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

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21st century standard model of language processing
Word order variation
Dryer 2011, WALS
Case marking is more common when the verb is late or order is variable

Dryer 2011, WALS

![Bar chart showing the proportion of languages with case for different verb order patterns.](image)
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
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


Hypothesis 1a:
Late developing dorsal connections impair complex syntactic interpretation

- Dorsal fiber tracts connecting temporal cortex and Broadman 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; Hartshome & Snedeker, 2013; Hartshome, O'Donnell, Sudo, Uruwashi, 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

"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:

Nominative NP2 generates P600 regardless of NP1 case

4;6 years
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)

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

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.’

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Present Study | Experiment: Interpretation of case marking in German

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.’

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Agent Preference in each time window

- Predictive looks **before** the verb, during the *Adverbial Region*. 
Agent preference in German vs. Turkish

![Bar chart showing agent preference in German-speaking and Turkish-speaking children.](chart.png)
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).


Contrasts with prior findings from novel verb and ERP studies (Dittmar, et al., 2008; Schipke et al; 2012; Knoll et al., 2012).
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

N400 tracks violation (use of case)
P600 flip (no use of case)
Thank you!

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