A compositional account of the apparent polysemy of Hindi  \textit{bhī}

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Discussion/Conclusions
Hindi *bhī*

- Hindi *bhī* (along with similar particles throughout South Asian languages) appears to be ambiguous between a plain additive and a scalar-additive reading.

  1. *rām parṭī mem āyā. shyām bhī āyā.* Ram party in came. Shyam *bhī* came. “Ram came to the party. Shyam came too.” [plain additive]

  2. *shyām bhī āyā! vah kabhī parṭī mem nahīṁ ātā.* Shyam *bhī* came! he anytime party in not comes. “Even Shyam came! He never comes to parties.” [scalar-additive]

- Is *bhī* really ambiguous?
- Are there two *bhī*s? Or not?
Additional pieces?

- Initial evidence of acoustic correlates of the 2 bhī-interpretations in differences in the realisation of the F0 excursion/L*H pitch accent, particularly the word-final F0 contour.
- Which raises the possibility that the scalar component, when it appears, derives not from bhī, but from something else (maybe realised as a prosodic element).
- Avoiding positing two bhīs or an element that makes bhī’s contribution redundant requires a compositional approach that augments the properties of the existentially-bound variable of the presupposition.
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Hindi “evens”: $bhī$, $tak$

- Hindi $tak$ as a scalar requires the focus constituent to be the lowest element on the relevant scale, but does not require a salient alternative [cf. Schwenter & Vasishth (2000)]
- while Hindi $bhī$ is seemingly ambiguous between a plain additive reading and a (non-exhaustive) scalar-additive reading [cf. Lahiri (1998), Schwenter & Vasishth (2000)]
Some Hindi particles with formal definitions

Differences between tak and the 2 bhī readings

(3) “This time, the exam was very difficult…”

a. ...klās kī sabse hośiyār chātrā fel ho gayī, aur maiṁ bhī / #tak fel ho gayā.
   class of most bright student failed, and I bhī / #tak failed.
   “...the class’s brightest student failed, and [I]F also failed.” [plain additive]

b. ...klās kī sabse hośiyār chātrā bhī / tak fel ho gayī.
   class of most bright student bhī / tak failed.
   “...even [the class’s brightest student]F failed.” [scalar-additive]

(4) “Who ate the goat’s eyes?” [adapted from Schwenter & Vasishth 2000]

a. B: meri dādī -tak-ne / #-ne-bhī khāyīṁ.
   B: my granny -tak-ERG / #-ERG-bhī ate.
   “[My granny]F (the least likely person of all) ate it.”

b. B’: mai-ne khāyīṁ aur meri dādī -tak-ne / -ne-bhī / -tak-ne-bhī
   B’: I-ERG ate and my granny -tak-ERG / -ERG-bhī / -tak-ERG-bhī
   ate.
   “I ate it and even [my granny]F ate it.”
Some Hindi particles with formal definitions

Summary of distribution of $bhī$ & $tak$

<table>
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<th>Exhaustive</th>
<th>Additive</th>
<th>Scalar</th>
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<tr>
<td>$tak$</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>$bhī$</td>
<td>NO</td>
<td>YES</td>
<td>SOMETIMES</td>
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</tbody>
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Proposed denotations

Assuming an alternative semantics of focus (Rooth 1985), $bhī$ is a particle that combines with an element $x$ and a (potentially partially-saturated) predicate $P$, asserts that $P(x)$, and presupposes that there exists some alternative element $x^*$ s.t. $R(x^*)$ is true for some focus alternative to $P(x)$:

\[ bhī_{\text{additive}} = \]
\[
\lambda x \lambda P : \exists x^* \exists R [x \neq x^* \land R(x^*) \in FA(P(x))] . P(x)
\]

The scalar-additive interpretation associated w/ $bhī$ requires that in addition to the existence of another salient alternative, that alternative must be less unexpected (=higher-ranked on a likeliness scale $S$):

\[ bhī_{\text{scalar-additive}} = \]
\[
\lambda S \lambda x_S \lambda P : \exists x^*_S \exists R [x \neq x^*_S \land R(x^*_S) \in FA(P(x_S)) \land x_S \prec x^*_S] . P(x_S)
\]

And scalar tak can be distinguished from scalar-additive $bhī$ by defining it as:

\[ tak = \]
\[
\lambda S \lambda x_S \lambda P : \forall x^*_S \exists R [R(x^*_S) \in FA(P(x_S)) \land x_S \prec x^*_S] . P(x_S)
\]
Typology of \textit{bhī}-like elements

- Parallels to the “ambiguous” behaviour of Hindi \textit{bhī} exist elsewhere in South Asia, both in Indo-Aryan, as in Nepali \textit{pani}, Skt. \textit{api}; and in Dravidian -\textit{um} (see Masica 1976; cf. Szabolcsi 2017)
- And outside of both South Asia and Indo-European: Basque \textit{ere}
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Two \textit{bhīs} and Occam’s Razor

- both “plain” additive \textit{bhī} and scalar-additive \textit{bhī} involve an additive component, with the latter differing from the former only in the “scalarising” of additive
- it seems attractive to refrain from multiplying \textit{bhī}s posited and try to provide a unified account
Rather than ambiguity, a separate element

Basque phonetic differences between additive & scalar-additive interpretations

- Etxeberria & Irurtzun (2015) report a similar situation for Basque *ere*, seemingly ambiguous between simple additive & scalar additive readings

(8) Jon ere etorri da.
   Jon *ere* come **AUX**
   “Jon came too / Even Jon came.”

Basque prosodic differences for elements associated with *ere*

Etxeberria & Irurtzun (2015) report significant differences for both duration and F0 measurements, with high F0 and intensity of the focussed element in Scalar conditions
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Hindi focus prosody pilot study

- both Lahiri (1998) (for Hindi) & Etxeberria & Irurtzun (2015) (for Basque) suggest that the scalar meaning component might be separate from the particle, contributed in some way by focus.
- previous studies of Hindi prosody (Khan 2016) & focus-related prosody (Patil et al. 2008; Féry 2010; Puri 2013; Kügler 2020)
- IO offer the best environment for observing acoustic correlates of focus (Kügler 2020)
- 2 native Hindi-speaking subjects read 20 target sentences (10 plain additive; 10 scalar-additive) along with background information (context)
- all target sentences of the form: Subj | IO bhī | DO | Verb
Test data

(9)  a. सबीन ने बलदेव और सुनीता को घड़ी दी। सबीन ने नीरा को भी घड़ी दी।

   “Sabeen gave a watch to Baldev and Suneeta. Sabeen gave Neera a watch too.” [plain additive]

(10) a. सब जानते हैं कि नीरा कभी घड़ी नहीं पहनती। सबीन ने नीरा को भी घड़ी दी।

   b. sab jānte haim ki nīrā kabhī ghaḍī nahīṁ pahntī. all know are that Neera anytime watch not wears.
   Sabīn ne nīra ko bhī ghaṛī dī. Sabeeñ ERG Neera DAT bhī watch gave.
   “Everyone knows Neera never wears a watch. Sabeen even gave a watch to Neera.” [scalar-additive]
Results of Prosodic Pilot Study

- no statistically significant difference in terms of duration between the two focus conditions
- statistically significant difference (t-test, \( p = .02 \)) in the F0 excursion of additive and scalar focused element for both speakers
- the additive seems to have a bigger excursion than scalar

![F0 excursion - Speaker1 - additive v. scalar](image1)

![F0 excursion - Speaker2 - additive v. scalar](image2)
Phonetic evidence for a separate prosodic element in Hindi

**Praat spectograms**

**ADDITIVE**

**SCALAR**
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Brief intro to continuation semantics

- continuation semantics, which has been used to analyse a number of linguistic phenomena, including scope-taking and presupposition projection (see de Groote 2001, 2006; Barker 2002; Shan 2005; Barker & Shan 2014)

- borrowed from the discovery of the use of continuations in computer science (Strachey & Wadsworth 1974; Felleisen 1987), as a means of providing a composition semantics to full jumps (i.e. ‘functional GOTO statements’).
Continuations

- A continuation is the (default) future of a computation.
- Every meaningful sub-expression has a continuation, e.g. the continuation of \textit{Rām} in \textit{Rām loves Sītā} is effectively \( \lambda x . x \) saw s; in \textit{Rām snores}, the continuation of \textit{Rām} is \( \lambda x . x \) snores.
- But some linguistic expressions have denotations which manipulate their continuations.
Continuation semantics analysis for *bhī* (+prosody) & (-prosody)

**Continuations, type-shifting, QPs**

- While DPs generally have access to their continuations, quantified DPs make non-trivial use of continuations (resulting in semantic forms where scope differs from its surface position), e.g. $\lambda P \lambda Q. \forall x [P(x) \rightarrow Q(x)]$

- Other DPs, like proper names, can be trivially continuised (e.g. via Lift (Partee 1987), which can been seen as adding a function on a continuation without an effect on scope-taking or other meaningful end results)
  - $\text{Lift}(x) = \lambda k. kx$, e.g. $[John]$ could be type-shifted from an $e$ type $j$ to an $\langle \langle e, t \rangle, t \rangle$ type $\lambda P. P(j)$

- Another thing that continuations can be used for is to delay computations, and allowing for variable capture
Continuised \( bhī \)

- In order to derive the scalar-additive interpretation of \( bhī \) from the plain additive interpretation + a contribution of a prosodic "scalaring" element, we need the variables ranked on a scale in the meaning of the prosodic component to be able to get captured by operators (\( \lambda, \exists \)) in the definition of \( bhī \).

- We can do this by wrapping the initial definition in a continuation function \( (k) \), producing a continuised version of (5), thus delaying the evaluation of the arguments associated with the propositional alternatives; this serves as a single base definition for \( bhī \):

\[
\lambda k \lambda x \lambda P : \exists x^* [k(\lambda y \lambda z. R(z) \in FA(P(y)))(x)(x^*)].P(x)
\]

- the continuation argument \( k \) applies to the original base presupposition, and the scalar entities are reserved (i.e. the composition is delayed).
Continuation semantics analysis for \(bhī\) (+-prosody) & (-prosody)

Definition of prosodic element

The prosodic component too utilises a function on its continuation (\(\lambda j\), with which the inner part of the denotation of \(bhī\) will be composed):

\[
[\text{SCALAR PROSODIC ELEMENT}] = \\
\lambda S \lambda j \lambda u \lambda w. [j(u)(w) & u, w \in S & u < w]
\]
Continuation semantics analysis for bhī (+prosody) & (-prosody)

Derivation of continuised scalar bhī

This allows for single definition of bhī, which can compose with the prosodic element (itself composed with a salient scale S) to produce the scalar-additive reading:

\[
\llbracket bhī \rrbracket (\llbracket \text{SCALAR PROSODIC ELEMENT} \rrbracket) = \\
[\lambda k \lambda x \lambda P : \exists x^*[k(\lambda y \lambda z. R(z) \in FA(P(y)))(x)(x^*)].P(x)] \\
(\lambda j \lambda u \lambda w[j(u)(w) \& u < w]) = \\
\lambda x \lambda P : \exists x^*[\lambda j \lambda u \lambda w. [j(u)(w) \& u < w](\lambda y \lambda z. R(z) \in FA(P(y)))(x)(x^*)].P(x) = \\
\lambda x \lambda P : \exists x^*[\lambda u \lambda w[\lambda y \lambda z. R(z) \in FA(P(y))(u)(w) \& u < w](x)(x^*)].P(x) = \\
\lambda x \lambda P : \exists x^*[\lambda u \lambda w[ R(w) \in FA(P(u)) \& u < w](x)(x^*)].P(x) = \\
\lambda x \lambda P : \exists x^*[ R(x^*) \in FA(P(x)) \& x < x^*].P(x)
\]

Which results in our original posited definition for scalar-additive bhī.
Deriving plain additive $bhī$

In the case of there being no scalar prosodic element in the environment for $bhī$ to combine with, the $\text{LOWER}$ operation can instead apply, saturating the continuation argument ($k$) with the identity function:

\[
\text{LOWER}([bhī]) = \\
\lambda k \lambda x \lambda P : \exists x^* [k(\lambda y \lambda z. R(z) \in FA(P(y)))(x)(x^*)].P(x)id = \\
\lambda k \lambda x \lambda P : \exists x^* [id(\lambda y \lambda z. R(z) \in FA(P(y)))(x)(x^*)].P(x) = \\
\lambda x \lambda P : \exists x^* [\lambda y \lambda z. R(z) \in FA(P(y))(x)(x^*)].P(x) = \\
\lambda x \lambda P : \exists x^* [R(x^*) \in FA(P(x))].P(x)
\]
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Discussion/Conclusions
Another Hindi particle, *hī*, has exhaustive properties similar to English *only*, but also a scalar component:

Bajaj (2016) examines a number of seemingly different uses of Hindi *hī*, including cases where the asserted true alternative is the most likely, as in (11), or the least desirable, as in (12):

(11)  
[\text{Ram} \text{ ki } \text{ patnī ne}]^F \text{ hī } \text{ Ram ko } \text{ cumā diyā.} \quad \text{[Ram of wife \_ERG\_}^F \text{ hī } \text{ Ram DAT kiss \_gave}} \quad \text{“[Ram’s wife only] gave Ram a kiss.” (= “The only person who kissed Ram was, of course, his wife.”) [wife most likely]}

(12)  
\text{Ram} [\text{comics}]^F \text{ hī } \text{ pāṛhtā } \text{ hai.} \quad \text{Ram [comics]}^F \text{ hī } \text{ read.HAB.SG is.} \quad \text{“Ram reads only comics.” (He doesn’t read better things like novels or dissertations.) [comics least desirable]}

\text{Prosodic “scalarising” element elsewhere in Hindi}
Bajaj (2016) argues that these different uses can be unified as:

\[-hii(C, p, w)\]

- Conventionally implicates:
  \[\neg \exists p' [p' \in C \land (p' >_{\text{likely}} p) \land (p' <_{\text{desirable}} p)]\]

- Asserts: \[p \land \forall p' [(p' \in C \land p'(w)) \rightarrow p' = p]\]

Here scalarisation seems invariant rather than variable (as in the case of \textit{bhī}), however...
...if focus is shifted to -ही, then it can be felicitous with the maximal endpoint of a desirability scale rather than the minimum (Bajaj 2016: 63):

(13) हम लोग चाहते हैं कि पैसा मिले, और पैसा-[HĪ]\(^F\)
we people wanted PAST that money receive, and money-[HĪ]\(^F\)
मिला.
received.

“We wanted money and it was money that we got.”

The possibility of flipping endpoints when prosodic focus is shifted suggests the possibility of a more compositional analysis which might involve the same prosodic component we posit in the case of भी.
Prosodic “scalarising” element elsewhere in Hindi

**Hindi to**

Perhaps also for Hindi *to* (Montaut 2016 and others), which also seems to associate with a variety of functions, including a variety of contrastive/intensive, as well as temporal “conjunction”, the latter of which is arguably scalar in nature.
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Distributed “even” elsewhere

While it does not involve an apparent prosodic component to “scalarise” the additive like Hindi or Basque, the Hungarian scalar-additive “even” also involves two clearly separate components (még...is):

(14) Jon zsíros-kenyeret kért. Feri is zsíros-kenyeret Jon.NOM lard.ADJ-bread.ACC asked. Feri.NOM too lard.ADJ-bread.ACC kért. asked
“Jon asked for some bread with lard. Feri also asked for some bread with lard.”

(15) Mindenki zsíros-kenyeret kért. Még Feri is everyone.NOM lard.ADJ-bread.ACC asked. still Feri.NOM too zsíros-kenyeret kért. lard.ADJ-bread.ACC asked
“Everyone asked for some bread with lard. Even Feri asked for some bread with lard.”
Connection to other ‘aspectual adverbials’

Similarities to elements like *already, still, anymore*; Hungarian *mégis*; Hindi *phir (bhī)* (both as concessive “still”) which involve focus and some presupposition, generally scalar, cf. Csirmaz & Slade (2020).
Future work

- a fuller phonetic investigation of the acoustic properties of plain additive vs scalar-additives contexts with $bhī$
- investigate other scalar contexts (like those that $hī$ is involved in) to see if a similar analysis can be fully worked out


References II


References IV

