Forgetting effects due to Local Coherence in 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 in the main clause is forgotten in sentences with 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: what we know

▸ 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 facilitates 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.'

▸ Explanation: expectation based accounts [2, 3]

The FORGETTING hypothesis

The prediction of the main clause verb by the head noun is forgotten in the presence of a locally coherent parse.

EXPERIMENT: Local Parse type × post-RC Clause Type

▸ *Ungrammatical* sentences with center-embedded relative clauses (RC) where the post RC material cannot be integrated with the head noun across all conditions.

▸ Local *Parse type*: -Locally coherent , +Locally coherent
  – In the +Locally coherent conditions, post RC material can be integrated with RC internal object noun in a locally coherent parse.
  – This manipulation utilizes Canonical(=SOV) word order in RC for -Locally coherent and Non-canonical(=SVO) word order for +Locally coherent (based on [6])

▸ post-RC *Clause Type*: Copula, Transitive.
  – Copula: agreement morphology does not match the head noun
  – Transitive: the transitive verb can not be integrated thematically with the head noun & agreement morphology does not match the head noun

(2)   a. NP_Masc [Rel-pro_Erg ... NP_Fem RC-V_Fem] **Adjective**_Fem **Copula**_Fem   -Locally coherent, Copula
      b. NP_Masc [Rel-pro_Erg ... RC-V_Fem NP_Fem] **Adjective**_Fem **Copula**_Fem   +Locally coherent, Copula
      c. NP_Masc [Rel-pro_Erg ... NP_Fem RC-V_Fem] NP_Dat **Verb**_Fem **Aux**_Fem   -Locally coherent, Transitive
      d. NP_Masc [Rel-pro_Erg ... RC-V_Fem NP_Fem] NP_Dat **Verb**_Fem **Aux**_Fem   +Locally coherent, Transitive

▸ **Main effect of Local Parse type:** Reading Times at the post RC verb for +Locally Coherent < -Locally Coherent if the prediction of the main clause clause verb is forgotten and the RC internal NP_Fem is integrated with the post-RC material in a locally coherent parse

▸ A significant interaction: the effect of Local Parse type on RTs may differ across the two structures

▸ An expectation-based account [2, 3] predicts no difference in RTs between the conditions at the post RC verb.
  – Since the critical verb-forms in the experimental items are *ungrammatical*, their probability of occurrence given prior words ought to be close to zero across all conditions.

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

Sample Item

(3)   Experimental Item ('/' indicates region breaks. **Critical region** bolded)
      a. vah laRkaa/ jisne/ kal/   bahut dilchaspii se/ kitaab/ paRhii thii/
          That boy_Masc who_Erg yesterday lots   interest   with book_Fem read_Fem had_Fem
          moTii thii
          fat_Fem   was_Fem

      b. vah laRkaa/ jisne/ kal/   bahut dilchaspii se/ paRhii thii/ kitaab/
          That boy_Masc who_Erg yesterday lots   interest   with read_Fem had_Fem book_Fem
          moTii thii
          fat_Fem   was_Fem

      c. vah laRkaa/ jisne/ kal/   bahut dilchaspii se/ kitaab/ paRhii thii/
          That boy_Masc who_Erg yesterday lots   interest   with book_Fem read_Fem had_Fem
          mujhe/ **bechnii paRii**
          I_Dat   sell_Fem   had-to_Fem

      d. vah laRkaa/ jisne/ kal/   bahut dilchaspii se/ paRhii thii/ kitaab/
          That boy_Masc who_Erg yesterday lots   interest   with read_Fem had_Fem book_Fem
          mujhe/ **bechnii paRii**
          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

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 +Locally coherent < -Locally coherent.

▸ RTs at the post-critical region:
  – a significant effect of Local Parse type (t=-4.32): RTs for +Locally coherent < -Locally coherent.

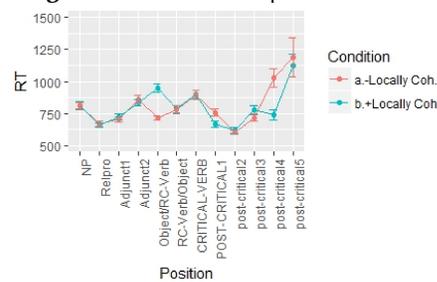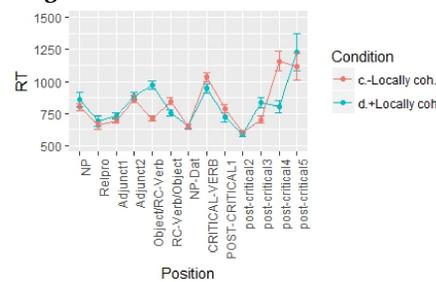**Figure 1.** RTs for the Copula condition

Figure 2. RTs for the Transitive condition

RESULTS: Ratings

▸ A significant effect of Parse type (t=-5.4): +Locally coherent < -Locally coherent

Table 1. Experimental items	Rating
a. -Locally coherent, Copula	4.4
b. +Locally coherent, Copula	3.8
c. -Locally coherent, Transitive	4.2
d. +Locally coherent, Transitive	3.8

Table 2. Filler sentences	Rating
Clearly grammatical fillers	5.2
Clearly ungrammatical fillers	2.4
All fillers	4.3

(1 to 7 scale, 7=highest)

CONCLUSION

Table 3. Summary of results	Critical Region(RT)	Post-critical region(RT)	Ratings
Parse Type		Significant	Significant
Clause Type	Significant		
Parse Type : Clause Type	Significant		

▸ RT results: Hindi 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 seems temporary since it does not translate to higher end-of-sentence acceptability ratings for +Locally coherent 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].

Further issues

▸ Local coherence occurs with a non-canonical word order (SVO) in the RC:
  – Role of head-finality – 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 integration of NP_Fem with the upcoming string.
  – Role of revision within the RC – more time in RC, more decay of NP_Masc. Combining RTs for RC-Object & RC-verb: a significant effect of Local Parse type in a Post hoc t-test (t=5.6)

Table 4. Means for combined RTs	Copula	Transitive
-Locally coherent	a. 749	c. 779
+Locally coherent	b. 867	d. 864

References

[1] Tabor, Galantucci & Richardson , 2004. [2] Hale, 2001. [3] Levy, 2008. [4] Levy & Keller, 2013. [5] Vasishth & Lewis, 2006. [6] Husain, Vasishth & Srinivasan, 2014. [7] Vasishth, Suckow, Lewis & Kern, 2011.