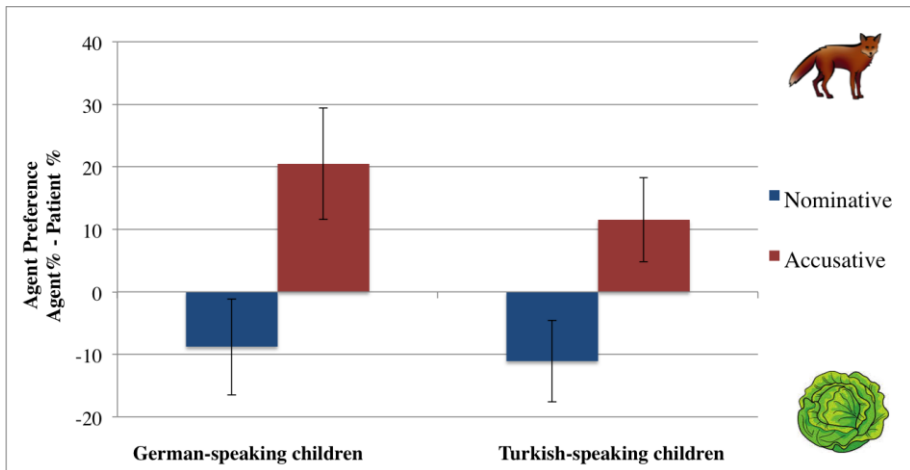
Results

Agent Preference in each time window



- Predictive looks **before** the verb, during the **Adverbial Region**.

Agent preference in German vs. Turkish



Discussion

- German-speaking 4-year-old children incrementally use case marking to **predict** upcoming arguments, prior to the verb.
- Expected if acquisition is driven by **early abstract mappings** between syntax and semantics (Pinker, 1984; 2007; Fisher, 2002; Gertner et al., 2006; Hartshorne & Snedeker, BUCLD 2013; Snedeker, AMLAP 2014; Hartshorne, O'Donnell, Sudo, Uruwashi, Lee, & Snedeker).
- Predicted by **constraint satisfaction models** of acquisition and processing (MacWhinney, Pleh, & Bates, 1985; MacDonald et al. 1994; Tanenhaus, et al. 1995; Snedeker & Trueswell, 2004; Trueswell & Gleitman, 2007; Özge, Küntay, & Snedeker, 2013).
- Contrasts with prior findings from **novel verb** and **ERP** studies (Dittmar, et al., 2008; Schipke et al; 2012; Knoll et al., 2012).

Discussion

- Previous failures of German-speaking preschoolers have fueled two strong claims:
 - Complex syntactic processes **mature late** in the brain (Friederici et al. 2006; Friederici, 2011; 2012; Brauer et al., 2011; Knoll et al., 2013).
 - Early syntactic representations are wholistic constructions generalized from representations of **individual verbs** (Tomasello, 1992; 2000; Pine et al., 1998; Savage, et al., 2003; Abbot-Smith & Tomasello, 2006).
- Present findings do not support these claims.

Accounting for discrepant results

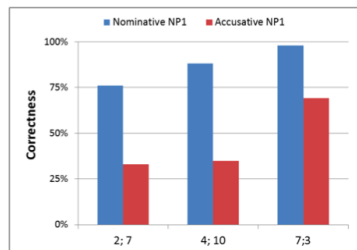
- Less Demanding Task?
 - **Unlikely:** Failures in passive listening (Schipke et al., 2012; Knoll et al., 2012).
- Presence of all participants in **discourse context**?
 - Could facilitate object topicalization.
- Use of **verb final** structures?
 - More time for processing of case prior to verb.
- Final role assignment reinforced by **animacy and world knowledge**?
 - Reduced interference from alternate mapping.

Accounting for discrepant results

Difference in perspective and coding

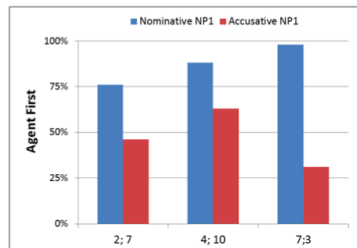
- Dittmar analyzes % correct

These differences are effects of
ORDER



- We analyze agent assignment

These differences are effects of
CASE



OK, but what about the fMRI and ERP data?

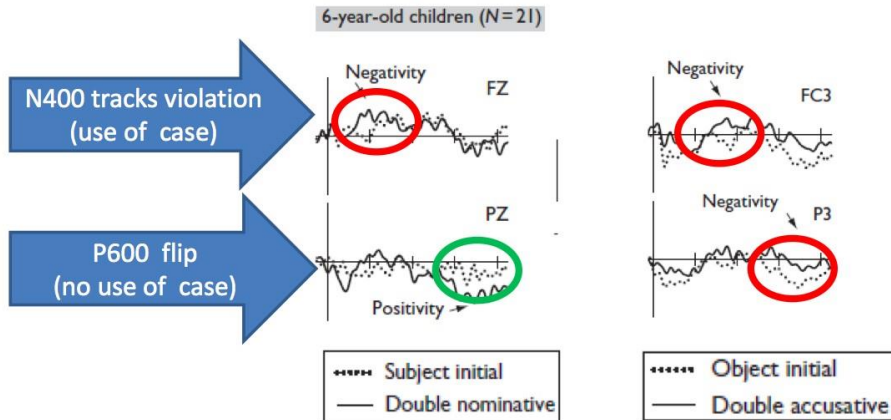
Let's assume:

- P600 and LIFG activation reflect conflict detection, error detection or reanalysis (Novick, Trueswell & Thompson-Schill, 2005; Kuperberg, 2007; Kim & Osterhout, 2005).
- Thematic prediction (like N400 modulation) reflects top-down activation of upcoming material (Kutas & Federmeier, 2011; Altmann & Mirkovic, 2009).
- Processing difficulties in children due to failure to detect errors and revise (Trueswell et al 1999; Novick, Trueswell, & Thompson-Schill, 2005).

Predicts non-adult-like patterns in Schipke and Knoll studies

Prediction: N400 to case errors in children

Schipke, Friederici & Oberecker, 2012



Thank you!

& Acknowledgements

Funding

Marie Curie International Outgoing Fellowship to D. Özge
(FP7-PEOPLE-2011-IOF-301637 DEV LANG COMPRHNSN).



Special thanks to:

Umut Özge for his program for trimming the gaze data.
Snedeker Lab Members & Harvard Language and Cognition Group &
Harvard LDS Seminar & METU Cognitive Science Colloquium &
Language and Cognition Lab of University of Bielefeld.