Forgetting effects in a head-final language: Evidence from Hindi

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Question

- What is the nature of prediction in head-final languages?
- This study:
  - Prediction is fallible.
  - Prediction of a head/structure is forgotten in the presence of a center-embedded relative clause in the language Hindi.
  - Local coherence effect [1].
  - Current results are not explicable by expectation-based accounts [2, 3].

Prediction in head-final languages

- Speakers of head final languages are assumed to be good at making predictions about the upcoming material based on the input received so far [4].
- Inclusion of pre-verbal elements. has been shown to facilitate processing at the predicted clause-final verb [5].

(1) vo laRkaa jisne us kaagaz.ko (mez.ke piichhe gire.hue) **dekhaa** bahut jigyaasu thaa
that boy who that paper$_{Acc}$ table$_{Gen}$ behind fallen saw very inquisitive was
'The boy who saw the paper (fallen behind the table) was very inquisitive.'

- Accounted for by expectation based accounts [2, 3].

EXPERIMENT

- Sentences with center-embedded relative clauses (RC).
- RC-internal Word Order × post-RC Clause Type.
  - RC-internal *Word Order*: Canonical(=SOV), Non-canonical(=SVO). (this manipulation based on [5])
  - post-RC *Clause Type*: Copula, Transitive.
- All sentences are *ungrammatical* - post RC material cannot be integrated with the head noun.
- In the non-canonical conditions, post RC material can be integrated with RC internal object noun in a locally coherent parse (underlined).

(2)
a. NP$_{Masc}$ [Rel-pro$_{Erg}$ ... NP$_{Fem}$ RC-V$_{Fem}$] **Adjective$_{Fem}$ Copula$_{Fem}$** — Canonical, Copula
b. NP$_{Masc}$ [Rel-pro$_{Erg}$ ... RC-V$_{Fem}$ NP$_{Fem}$] **Adjective$_{Fem}$ Copula$_{Fem}$** — Non-Canonical, Copula
c. NP$_{Masc}$ [Rel-pro$_{Erg}$ ... NP$_{Fem}$ RC-V$_{Fem}$] NP$_{Dat}$ **Verb$_{Fem}$ Aux$_{Fem}$** — Canonical, Transitive
d. NP$_{Masc}$ [Rel-pro$_{Erg}$ ... RC-V$_{Fem}$ NP$_{Fem}$] NP$_{Dat}$ **Verb$_{Fem}$ Aux$_{Fem}$** — Non-Canonical, Transitive

(3) Experimental Item ('/' indicates region breaks. **Critical region** bolded)

a. vah laRkaa/ jisne/ kal/ bahut dilchaspii se/ kitaab/ paRhii thii/ **moTii thii**
That boy$_{Masc}$ who$_{Erg}$ yesterday lots interest with book$_{Fem}$ read$_{Fem}$ had$_{Fem}$ fat$_{Fem}$ was$_{Fem}$

b. vah laRkaa/ jisne/ kal/ bahut dilchaspii se/ paRhii thii/ kitaab/ **moTii thii**
That boy$_{Masc}$ who$_{Erg}$ yesterday lots interest with read$_{Fem}$ had$_{Fem}$ book$_{Fem}$ fat$_{Fem}$ was$_{Fem}$

c. vah laRkaa/ jisne/ kal/ bahut dilchaspii se/ kitaab/ paRhii thii/ mujhe/ **bechnii paRii**
That boy$_{Masc}$ who$_{Erg}$ yesterday lots interest with book$_{Fem}$ read$_{Fem}$ had$_{Fem}$ I$_{Dat}$ sell$_{Fem}$ had-to$_{Fem}$

d. vah laRkaa/ jisne/ kal/ bahut dilchaspii se/ paRhii thii/ kitaab/ mujhe/ **bechnii paRii**
That boy$_{Masc}$ who$_{Erg}$ yesterday lots interest with read$_{Fem}$ had$_{Fem}$ book$_{Fem}$ I$_{Dat}$ sell$_{Fem}$ had-to$_{Fem}$

(4) Spillover region ('/' indicates region breaks. **Post-critical region** bolded)
... **aur**/ vahi kitaab/ kaii dostoM ne bhi/ khariidii
And that book$_{Fem}$ many friends Erg also bought$_{Fem}$

HYPOTHESIS and PREDICTIONS

Predictions for RTs at Critical region:

- Main effect of Word Order due to local coherence [1].
  - RTs for Non-canonical < Canonical if the RC internal NP$_{Fem}$ is structurally integrated with the post-RC material.
  - No such locally coherent structure is possible in the Canonical order.
- A significant interaction for RTs: a-b < c-d.
  - For the Copula, local coherence could arise simply due to the copula having agreement morphology (=Feminine) which matches the local noun NP$_{Fem}$.
  - The locally coherent parse is more complex for the Transitive:
    - while there is matching (=Feminine) agreement (like the Copula condition)
    - structural changes are required to incorporate NP$_{Fem}$ as an object of the post-RC verb - the typical word order for the post-RC material is *NP$_{Dat}$ NP$_{Fem}$*.
- An expectation-based account [2, 3] does not predict any difference in RTs between the conditions at the critical verb.
  - The processing complexity at a word is quantified using its conditional probability.
  - Since the critical verb-forms in the experimental items are ungrammatical, their probability of occurrence given prior words will be close to zero.

Methods

- Centered self-paced reading + Acceptability rating
- 24 latin-squared items, 56 fillers
- N=52 native speakers of Hindi at the Indian Institute of Technology, Delhi
- Pre-registered on AsPredicted.com

RESULTS: RTs

- Linear-mixed effects models were used for all statistical analyses.
- RTs at the critical region:
  - a significant main effect of Clause Type (t=-4.06): RTs for Transitive > Copula.
  - a significant interaction effect (t=-2.56): driven by the Transitive condition - RTs for Non-canonical < Canonical.
- RTs at the post-critical region:
  - a significant effect of Word Order (t=-4.32): RTs for Non-canonical < Canonical.

Figure 1. RTs at the critical region

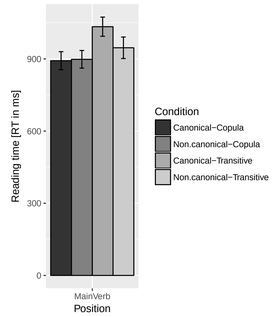
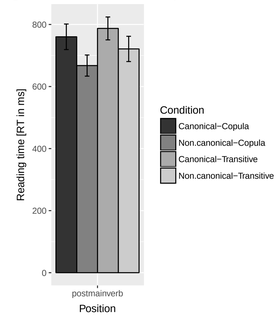


Figure 2. RTs at the post-critical region



RESULTS: Ratings

- A significant effect of Word Order (t=-5.4) - Non-canonical < Canonical.

Table 1. Ratings for experimental items

	Rating
a. Canonical, Copula	4.4
b. Non-canonical, Copula	3.8
c. Canonical, Transitive	4.2
d. Non-canonical, Transitive	3.8

Table 2. Ratings for filler sentences

	Rating
Clearly grammatical fillers	5.2
Clearly ungrammatical fillers	2.4
All fillers	4.3
(1 to 7 scale, 7=highest)	

Summary

	Critical Region(RT)	Post-critical region(RT)	Ratings
Word Order		Significant	Significant
Clause Type	Significant		
Word Order : Clause Type	Significant		

CONCLUSION

- RT results: Hindi speakers are susceptible to local coherence in the non-canonical conditions where the RC internal NP$_{Fem}$ appears after the RC verb.
- The results cannot be explained under an expectation-based account.
- Speakers are unable to sustain the prediction of the matrix verb that was to be integrated with the head noun, NP$_{Masc}$, in the face of a locally coherent parse.
- This effect may be due to the head-final nature of Hindi – the finite verb in the RC could be a strong cue for a clause boundary and the RC-final NP$_{Fem}$ may be treated as being beyond this boundary allowing NP$_{Fem}$ to be integrated with the upcoming string.
- This local coherence effect seems temporary since it does not translate to higher end-of-sentence acceptability ratings for non-canonical sentences.
- The results demonstrate fallibility in prediction processes in a head-final language using a relatively simple structure.
- Therefore, it is important to further investigate broad claims about the absence of forgetting effects caused by memory constraints in head-final languages [7].

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References

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