

# Psycho- and Neurolinguistic Perspectives

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Today:

- Evidence as to the Processing of German Word Order, Case and Agreement from a Psycho- and Neurolinguistic Perspective
  - Bader et al. — Serial Model (Minimalist Assumptions)
  - Bornkessel-Schlesewsky, Schlesewsky et al. — Interactive Model (RRG Assumptions)
- Evidence as to the Processing of Urdu/Hindi Word Order and Case from a Psycho- and Neurolinguistic Perspective
  - Neurotypology: Bornkessel-Schlesewsky, Schlesewsky et al. — Interactive Model (RRG Assumptions)
  - Focus and Word Order (Vasisth et al.)

German shows a strong preference for SO word order (survey of literature in Bader and Bayer 2006).

(1)

Die Gans schiebt Mutti in den Ofen.

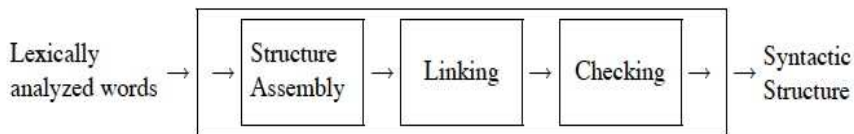
The goose puts mom into the oven

Either 'Mom puts the goose into the oven'

or 'The goose puts mom into the oven'

- Other factors: animacy, case, thematic roles (?), weight/length, pronominal status.
- **Question:** How to integrate the interplay between syntactic processing and these further factors into a model of human sentence processing?

- Bader and Bayer (2006) is a very comprehensive discussion of
  - a. Experimental findings with respect to German case, word order and agreement.
  - b. A Model for Human Sentence Processing (HSPM = Human Sentence Processing Mechanism)
- They defend a *syntax-first, serial model* of processing.
- Parsing is assumed to be *incremental*.
- The underlying syntactic assumptions are couched within the Minimalist Program.



*Figure 1.1.* A model of the HSPM

- a. **Structure assembly** Processes that compute phrase-structure trees
- b. **Linking Processes** that associate phrases within the phrase-structure tree with argument structure positions
- c. **Checking Processes** that check the proper distribution of Case features and the agreement between a verb and its subject

- Semantics of Information Packaging does parts of Word Order  
pronouns > def DPs > Indefs
- This is not dealt with explicitly.

The HSPM is posited to adhere to the following parsing heuristics.

- **Simplicity** No vacuous structure building. (Gorrell, 1995)
- **Minimal Chain Principle** Avoid postulating unnecessary chain members at S-structure, but do not delay required chain members. (De Vincenzi, 1991: 13)
- **The Case Preference Principle** If possible, prefer nominative Case over accusative Case.

Dative is analyzed as being a KP (KasePhrase) and is thus different from the other cases and therefore is dispreferred because of Simplicity.

So:

- SO/OS Ambiguities exhibit a preference for SO (see goose-oven example).
- OO Ambiguities exhibit a preference for accusative over dative case.

- (10) a. Ich weiß, daß Maria ein Päckchen geschickt hat.  
I know that M. a parcel sent has  
'I know that Maria has sent a parcel.'
- b. #Ich weiß, daß Maria ein Päckchen geschickt wurde.  
I know that M. a parcel sent was.  
'I know that a parcel was sent to Maria.'

# Bader and Bayer: Linking Algorithm

## 1. Argument Linking

Link each DP within the CPPM to a position within the verb's argument structure.



## 2. Feature Handling

### A. Feature Checking

Check the relevant features (Case for subject and objects, number and person for subject).

### B. Feature Repair

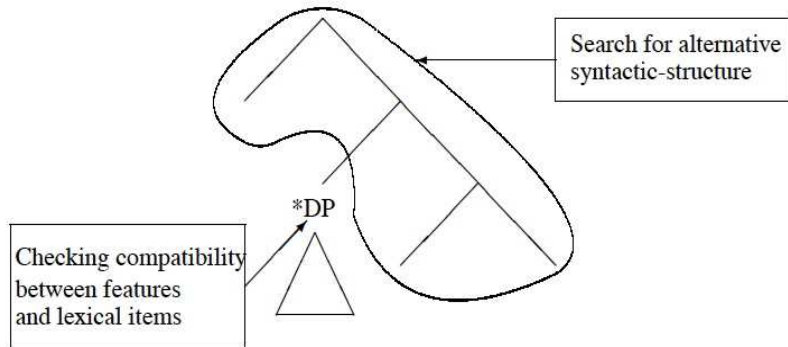
For each resulting feature mismatch, where a feature mismatch has the form "Feature value  $\alpha$  assigned to XP instead of feature value  $\beta$ ", determine if the lexical material of XP would be compatible with the assignment of  $\beta$ .

If so, replace  $\alpha$  with  $\beta$  and - if necessary - adjust the phrase-marker accordingly.

Figure 6.2. The Linking-Based Checking Algorithm (LBCA)

(CPPM = Current Partial Phrase Marker)

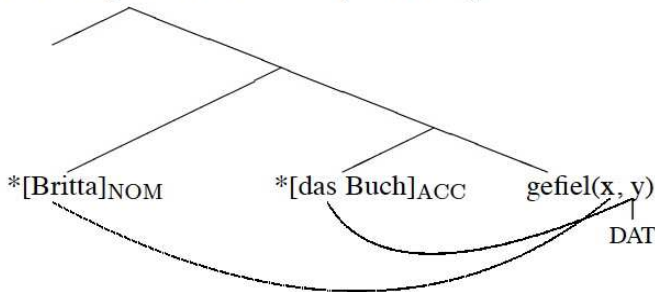
(5)



# Bader and Bayer: Linking Algorithm Example

- (6) (Keiner wußte,) daß Britta das Buch gefiel.  
Nobody knew that Britta-DAT the book-NOM pleased  
'Nobody knew that the book pleased Britta.'

- (7) a. Resulting Structure after Step 1 and Step 2A:



- b. Step 2B:

- $DAT \rightarrow Britta? \text{ ☺}$
- $NOM \rightarrow [das\ Buch]? \text{ ☺}$

Bornkessel-Schlesewsky and Schlesewsky (B&S) propose an alternative model:

- Underlying syntactic assumptions based on Role and Reference Grammar (RRG).
- RRG is basically a Linking Theory (for a brief description, see Butt 2006).
- B&S's model: extended Argument Dependency Model (eADM)
- Has serial properties, but relies on interaction.
- In particular, argues that prominence scales should be incorporated as part of the primary linking (argument identification).
- This later idea contrasts with Bader&Bayer, for whom this type of information comes in late.

(4) *The interface hypothesis* of incremental argument interpretation

Incremental argument interpretation (i.e. role identification and assessment of role prototypicality) is accomplished by the syntax–semantics interface, that is, with reference to a cross-linguistically defined set of prominence scales and their language-specific weighting.

The relevant prominence scales are:

- a. morphological case marking (nominative > accusative / ergative > nominative)
- b. argument order (argument 1 > argument 2)
- c. animacy (+animate > –animate)
- d. definiteness/specificity (+definite/specific > –definite/specific)
- e. person (1st/2nd person > 3rd person)

# Bornkessel-Schlesewsky and Schlesewsky (B&S)

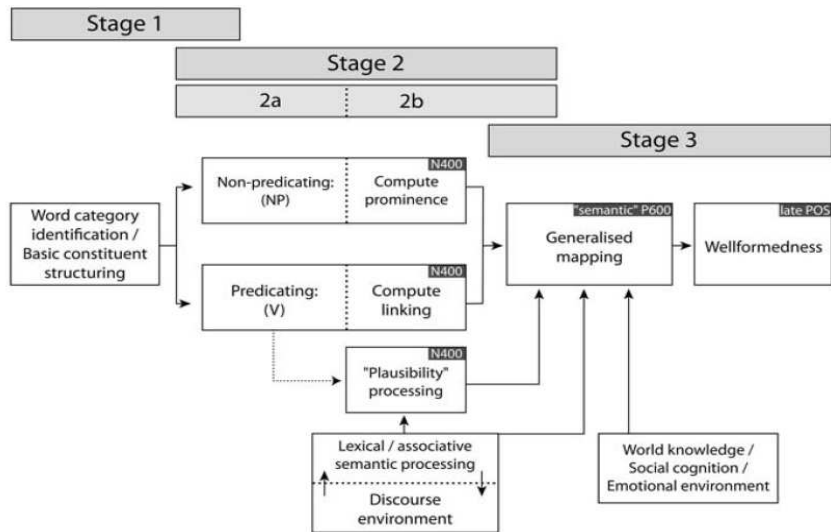
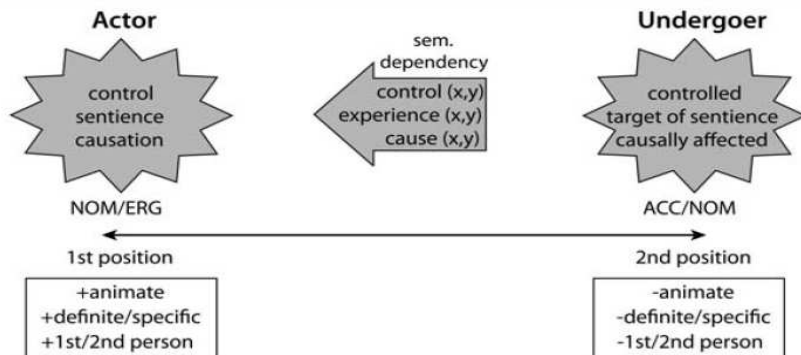


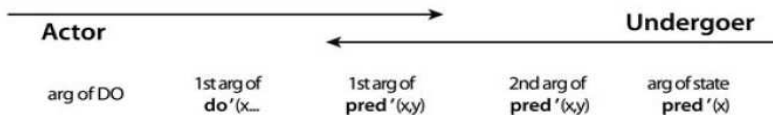
Fig. 4. The architecture of the latest version of the extended Argument Dependency Model (eADM; Bornkessel-Schlesewsky and Schlesewsky 2008a).

# Bornkessel-Schlesewsky and Schlesewsky (B&S)

## A. Compute prominence



## B. Compute linking



# Experiments — Looking at the Details

- A huge literature exists on case, word order and agreement in German.
- A very large set of experiments has been conducted through a variety of methods.
- Most of this literature is very nicely and compactly summarized in Bader and Bayer (2006), Bornkessel-Schlesewsky and Schlewsky (2009).
- Experimental Methods include:
  - Speeded grammaticality judgement tasks (reaction times and percentage correct).
  - ERP (Event-Related Potentials)
  - fMRI (functional magnetic resonance imaging)

## Some Interesting Factors:

- **Animacy**

- B&S argue that *animacy* is an especially important factor in the prominence scales.
- B&B dispute this.

- **Thematic Roles**

- B&B argue that thematic role hierarchies are not relevant.
- In fact, the eADM of B&S does not use thematic role hierarchies.

- **Agreement**

- Meng and Bader (2000) show that Agreement is not as good a disambiguator as case is.

# ERP Evidence for Animacy — B&S 2009

## (6) Example stimuli from Frisch and Schlesewsky (2001)

Paul fragt sich, . . .

Paul asks himself, . . .

a. . . welchen Angler                      der Jäger                      gelobt hat.

. . . [which angler]:ACC              [the hunter]:NOM              praised has.

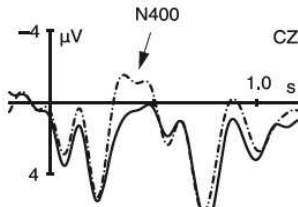
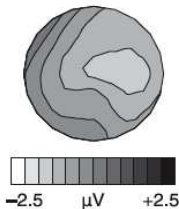
‘. . . which angler the hunter praised.’

b. . . welchen Angler                      der Zweig                      gestreift hat.

. . . [which angler]:ACC              [the twig]:NOM              brushed has.

‘. . . which angler the twig brushed.’

### A. German



-- NP2 = Actor (inanim)

— NP2 = Actor (anim)

(2)

dass Max das Gedicht gefallen hat  
that Max.Dat the.Nom poem.Nom pleased has  
'that the poem pleased Max'

(3)

dass Max die Lehrerin gefallen hat  
that Max.Dat the.Nom teacher.Nom pleased has  
'that the teacher pleased Max'

*Table 6.6.* Percentages of Correct Judgments and Judgment Times for Correct Judgments (ms) for Experiment 3A (Standard Errors by Subjects in Parentheses)

|                    | <i>First DP animate,<br/>second DP inanimate</i> |                  | <i>Both DPs animate</i> |                  |
|--------------------|--|------------------|-------------------------|------------------|
|                    | <i>Unambiguous</i>                               | <i>Ambiguous</i> | <i>Unambiguous</i>      | <i>Ambiguous</i> |
| Percentage correct | 97 (1.3)   | 90 (2.2)         | 94 (1.8)                | 67 (4.8)         |
| Judgment time      | 477 (35.8)                                       | 599 (40.6)       | 498 (39.4)              | 743 (56.1)       |

# Bader and Bayer – Animacy

- (4) dass Max die Lehrerin gefallen hat  
that Max.Dat the.Nom teacher.Nom pleased has  
'that the teacher pleased Max' (underlying OS Verb)
- (5) dass Max die Lehrerin geholfen hat  
that Max.Dat the.Nom teacher.Nom helped has  
'that the teacher helped Max' (underlying SO Verb)

Table 6.8. Percentages of Correct Judgments and Judgment Times for Correct Judgments (ms) for Experiment 3B (Standard Errors by Subjects in Parentheses)

|                    | <i>SO-Verb</i>     |                  | <i>OS-Verb</i>     |                  |
|--------------------|--------------------|------------------|--------------------|------------------|
|                    | <i>Unambiguous</i> | <i>Ambiguous</i> | <i>Unambiguous</i> | <i>Ambiguous</i> |
| Percentage correct | 94 (2.2)           | 45 (6.2)         | 91 (3.2)           | 63 (5.2)         |
| Judgment time      | 581 (44.4)         | 930 (98.7)       | 606 (48.8)         | 858 (73.3)       |

## Conclusion:

- OS-Verb (*gefallen* 'pleased') NP1[+anim] NP2[-anim] → not much of a problem
- OS-Verb (*gefallen* 'pleased') NP1[+anim] NP2[+anim] → more of a problem
- SO-Verb (*geholfen* 'helped') NP1[+anim] NP2[+anim] → big problem

So, Animacy cannot be considered to be a primary factor, verb type and syntactic position would seem to be primary.

- B&B argue contra Bornkessel et al. (2003) and others that thematic roles do not play a role.
- They contrast the following three versions of a clause via a speeded grammaticality task.

(6) a.

dass Fritz        eine Postkarte        geschickt hat  
that Fritz.Nom a.Acc postcard.Acc sent        has  
'that Fritz has sent a postcard' (Active)

b.

dass Fritz        eine Postkarte        geschickt bekam  
that Fritz.Nom a.Acc postcard.Acc sent        got  
'that Fritz got a postcard sent' (Become Passive)

c.

dass Fritz        eine Postkarte        geschickt wurde  
that Fritz.Dat a.Nom postcard.Nom sent        was  
'that Fritz was sent a postcard' (Passive)

These sentences allow one to set up the following mismatch between thematic roles and case marking.

## Mismatch — Thematic Roles and Case

- a. dass NOM ACC / AGENT THEME geschickt HAT.
- b. dass NOM ACC / RECIPIENT THEME geschickt BEKAM.
- c. dass DAT NOM / RECIPIENT THEME geschickt WURDE.

- If thematic roles were relevant, there should be an effect for condition b (the become passive).
- But in fact there is none.

# Thematic Roles — Bader and Bayer

Table 6.12. Percentages of Correct Judgments and Judgment Times for Correct Judgments (ms) for Experiment 5 (Standard Errors by Subjects in Parentheses)

|                    | <i>Active</i> |                 | <i>Active/Recipient Passive</i> |                 | <i>Passive</i> |                 |
|--------------------|---------------|-----------------|---------------------------------|-----------------|----------------|-----------------|
|                    | <i>Ambig.</i> | <i>Unambig.</i> | <i>Ambig.</i>                   | <i>Unambig.</i> | <i>Ambig.</i>  | <i>Unambig.</i> |
| Percentage correct | 78<br>(3.3)   | 72<br>(3.6)     | 93<br>(1.9)                     | 89<br>(2.2)     | 75<br>(3.7)    | 92<br>(2.2)     |
| Judgment time      | 793<br>(39.2) | 810<br>(42.6)   | 681<br>(37.2)                   | 685<br>(37.4)   | 862<br>(50.4)  | 657<br>(36.8)   |

- But in fact, Bornkessel-Schlesewsky and Schlewsky (2009) do not rely on Thematic Roles.
- RRG assumes linking from lexical semantic decompositional structures to the Proto-Roles Actor and Undergoer.
- Datives are marked.
- So the crucial part of the data would seem to make sense under their account as well.

# Agreement — Meng and Bader

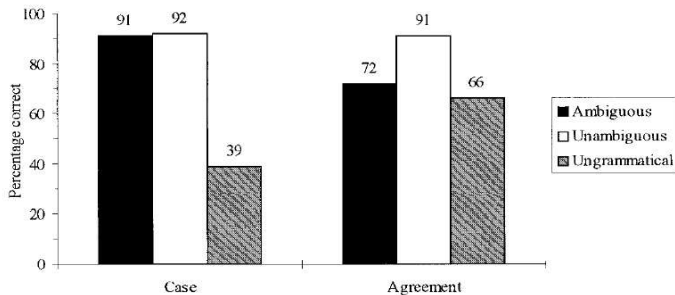
Meng and Bader (2000) show that Case marking is a much better disambiguator in German than agreement.

TABLE 1  
Sample item from Experiment 1A

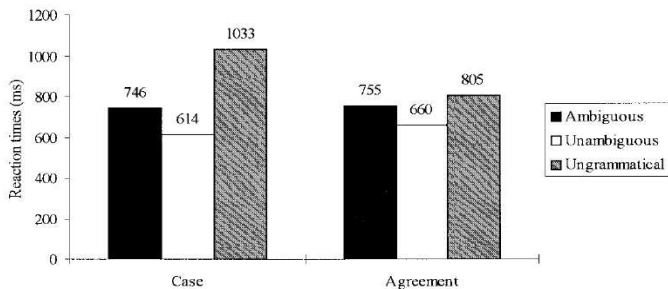
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|                  |  |
|------------------|--|
| <i>Case</i>      |  |
| Ambiguous        | Welche Politikerin aus der Opposition attackierte der Minister?<br><i>Which politician from the opposition attacked the minister</i><br>“Which politician from the opposition did the minister attack?”    |
| Unambiguous      | Welchen Politiker aus der Opposition attackierte der Minister?<br><i>Which politician from the opposition attacked the minister</i><br>“Which politician from the opposition did the minister attack?”     |
| Ungrammatical    | Welcher Politiker aus der Opposition attackierte der Minister?<br><i>Which politician from the opposition attacked the minister</i>  |
| <i>Agreement</i> |  |
| Ambiguous        | Welche Politikerin aus der Opposition attackierten die Minister?<br><i>Which politician from the opposition attacked the ministers</i><br>“Which politician from the opposition did the ministers attack?” |
| Unambiguous      | Welchen Politiker aus der Opposition attackierten die Minister?<br><i>Which politician from the opposition attacked the ministers</i><br>“Which politician from the opposition did the ministers attack?”  |
| Ungrammatical    | Welcher Politiker aus der Opposition attackierten die Minister?<br><i>Which politician from the opposition attacked the ministers</i>  |

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**Figure 1.** Experiment 1A: Mean percentages of correct grammaticality judgements (36 subjects, 30 sentences) by disambiguation (case, agreement) and ambiguity (ambiguous, unambiguous, ungrammatical).



**Figure 2.** Experiment 1A: Mean reaction times for correct grammaticality judgements (33 subjects, 29 sentences) by disambiguation (case, agreement) and ambiguity (ambiguous, unambiguous, ungrammatical).

- Case identifies arguments.
- When case is ambiguous, position is most important.
- Position in general is more salient for processing (very strong preferences show up in the experimental data).
- Agreement seems to be a very weak disambiguator.
- The processing models discussed both assume some kind of serial processing and some kind of interaction or repair.
- They differ in the weight/importance given to further factors such as animacy.

Understanding the factors involved better is currently being done in (at least) two ways:

- Corpus Studies (see lecture yesterday)
- Experimentation with patterns in other languages (e.g., Neurotypology)

We here present just two experiments for Urdu/Hindi (not much more exists to date).

- Choudhary et al. (2009) investigate the effects of ergative/aspect mismatch with an EEG/ERP study.
- Recall that in Urdu/Hindi, when the verb is transitive, the ergative can only appear if the verbal morphology is perfect.
- Choudhary et al. (2009) find an N400 as well as a P600 effect.
- They use this to argue that N400 can also reflect structural, rather than semantic properties.

# Ergative Case and Aspect

The material was presented in an auditory manner.

| Critical sentence types |                                      |                           |                                    |            |
|-------------------------|--------------------------------------|---------------------------|------------------------------------|------------|
| Condition               | Example                              |                           |                                    |            |
| NI                      | shikshak<br>teacher.NOM              | maalii-ko<br>gardener-ACC | dekh- <b>taa</b><br>see-IPFV-3SG.M | hai<br>AUX |
|                         | "The teacher sees the gardener."     |                           |                                    |            |
| EI                      | *shikshak-ne<br>teacher-ERG          | maalii-ko<br>gardener-ACC | dekh- <b>taa</b><br>see-IPFV-3SG.M | hai<br>AUX |
|                         | "The teacher sees the gardener."     |                           |                                    |            |
| NP                      | *shikshak<br>teacher.NOM             | maalii-ko<br>gardener-ACC | dekh- <b>aa</b><br>see-PFV-3SG.M   | hai<br>AUX |
|                         | "The teacher has seen the gardener." |                           |                                    |            |
| EP                      | shikshak-ne<br>teacher-ERG           | maalii-ko<br>gardener-ACC | dekh- <b>aa</b><br>see-PFV-3SG.M   | hai<br>AUX |
|                         | "The teacher has seen the gardener." |                           |                                    |            |

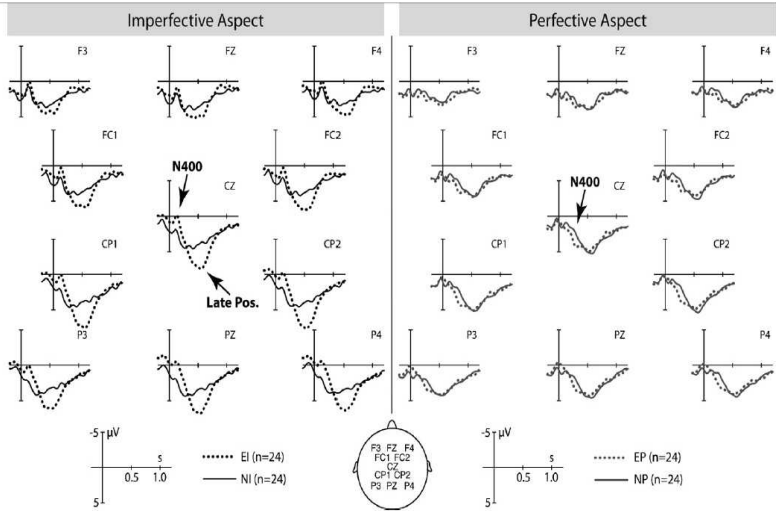


Fig. 1. Grand average ERPs (N=24) time-locked to the onset of the critical aspect marker (onset at the vertical bar). The left panel shows comparisons between imperfective sentences with correct (NI) and incorrect (EI) subject case marking. The right panel shows comparisons between perfective sentences with correct (EP) and incorrect (NP) subject case marking. Negativity is plotted upwards.

## Discussion:

- The ergative clearly has a large semantic effect/component (agentivity, volitionality; cf. lecture 2).
- So it is perhaps not surprising that an N400 is found — one would need to test for unergatives and the ergative with must/want constructions as well.

- Another study by Patil et al. (2008) investigates SOV vs. OSV word order in Hindi.
- This is a production experiment (so far have only had comprehension).
- Goal: test the prosodic phrasing in SOV vs. OSV to see whether focus is really implicated and how it is marked.
- Result:
  - Focus induces post-focus compression.
  - Effect only seen in Subject-Focus SOV sentences.
  - This may have to do with the fact that the immediately preverbal position is the default focus position.

- Interactions between Case, Word Order and Agreement are very complex.
- Much theoretical work on it.
- Much experimental and corpus linguistic work on languages like German.
- Very little known about other languages — much more work needs to be done.

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