A compositional account of the apparent polysemy of Hindi *bhī*

Benjamin Slade, Vandana Puri, Archna Bhatia, Aniko Csirmaz

11th meeting of (Formal) Approaches to South Asian Languages
University of Minnesota
28 March 2021

Overview

1. The conceit: Two *bhī* or not two *bhī*?
2. Some Hindi particles with formal definitions
3. Rather than ambiguity, a separate element
4. Phonetic evidence for a separate prosodic element in Hindi
5. Continuation semantics analysis for *bhī* (+prosody) & (-prosody)
6. Prosodic "scalarising" element elsewhere in Hindi
7. 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 meṁ āyā. shyām bhī āyā.
  Ram party in came. Shyam *bhi* came.
  "Ram came to the party. Shyam came too." [**plain additive**]

  (2) shyām bhī āyā! vah kabhī parṭī meṁ 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 *bhī*s 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.

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)]

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***
khāyīṁ.
ate.
"I ate it and even [my granny]^{F} ate it."

Summary of distribution of *bhī* & *tak*

	Exhaustive	**Additive**	**Scalar**
tak	YES	NO	YES
bhī	NO	YES	SOMETIMES

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 $P(x)$:

$[\![bh\bar{\imath}_{\text{additive}}]\!] =$

(5) $\lambda x \lambda P : \exists x^* \exists R[x \neq x^* \ \& \ R(x^*) \in FA(P(x))].P(x)$

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):

$[\![bh\bar{\imath}_{\text{scalar-additive}}]\!] =$

(6) $\lambda S \lambda x_S \lambda P : \exists x^*_S \exists R[x \neq x^* \ \& \ R(x^*_S) \in FA(P(x_S)) \ \& \ \mathbf{x_S} \prec \mathbf{x^*_S}].P(x_S)$

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

$[\![tak]\!] =$

(7) $\lambda S \lambda x_S \lambda P : \forall x^*_S \exists R[R(x^*_S) \in FA(P(x_S)) \ \& \ x_S \prec x^*_S].P(x_S)$

Typology of *bhī*-like elements

- Parallels to the "ambiguous" behaviour of Hindi *bhī* exist elsewhere in South Asia, both in Indo-Aryan, as in Nepali *pani*, Skt. *api*; and in Dravidian *-um* (see Masica 1976; cf. Szabolcsi 2017)
- And outside of both South Asia and Indo-European: Basque *ere*

Two *bhī*s and Occam's Razor

- both "plain" additive *bhī* and scalar-additive *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 *bhī*s posited and try to provide a unified account

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]

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

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 ।

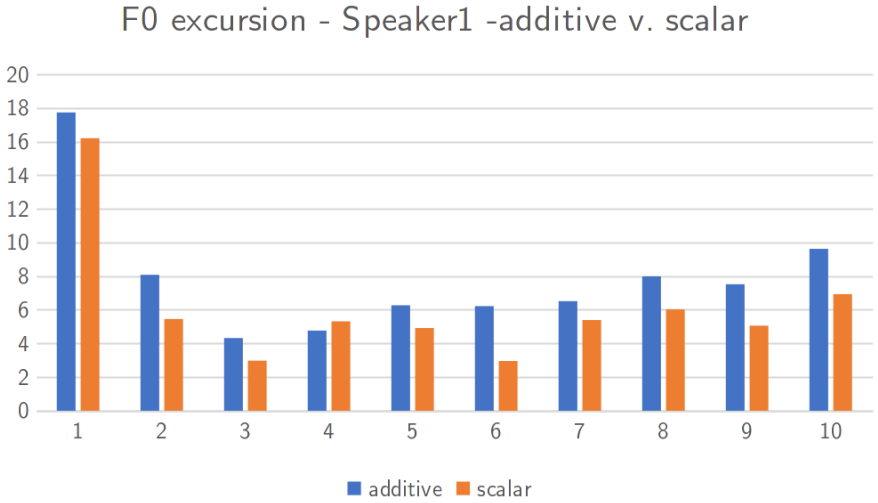
b. Sabīn ne baldev aur sunītā ko ghaṛī dī. Sabīn ne
Sabeen ERG Baldev and Suneeta DAT watch gave. Sabin ERG
nīra ko bhī ghaṛī dī
Neera DAT *bhī* watch gave.
"Sabeen gave a watch to Baldev and Suneeta. Sabeen gave
NEERA a watch too." [**plain additive**]

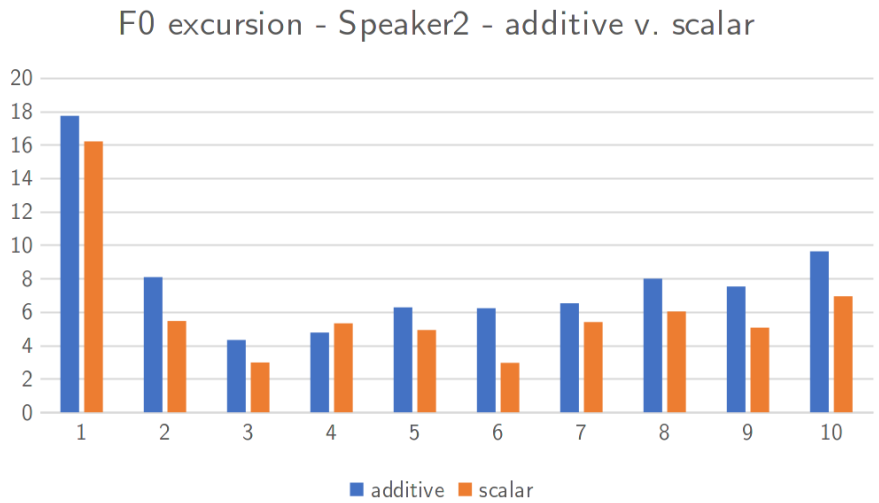
(10) a. सब जानते हैं कि नीरा कभी घड़ी नहीं पहनती । सबीन ने नीरा को भी घड़ी दी।

b. sab jānte haiṁ ki nīrā kabhī ghaḍī nahīṁ pahntī.
all know are that Neera anytime watch not wears.
Sabīn ne nīra ko bhī ghaṛī dī.
Sabeen ERG Neera DAT *bhī* watch gave.
"Everyone knows Neera never wears a watch. Sabeen even gave
a watch to NEERA." [**scalar-additive**]

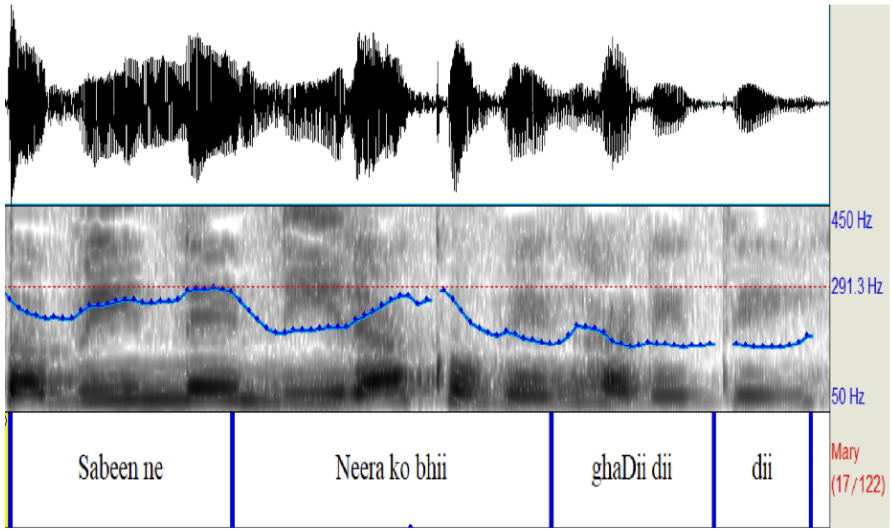
Results of Prosodic Pilot Study

- 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

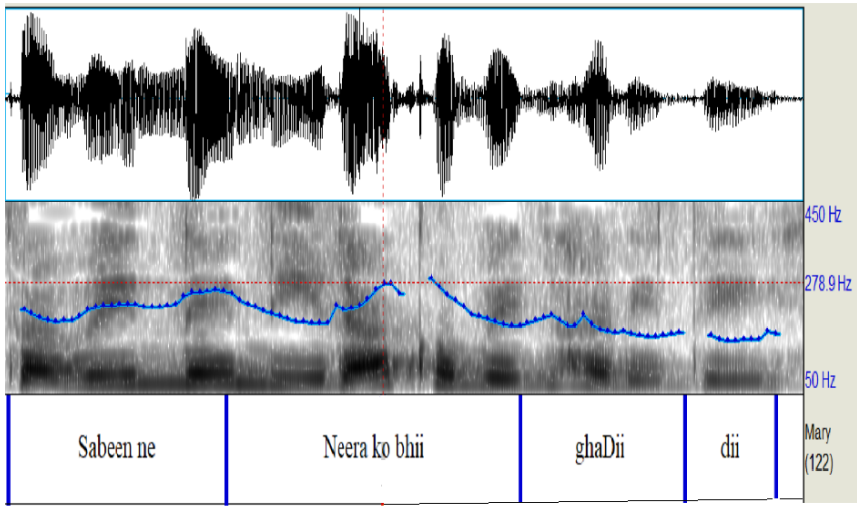




Praat spectograms



ADDITIVE



SCALAR

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 *Rām* in *Rām loves Sītā* is effectively $\lambda x.x$ saw s; in *Rām snores*, the continuation of *Rām* is $\lambda x.x$ snores
- but some linguistic expressions have denotations which manipulate their continuations

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 $\lambda P . P(\text{j})$
- 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 (λ,$\exists$) 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*:

$[\![bh\bar{\imath}_{(\text{continuised})}]\!] =$

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

- the continuation argument k applies to the original base presupposition, and the scalar entities are reserved (i.e. the composition is delayed).

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):

$[\![\text{SCALAR PROSODIC ELEMENT}]\!] =$

$\lambda S \lambda j \lambda u \lambda w.[j(u)(w)\ \&\ u, w \in S\ \&\ u \prec w]$

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:

$[\![bh\bar{\imath}]\!]([\![\text{SCALAR PROSODIC ELEMENT}]\!]) =$

$$[\lambda k\lambda x\lambda P : \exists x^*[k(\lambda y\lambda z.R(z) \in FA(P(y)))(x)(x^*)].P(x)]$$
$$(\lambda j\lambda u\lambda w[j(u)(w)\ \&\ u \prec w]) =$$
$$\lambda x\lambda P : \exists x^*[\lambda j\lambda u\lambda w.[j(u)(w)\ \&\ u \prec w](\lambda y\lambda z.R(z) \in FA(P(y)))(x)(x^*)].P(x) =$$
$$\lambda x\lambda P : \exists x^*[\lambda u\lambda w[\lambda y\lambda z.R(z) \in FA(P(y))(u)(w)\ \&\ u \prec w](x)(x^*)].P(x) =$$
$$\lambda x\lambda P : \exists x^*[\lambda u\lambda w[R(w) \in FA(P(u))\ \&\ u \prec w](x)(x^*)].P(x) =$$
$$\lambda x\lambda P : \exists x^*[R(x^*) \in FA(P(x))\ \&\ x \prec x^*].P(x)$$

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 LOWER operation can instead apply, saturating the continuation argument (k) with the identity function:

LOWER($[\![bh\bar{\imath}]\!]$) =

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

Hindi *hī* 1

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) [Rām kī patnī ne]^F hī Rām ko cumā diyā.
[Ram of wife ERG]^F *hī* Ram DAT kiss gave
"[Ram's wife only] gave Ram a kiss." (= "The only person who kissed Ram was, of course, his wife.") [wife MOST LIKELY]

(12) Rām [comics]^F hī paṛhtā hai.
Ram [comics]^F *hī* read.HAB.SG is.
"Ram reads only comics." (He doesn't read better things like novels or dissertations.) [comics LEAST DESIRABLE]

Hindi *hī* 2

Bajaj (2016) argues that these different uses can be unified as:

-*hii*(C,p,w)

- Conventionally implicates:
  $\neg\exists p'[p' \in C \wedge ((p' \succ_{likely} p) \wedge (p' \prec_{desirable} p))]$
- Asserts: $p \wedge \forall p'[(p' \in C \wedge p'(w)) \rightarrow p' = p]$

Here scalarisation seems invariant rather than variable (as in the case of *bhī*), however...

Hindi *hī* 3

...if focus is shifted to *-hī*, then it can be felicitous with the maximal endpoint of a desirability scale rather than the minimum (Bajaj 2016: 63):

(13) ham log cāhte the ki paisā mile, aur paisā-[HĪ]^F
we people wanted PAST that money receive, and money-[*HĪ*]^F
milā.
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 *bhī*.

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.

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 I

Bajaj, Vandana. 2016. *Scaling up exclusive -hii*. New Brunswick, NJ: Rutgers University dissertation.

Barker, Chris. 2002. Continuations and the nature of quantification. *Natural Language Semantics* 10. 211–242.

Barker, Chris & Chung-Chieh Shan. 2014. *Continuations and natural language* (Oxford Studies in Theoretical Linguistics 53). New York, NY: Oxford University Press.

Csirmaz, Aniko & Benjamin Slade. 2020. Anatomy of Hungarian aspectual particles. In Veronika Hegedűs & Irene Vogel (eds.), *Approaches to Hungarian: Papers from the 2017 Budapest Conference*, 26–45. Amsterdam: John Benjamins.

de Groote, Philippe. 2001. Type raising, continuations, and classical logic. In *Proceedings of the thirteenth Amsterdam Colloquium*, 97–101.

de Groote, Philippe. 2006. Towards a Montagovian account of dynamics. *Semantics and Linguistic Theory* 16. 1–16.

Etxeberria, Urtzi & Aritz Irurtzun. 2015. The emergence of scalar meanings. *Frontiers in Psychology* 6. doi:10.3389/fpsyg.2015.00141.

References II

Felleisen, Matthias. 1987. *The calculi of lambda-v-CS conversion: A syntactic theory of control and state in imperative higher-order programming languages*. Bloomington: Indiana University dissertation.

Féry, Caroline. 2010. Indian languages as intonation 'phrase languages'. In S. Imtiaz Hasnain & Shreesh Chaudhary (eds.), *Problematizing language studies: Festscrift for Rama Agnihotri*, 288–312. Delhi: Aakar Books.

Khan, Sameer ud Dowla. 2016. The intonation of South Asian languages: Towards a comparative analysis. In Mythili Menon & Saurov Syed (eds.), *Proceedings of FASAL 6*, 23–26.

Kügler, Frank. 2020. Post-focal compression as a prosodic cue for focus perception in Hindi. *Journal of South Asian Linguistics* 10(2). 38–59.

Lahiri, Utpal. 1998. Focus and Negative Polarity in Hindi. *Natural Language Semantics* 6. 57–123.

Masica, Colin P. 1976. *Defining a linguistic area: South Asia*. Chicago: University of Chicago Press.

References III

Montaut, Annie. 2016. The discourse particle *to* and word ordering in Hindi: From grammar to discourse. In M.M. Jocelyne Fernandez-Vest & Robert D. Van Valin (eds.), *Information Structuring in Spoken Languages from a Cross-linguistic Perspective*, 263–284. Berlin: De Gruyter Mouton.

Partee, Barbara H. 1987. Noun phrase interpretation and type-shifting principles. In Jeroen Groenendijk & Martin Stokhof (eds.), *Studies in Discourse Representation Theory and the theory of Generalized Quantifiers* (GRASS 8), 115–144. Dordrecht: Foris.

Patil, Umesh, Gerrit Kentner, Anja Gollrad, Frank Kügler, Caroline Féry & Shravan Vasishth. 2008. Focus, word order and intonation in Hindi. *Journal of South Asian Linguistics* 1(1). 53–67.

Puri, Vandana. 2013. *Intonation in Indian English and Hindi late and simultaneous bilinguals*. Urbana: University of Illinois dissertation.

Rooth, Mats. 1985. *Association with focus*. Amherst: University of Massachusetts dissertation.

Schwenter, Scott A. & Shravan Vasishth. 2000. Absolute and relative scalar particles in Spanish and Hindi. *Annual Meeting of the Berkeley Linguistics Society* 26(1). 225–233. doi:10.3765/bls.v26i1.1124.

References IV

Shan, Chung-chieh. 2005. *Linguistic side effects*. Cambridge, Mass: Harvard University dissertation.

Strachey, Christopher & Christopher Wadsworth. 1974. Continuations: A mathematical semantics for handling full jumps. Tech. Rep. PRG-11. Oxford University, Computing Laboratory.

Szabolcsi, Anna. 2017. Additive presuppositions are derived through activating focus alternatives. In *21st Amsterdam Colloquium*, 455–464.