Syntax and Prosody in Urdu/Hindi Questions

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Joint work with

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Workshop *Pertinacity Pertains!*

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Context

- Part of a Research Unit (FOR 2111) *Questions at the Interfaces* at Konstanz
  - Looking at non-canonical uses of questions across languages.
  - Butt, Bögel, Jabeen and Mumtaz represent Project P4, working on Urdu/Hindi.
  - Biezma is Project P2, looking at Romance.
- Generally trying to understand the interplay between **prosody, morphosyntax** and **semantics/pragmatics** with respect to non-canonical questions.
- We've been at it since around 2014.

- But now we are (hopefully) done with respect to one aspect of questions in Urdu/Hindi: **polar *kya* 'what'**.
- Focus in this talk: the prosody-syntax interface.

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Context

- We work within LFG (Lexical Functional Grammar).
- LFG does not have a long or deep tradition of working on the "sound" side of things.
  - Very computationally/formally grounded approach.
  - Much work done at PARC.
  - Early strategic decision not to pursue work in Automatic Speech Recognition, etc.
- So very little work on phonology or prosody until the 1990s.

Context

What changed?

- Aditi hired Miriam in 1997 and told her to stop mucking about only with syntax and to read up on phonology.
- Particular project: Complex Predicates (A2 in the SFB 471)
- Outcome 1:
  - Architectural discussions with Ron Kaplan and John Maxwell III at PARC.
  - Collaboration with Tracy Holloway King on a computational implementation of prosodic effects found within complex predicates in Bangla.

    $\longrightarrow$ First paper on the prosody-syntax interface in LFG.
    $\longrightarrow$ Based on data and insights from Hayes and Lahiri (1991) and Lahiri and Fitzpatrick-Cole (1999).
- Outcome 2:
  - Butt and Lahiri (2003): light verbs do not undergo grammaticalization across time — they are pertinacious.

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First Stab at the Prosody-Syntax Interface

1998: Interfacing phonology with LFG

XLE Demo

- Clauses with two Vs in Bengali (and other South Asian languages) are ambiguous when looking just at the surface string.

(1) tara tʃeleder mer-e pʰel-etʃe
Tara.Nom boy.Pl.Acc hit-Perf fall-Perf.3.Sg
Reading 1: 'Tara, having beating the boys, fell.'
Reading 2: 'Tara beat up the boys.' (V-V complex predicate)

- Disambiguated via prosodic information.

Architecture of Prosody-Syntax Interface

- Butt and King's (1998) implementation reflects a **syntacto-centric** architecture of the prosody-syntax interface.
- Prosodic phrasing is determined based on the syntactic structure
  $\longrightarrow$ syntax is primary
- This is the dominant view in the field
  (also assumed in Hayes and Lahiri (1991)).
- However, patterns across languages point more towards an architecture in which
  - prosody and syntax are each governed by a separate set of prinicples
  - mismatches between syntax and prosody are a feature, not a bug
    (regular part of the system, not exceptions).
- This talk works with Bögel's (2015) conception of the prosody-syntax interface via LFG's multi-dimensional projection architecture.

Structure of Talk

1. Polar and constituent questions in Urdu/Hindi.
2. Intonation: What we know
3. Polar *kya* as a marker of uncertainty.
4. The Prosody-Syntax Interface
5. An end-to-end analysis: prosody, syntax, semantics/pragmatics of polar *kya*
6. Summary

Polar Questions

- Urdu/Hindi has basic SOV word order.
- Major constituents may scramble.
- Question vs. declarative status is signaled via intonation.

Declarative: Intonational phrase boundary is L-L%

(2) ʃahina=ne norina=ko mara$_{\text{L-L\%}}$
Shahina.F=Erg Norina.F=Acc hit-Perf.M.Sg
'Shahina hit Norina.' (Declarative)

Polar Question: Intonational phrase boundary is L/H-H%

(3) ʃahina=ne norina=ko mara$_{\text{L/H-H\%}}$
Shahina.F=Erg Norina.F=Acc hit-Perf.M.Sg
'Did Shahina hit Norina?' (Polar Question)

Polar Questions

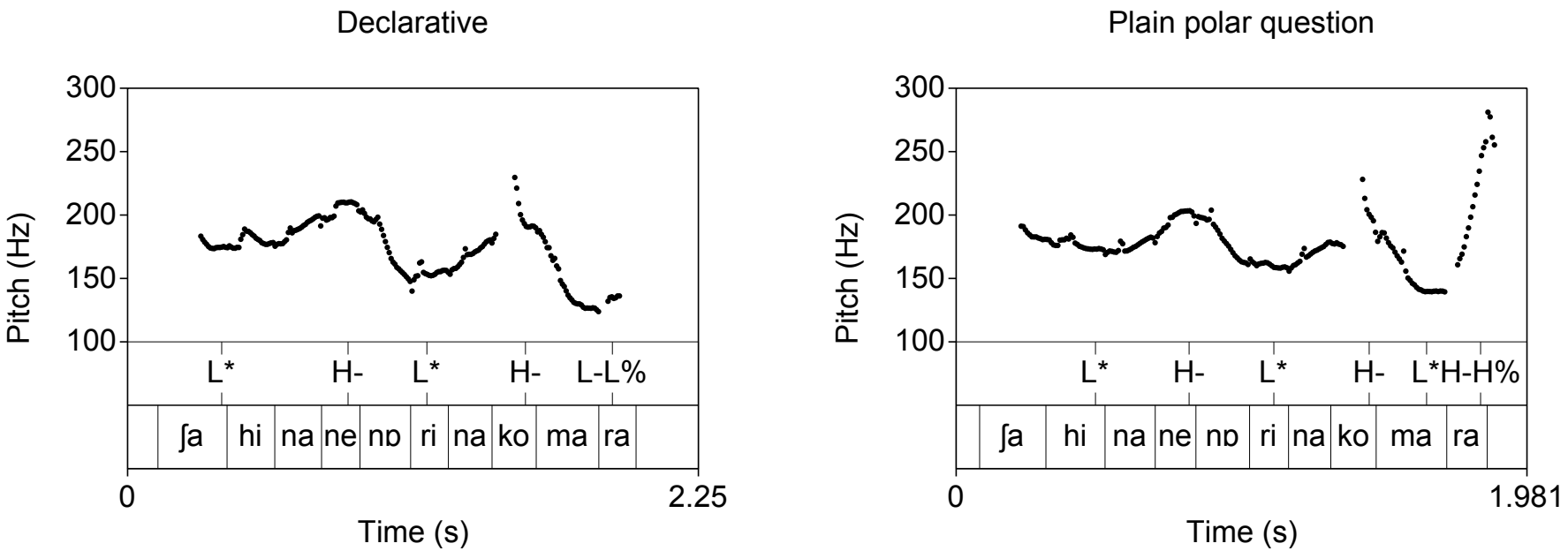


Figure: F_0 contour of a string identical declarative and polar question.

Intonational Patterns in General

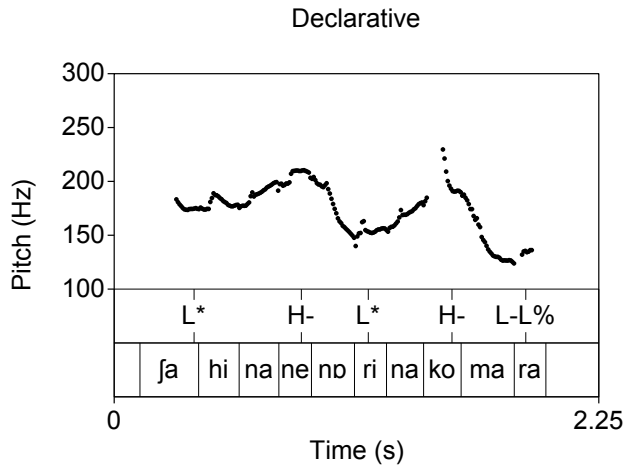


Figure: F_0 contour of a declarative

- Urdu/Hindi shows a very regular pattern of a series of LHs.
- The last bit (mostly a syntactic constituent) is always falling.
- This is broadly in line with what Hayes and Lahiri (1991) show for Bengali.

The nature of LH

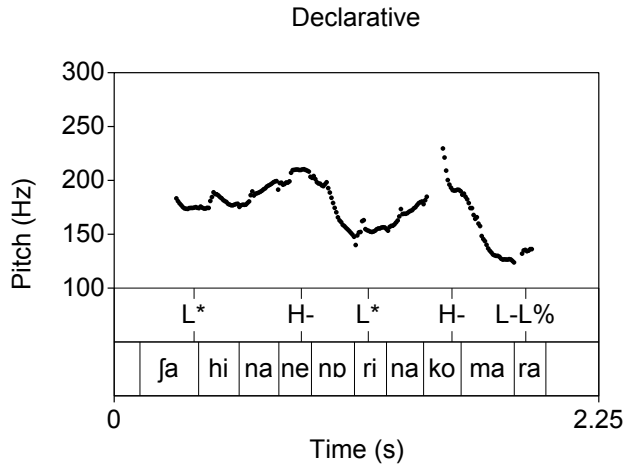


Figure: F_0 contour of a declarative

- The precise nature of the LHs in Urdu/Hindi has been controversially discussed.
- Féry (2010) argues that native speakers are inconsistent intuitions about lexical stress speak against the existence of lexical stress.
- Our own work shows solid evidence for lexical stress, with inconsistent intuitions confined to instances of syllable weight and weight clash (Mumtaz et al. 2020).
- The overall evidence seems to be compatible with an L*H, so this is what we assume (cf. also Urooj et al. (2019)).

Phrasing Considerations

- Urdu/Hindi prosodic phrasing has also been discussed controversially.
- Suggestion in the literature: the L*H corresponds roughly to a content word (Moore 1965, Harnsberger 1994, Puri 2013).
- We think the L*H probably corresponds to a prosodic word, but this needs to be established (we are still working on this, looking at clitics).
- There is little evidence for a prosodic phrase: the series of L*H seem to get grouped into an intonational phrase without any intermediary prosodic constituents.
- Current take in the literature:
  - The LH corresponds to an accentual phrase (AP) (Féry 2010, Urooj et al. 2019).
  - We are adopting this analysis for now.

Focus

- The phonetic realization of focus has been studied in several papers (Patil et al. 2008, Genzel and Kügler 2010, Féry et al. 2016, Jabeen and Braun 2018).
- Looking across the studies and our own data/studies, the most reliable cue seems to be pitch excursion (but also duration, post-focal compression).
- This talk: differences in f0 for focus.

Polar Questions

Back to polar questions:

- Question vs. declarative status is signaled via intonation.

  Declarative: Intonational phrase boundary is L-L%

  (4) ʃahina=ne norina=ko mara$_{\text{L-L\%}}$
  Shahina.F=Erg Norina.F=Acc hit-Perf.M.Sg
  'Shahina hit Norina.' (Declarative)

  Polar Question: Intonational phrase boundary is L/H-H%

  (5) ʃahina=ne norina=ko mara$_{\text{L/H-H\%}}$
  Shahina.F=Erg Norina.F=Acc hit-Perf.M.Sg
  'Did Shahina hit Norina?' (Polar Question)

- One could invent some invisible syntactic structure to "hang" the prosodic information on.
- More likely: prosody is what signals interrogativity in polars (without help from the syntax).

Polar *kya* 'what'

- But – the picture is more complex!
- Polar questions can optionally be expressed with *kya* 'what'.

(6) (**kya**) ʃahina=ne norina=ko mara?
what Shahina.F=Erg Norina.F=Acc hit-Perf.M.Sg
'Did Shahina hit Norina?'

- Questions to answer:
  - What is the meaning and function of this 'what'?
  - What is its distribution?
  - How can all this be modeled?

Polar *kya* 'what'

- Grammars and previous literature report polar *kya* as appearing only clause initially in Urdu/Hindi.
- In contrast, Bhatt and Dayal (2020) point out that it can appear anywhere in the clause.

(7)

(kya)	ɑnu=ne	(kya)	uma=ko	(kya)	kɪtab	(%kya)	d-i	(kya)?
what	A.F=Erg	what	U.F=Dat	what	book.F.Sg.Nom	what	give-Perf.F.Sg	what

'Did Anu give a/the book to Uma?

- However, it is strongly **dispreferred** in the immediately preverbal position.
- Hypothesis: this is because the immediately preverbal position is the default position for:
  - focus
  - and therefore **wh-constituent questions**.

Wh-Questions in Urdu/Hindi

Urdu/Hindi has traditionally been characterized as a **wh-in-situ** language (but also see Bayer and Cheng 2015).

(8) a. sita=ne d^{h}yan=se **ram=ko** dek^{h}-a t^{h}-a
Sita.F=Erg attention.M=Inst Ram.M=Acc see-Perf.M.Sg be.Past-M.Sg
'Sita had looked at Ram carefully'

b. sita=ne d^{h}yan=se **kɪs=ko** dek^{h}-a t^{h}-a?
Sita.F=Erg attention.M=Inst who.Obl=Acc see-Perf.M.Sg be.Past-M.Sg
'Who had Sita looked at carefully?'

- Besides the default position, wh-words can appear anywhere in the clause:
  1. They have exactly the same kind of scrambling possibilities as normal NPs (Manetta 2012).
  2. **But:** there is a difference in interpretation which has to do with information structure.
  3. For example, see Butt et al. (2016) on immediately postverbal wh-constituents within the verbal complex as expressions of secondary focus.

Wh-Questions in Urdu/Hindi

- The **default** position for wh-words is actually not the in-situ position.
- It is the immediately **preverbal** position.
- This is the default focus position
  (Gambhir 1981, Butt and King 1996, 1997, Kidwai 2000).

(9) a. **sita=ne** ram=ko dek^{h}-a t^{h}-a
Sita.F=Erg Ram.M=Acc see-Perf.M.Sg be.Past-M.Sg
'Sita had seen Ram.'

b. ram=ko **kɪs=ne** dek^{h}-a t^{h}-a?
Ram.M=Acc who.Obl=Erg see-Perf.M.Sg be.Past-M.Sg
'Who saw Ram?'

Default Position for Focus

- Féry et al. (2016) conducted a comparative study of Hindi and Indian English.
- They asked questions like:
  - *In front of the well, who is pushing the car?* (Questioning the Subject)
  - *In front of the well, what is the man pushing?* (Questioning the Object)
- They found the following word orders in the responses.

	SOV	OSV
Subject Questioned (n=28)	6	22
Object Questioned (n=26)	26	–

$\Longrightarrow$ Default information focus position is immediately preverbal.

Wh-Questions in Bollywood Scripts

- We extracted wh-words (k-words) from 12 Bollywood Scripts.
- The table shows the word order distribution of a subset of wh-words
- Again, the default position is the immediately preverbal position.

Distribution	**Core Arguments** (without *kya*)	**Adjuncts** ('where', 'when')	**Total**
Single Word	28	14	42
Initial	9	10	19
Medial	2	12	14
Preverbal	**118**	**209**	**327**
In Verbal Complex	0	5	5
Postverbal/Final	6	7	13
Embedded	12	17	29
No Verb	14	5	19
Total	189	279	468

Uses of *kya* 'what'

- Polar *kya* and the wh-word *kya* are clearly related.
- Besides these two uses, there are several more in Urdu/Hindi.
  1. Thematic (constituent) *kya*
  2. Scope marking
  3. Expression of 'what's the point'
  4. With Alternative Questions (AltQs)
- The next slides show these, but we concentrate on polar *kya*.
- With a short excursion to AltQs.

Uses of *kya* 'what'

Thematic wh-word 'what'

1. As a wh-constituent

(10) sita=ne **kya** dek^{h}-a t^{h}-a
Sita.F=Erg what see-Perf.M.Sg be.Past-M.Sg
'What had Sita seen?'

2. Within an NP

(11) ʃahina=ne naz=ko [**kya** tofa] di-ya?
Shahina.F=Erg Naz.F=Dat what present.M.Sg.Nom give-Perf.M.Sg
'What gift did Shahina give to Naz?'

Uses of *kya* 'what'

- Wh-counterpart of the scope marking construction (Dayal 1996, 2000)
- Licenses matrix scope of wh-in-situ

(12) a. sita **ye** soc-ti hai [ki ram
Sita.F.Nom this think-Impf.F.Sg be.Pres.3.Sg that Ram
ja-ye-ga]
go-3.Sg-Fut-M.Sg
'Sita thinks that Ram will go.'
(lit.: Sita thinks this, that Ram will go.)

b. sita **kya** soc-ti hai [ki kon
Sita.F.Nom what think-Impf.F.Sg be.Pres.3.Sg that who
ja-ye-ga?]
go-3.Sg-Fut-M.Sg
'Who does Sita think will go?'
(lit.: What does Sita think, that who will go?)

Uses of *kya* ‘what’

In an adjunct use, roughly meaning ‘what’s the point’.

(13) ɑb mẽ us=se **kya** mɪl-ũ?
now I.Nom Pron.Obl=Inst what meet-Subj.1.Sg
‘What’s the point of meeting with him/her now?
(lit. What should I meet with him/her?)’

Uses of *kya* 'what'

The *kya* 'what' is also found with AltQs
(Han and Romero 2004, Bhatt and Dayal 2020).

(14)

(kya)	candra=ne	kofi	p-i	ya	cai
what	Chandra.F=Erg	coffee.F.Nom	drink-Perf.F.Sg	or	tea.F.Nom

'Did Chandra drink tea or coffee?'

kya and Alternative Questions

- **Interesting Puzzle:** Bhatt and Dayal (2020) show that when *kya* is initial, one can get two readings with sentences containing 'or'.

(15) **kya** candra=ne kofi ya cai p-i?
what Chandra.F=Erg coffee.F.Nom or tea.F.Nom drink-Perf.F.Sg
'Did Chandra drink tea or coffee?'
Alternative Question Reading: Did Chandra drink tea or did she drink coffee?
Polar Question Reading: Is it the case that Chandra drank either tea or coffee?'

- But when the *kya* is final, the alternative question reading is out.

(16) candra=ne kofi ya cai p-i **kya**?
Chandra.F=Erg coffee.F.Nom or tea.F.Nom drink-Perf.F.Sg what
'Did Chandra drink tea or coffee?'
*Alternative Question Reading: Did Chandra drink tea or did she drink coffee?
Polar Question Reading: Is it the case that Chandra drank either tea or coffee?'

Polar *kya* 'what'

- Bhatt&Dayal establish that polar *kya* is NOT a question marker.
  - It is optional in matrix clauses.
  - Generally disallowed in embedded clauses.
  - **But:** complements of "rogative" predicates like 'wonder' and 'ask' are an exception — they cannot explain this fact.
- We (Biezma et al. submitted), in contrast, can now explain these and other facts!!
- Clue lies in understanding the subtle pragmatic constraints on polar *kya*.

Analyses of polar *kya*

- We began with a hypothesis that polar *kya* expresses rhetorical questions.

(17) Context: A is telling B how to behave in a situation. B says (with sarcasm):

B: tʊm mer-i ɑmmɑ̃ ho **kya**?
you.Nom my-F.Sg mother.F.Sg.Nom be.Pres.2 what
'Are you my mother?'

- But this did not account for all of the data.

Analyses of polar *kya*

Biezma et al. (2018) proposed that:

- Polar-*kya* is a focus sensitive question operator.
- It constrains the alternatives that the speaker is entertaining.
- Prediction:
  - Nothing/No cannot be the answer to a polar *kya* question.
  - So non-serious invitations should also not be able to be offered with polar *kya*.

Indeed, (18) can only be said if one actually intends to produce a cup of coffee.

(18) (kya) ap (kya) coffee l-ẽ-g-e?
what you.Hon what coffee.F.Sg take-2.Pl-Fut-M.Pl
'Will you have coffee?'

However, this also did not account for all of the data.

Surprise, incredulity...

A corpus study (Bollywood movies) yielded the observation that polar *kya* questions tend to be used in situations when an extra pragmatic import is to be conveyed, particularly with respect to **surprise**.

(19) **kya** ye sɑc hɛ?
what this true be.Pres.3Sg
'Could this be true?' Script, *Socha Na Tha*
Context: Guy is told by his family that he can actually marry who he wishes, which is something he has been struggling for all movie.

(20) **kya** mɛ̃ tʊm=se pyar kɑr-ta hũ?
what I.Nom you=Inst love do-Impf.M.Sg be.Pres.1.Sg
'Is it possible I am in love with you?' Script of *Socha Na Tha*
Context: guy has been chasing woman X the whole movie and has now just figured out that he is actually in love, with woman Y, his best friend.

(21) tu pagɑl hɛ **kya**?
you.Fam.Nom crazy be.Pres.3.Sg what
'Are you crazy?' *Socha Na Tha*
Context: The groom has just proposed the bride to cancel herself their wedding so he can marry someone else. The speaker is the groom's best friend, present at the time of the proposal.

ForceP and Scope

- Bhatt and Dayal (2020) see polar *kya* as an instantiation of new class of beings: Polar Question Particles (PQPs).
- They situate it in ForceP and take its position to indicate the scope of what is up for being questioned.

(22) S IO *kya* Adv DO Verb Aux

ram=ne sita=ko *kya* kɑl kɪtab d-i
Ram.M=Erg Sita.F=Dat *kya* yesterday book.F.Sg.Nom give-Perf.F.Sg
t^h-i
be.Past-F.Sg
'Had Ram given a/the book to Sita yesterday,...
(i) #ya mina=ne?
or Mina.F=Erg
'or had Mina?'
(ii) #ya vina=ko?
or Vina.F=Dat
'or to Vina?'
(iii) ya parsõ?
or day before yesterday
'or the day before yesterday?'
(iv) ya mɛgɛzin?
or magazine.F.Sg.Nom
'or a magazine?'

Just Scope

However, we showed that when an item to the left is stressed and thus focused, it does become available for being questioned.

(23) S IO *kya* Adv DO Verb Aux

ram=ne	sita=ko	**kya**	kɑl	kɪtab	d-i
Ram.M=Erg	Sita.F=Dat	what	yesterday	book.F.Sg.Nom	give-Perf.F.Sg

t^h-i
be.Past-F.Sg
'Had Ram given a/the book to Sita yesterday,...
(i) ya mina=ne?
or Mina.F=Erg
'or had Mina?'

Right Generalization:

- By default polar *kya* takes scope over items to its right.
- Given non-default prosody (stress on particular items) or the right context, it can also associate with other items in a clause.

Uncertainty

- After all this uncertainty in analysis, we (=María Biezma) dug much deeper into the languge.
- And realized: **polar *kya* is a marker for uncertainty**.
- This is a surprisingly simple explanation that accounts for all the data we have found so far.
  1. Polar *kya* can embed under rogatives like 'wonder' because the the speaker is uncertain about whatever is being wondered about.
  2. It cannot embed under non-rogative verbs like 'know, think', etc. because there is no uncertainty expressed about the embedded complement.
  3. It lends itself for expressions of surprise (uncertainty) and sarcasm (pretending to be uncertain about something that is clearly established, flouting Maxims of Conversation).
  4. If you are certain you do not want to offer somebody a cup of coffee, you cannot use polar *kya*.

Further Evidence

Bhatt and Dayal (2020) note that polar *kya* is not possible in sentences like the following.

(24) a. ɑre, (**kya*) tʊm yɑhĩ ho?
oh what you.Nom here be.2.Pl
'Oh, you are still here?'

b. ɑre, (**kya*) tʊm gɑ-ye nahĩ?
oh what you.Nom go-Perf.M.Pl not
'Oh, you didn't leave?'

- Under our analysis this follows because one own's visual evidence establishes firmly that the person is still there, so there is no room for uncertainty and hence no room for polar *kya*.
- However, if one imagines a situation in which the speaker is temporarily blind and has heard a noise and is uncertain about whether the addressee has left, polar *kya* becomes good.

Formal Analysis

- Polar *kya* is focus sensitive.
- Syed and Dash (2017) compare polar 'what' across Hindi, Bangla and Oṛiya and conclude that polar 'what' is a focus sensitive operator.
- We adopt this basic analysis (cf. Biezma et al. (2018)) and see polar *kya* as a type of focus sensitive operator.

Ultimate Analysis

(25) *kya* intuitively: $[\![[_Q[\boldsymbol{kya}\ [\sim \Phi]]]]\!] = [\![[_Q \sim \Phi]]\!]$
defined only if the speaker believes that there are more than one live salient alternatives in the context of utterance.

- Note: the analysis of the semantics and pragmatics of polar *kya* is entirely due to María Biezma.

Formal Analysis

We need the following formal machinery and assumptions.

- For access to questioner's private beliefs: **Doxastic Alternatives**

  $Dox_{x,w} = \{w' : w' \text{ is compatible with what } x \text{ believes to be true in } w\}$

- Assumption: PolQs denote singleton sets (Roberts 1996, Biezma and Rawlins 2012)
- In Hamblin-style semantics, propositions are also singleton sets.
- Need to extract the 'content proposition'.

(26) Let Φ be a syntactic expression s.t. $[\![\Phi]\!]^o = \Phi$, where Φ is a singleton set containing $\phi_{\langle s,t\rangle}$ ($[\![\Phi]\!]^o = \{\phi_{\langle s,t\rangle}\}$). We call $\phi_{\langle s,t\rangle}$ *contentProp*(Φ)).

(27) Consider the interrogative sentence *Did Ravi give a toy to Amra?*, with the syntax [$_Q$Ravi gave a toy to Amra].

a. $[\![[_Q \textbf{Ravi gave a toy to Amra}]]\!]^o = \{\lambda w.$ Ravi gave a toy to Amra in $w\}$ ...

b. *contentProp*([$_Q$Ravi gave a toy to Amra]) = $\lambda w.$ Ravi gave a toy to Amra in w.

Formal Analysis — Focus

- Following the Roothian tradition (Rooth 1992), sentences have an ordinary semantic value ($[\![\cdot]\!]^o$) and a focus semantic value ($[\![\cdot]\!]^f$).
- A definition of focus meaning that suffices for our purposes:

(28) Let Φ be a sentence with focus marking.
$[\![\Phi]\!]^f = \{p : p = \mathit{contentProp}(\Psi),$ for all Ψ resulting from replacing in Φ the focus element with expressions of the same type $\}$

(29) $[\![[\textbf{Ravi gave a toy to } \textbf{AMRA}_{\textbf{F}}]]\!]^f = \{\lambda w.$ Ravi gave a toy to Amra in w; $\lambda w.$ Ravi gave a toy to Sita in w; $\lambda w.$ Ravi gave a toy to Volkswagen in w; $\ldots\}$

Formal Analysis — Presuppositions

- A '~' from Biezma (2020) (building on Constant 2014).
- The main work of '~' is to trigger the presupposition regarding the discourse in which the utterance is embedded.
- Establishes that there is a discourse antecedent that is a subset of the focus value.

(30) Roothian '~' adapted to Hamblin semantics, where OP is an operator collecting alternatives in the Hamblin system (e.g., '$\exists$' or 'Q') if there is one:

a. $[\![\mathbf{OP} \sim \phi]\!]^o = [\![\mathbf{OP}\phi]\!]^o$ b. $[\![\mathbf{OP} \sim \phi]\!]^f = [\![\mathbf{OP}\phi]\!]^o$

c. ... and presupposes that the context contain an antecedent C such that:

(i) $C \subseteq [\![\phi]\!]^f$ (ii) $|C| > 1$ (iii) $[\![\phi]\!]^o \subset C$

Formal Analysis: Regular Polar Questions

- There are some further bits and pieces dealing with situations in which none of the live focus alternatives is true.
- See fuller paper for those.

Walkthrough for simple polar question:

(31) Let Φ be a syntactic expression and $[\![\Phi]\!]$ a set of propositions.

$[\![[_{\boldsymbol{Q}}\Phi]]\!]^{\boldsymbol{o}} = [\![\Phi]\!]^{\boldsymbol{o}}$,
defined only if $[\![\Phi]\!]^{\boldsymbol{o}} \subseteq \text{SalientAlts}(\Phi)$ & $|\text{SalientAlts}(\Phi)| > 1$

(32) a. $[_{\boldsymbol{Q}}\sim$ [Ravi gave a toy to $\text{Amra}_{\mathbf{F}}$]]

b. $[\![$[**Ravi gave a toy to** $\textbf{A}\textsc{mra}_{\mathbf{F}}$]$]\!]^{\boldsymbol{f}}$ = {Ravi gave a toy to Amra; Ravi gave a toy to Sita; Ravi gave a toy to Tina;...}

(33) $[\![[_{\boldsymbol{Q}}\sim$ [**Ravi gave a toy to** $\textbf{A}\textsc{mra}_{\mathbf{F}}$]$]\!]^{\boldsymbol{o}}$ = {λw.Ravi gave a toy to Amra in w}, felicitous only if there is a question open in the discourse of the form *to whom did Ravi give a toy?*, that Ravi gave a toy to Amra is a live alternative and there is at least another live alternative.

Formal Analysis: Polar kya

- Final analysis for polar *kya*
- We assume that polar *kya* signals the presence of an operator in the clause that takes propositions as arguments.

(34) $[\![[_{\mathbf{Q}}[\mathbf{kya}\ [\sim \Phi]]]]\!]^{o} = [\![[_{\mathbf{Q}} \sim \Phi]]\!]^{o}$

defined only if $\exists m_{\mathbf{1}}, m_{\mathbf{2}} \in \text{SalientAlts}(\Phi), m_{\mathbf{1}} \neq m_{\mathbf{2}}$, $m_{\mathbf{i}} \cap Dox_{\mathbf{x},\mathbf{w}} \neq \varnothing$ for $i \in \{1, 2\}$, where w is the world of evaluation and x the attitude holder.

Paraphrase: An utterance with *kya* has the meaning of the utterance without *kya* but imposes the condition that there are different possible answers compatible with the attitude's holder doxastic alternatives (i.e., the attitude holder is 'uncertain').

LFG Analysis

- The semantic analysis by Biezma et al. assumes a syntax that will deliver the right bits which polar *kya* can take scope over.
- This talk:
  - provide the syntactic underpinnings.
  - integrate information from prosody (cf. Butt et al. (2017))
  - We follow the general syntactic analyses as established as part of the Urdu grammar (Butt and King 2007).

LFG Analysis

- Let's begin with *kya* itself.
- Analysis:
  - Work with just one lexical entry: *kya* is analyzed as a Q (following Slade (2011)).
  - Differentiate between polar *kya* and other uses via functional information.
  - Example: polar vs. thematic (constituent) *kya*

kyA Q (↑PRED) = 'kyA'

Disjunct 1 — polar kyA
(↑UNCERTAINTY-OPERATOR) = ↓
(↑QUESTION-TYPE) = polar

Disjunct 2 — wh-kyA
(↑QUESTION-TYPE) = constituent
(↑NTYPE NSYN) = pronoun
(↑PRON-TYPE) = int
(↑CASE) = nom

- But won't this lead to massive (unwanted) ambiguity?

Ambiguity: Polar kya vs. Constituent Questions

In fact, some utterances are ambiguous between polar *kya* and wh-constituent interpretations.

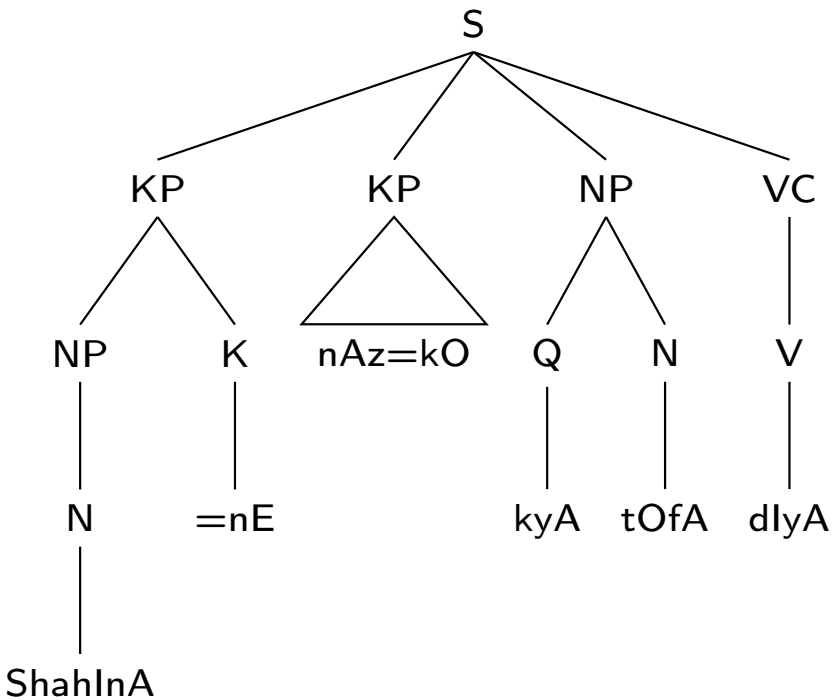
(35) mɛ̃ **kya** bol-ũ?
I.Nom what speak-1.Sg
Constituent Question: 'What should I say?'
Polar Question: 'Should I say (something)?' Script, *Ankhon Dekhi*

(36) **kya** ʈaklif ho rɑh-i hɛ [...]?
what bother.Nom be Prog-F.Sg be.Pres.3.Sg
Constituent Question: 'What's bothering (you)?'
Polar Question: 'Is something bothering (you)?' Script, *Ankhon Dekhi*

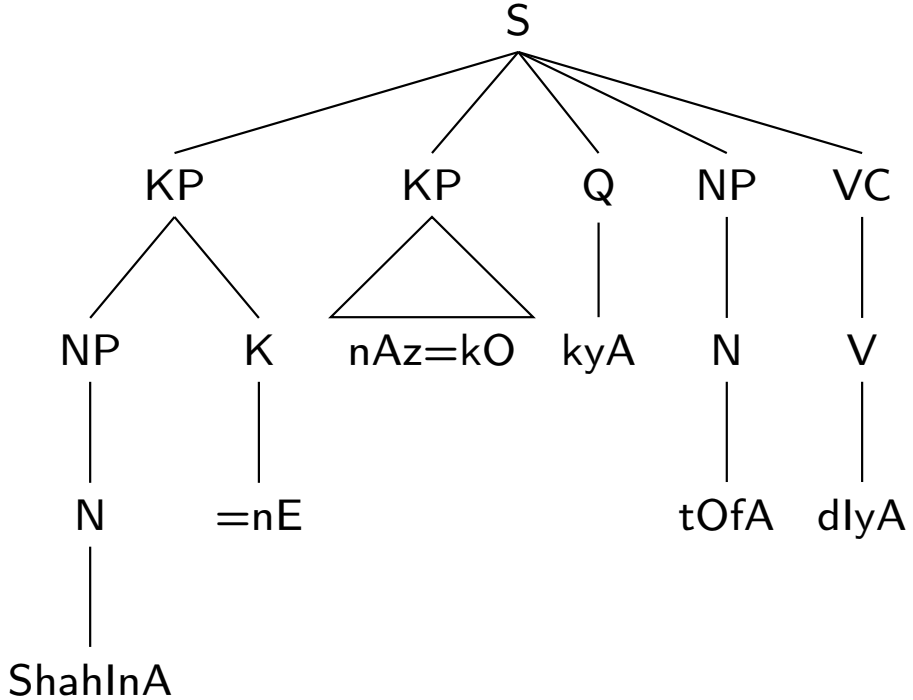
(37) ʃahina=ne naz=ko **kya** tofa di-ya
Shahina=Erg Naz=Acc what present.M.Sg give-Perf.M.Sg
Constituent Question: 'What gift did Shahina give to Naz?'
Polar Question: 'Did Shahina (actually) give a gift to Naz?'

One String — Two Possible Analyses

Wh-Question



Polar kya



→ Spelling: Transliteration from Arabic-based Urdu script (Malik et al. 2010).

Syntactic ambiguities - resolved by prosody

While the strings are in principle ambiguous, prosodic information clearly distinguishes between the two possibilities.

(38) ʃahina=ne naz=ko **kya** tofa di-ya
Shahina=Erg Naz=Acc what present.M.Sg give-Perf.M.Sg
a) Polar Question: 'Did Shahina (actually) give a gift to Naz?'
b) Constituent Question: 'What gift did Shahina give to Naz?'

a) Play Sound b) Play Sound

→ Conclusion: prosodic information crucial for the overall analysis!

- The thematic wh-word *kya* has a high tone: H*.
- The polar *kya* is always flat or falling.

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How should the prosodic information be integrated into the analysis (architecture wise) so it enables a disambiguation of the syntactic analyses?

⇒ We analyze *kya* at the prosody–syntax interface following the proposal made by Bögel (2015).

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→ syntax is necessary - but not very interesting ;-)

- ended up in Aditi's phonology class (which was VERY interesting)
- So: what to do if you are stuck in LFG with a beautiful architecture, detailed syntax and semantics in theory and computation, and a very nice community ... but which does not care much about phonology?

→ create your own p-structure plug-in so you can continue to be an LFG person while doing what you like (which is phonology)

⇒ So yes, Aditi can indeed be blamed for a lot of the phono-stuff showing up in LFG!

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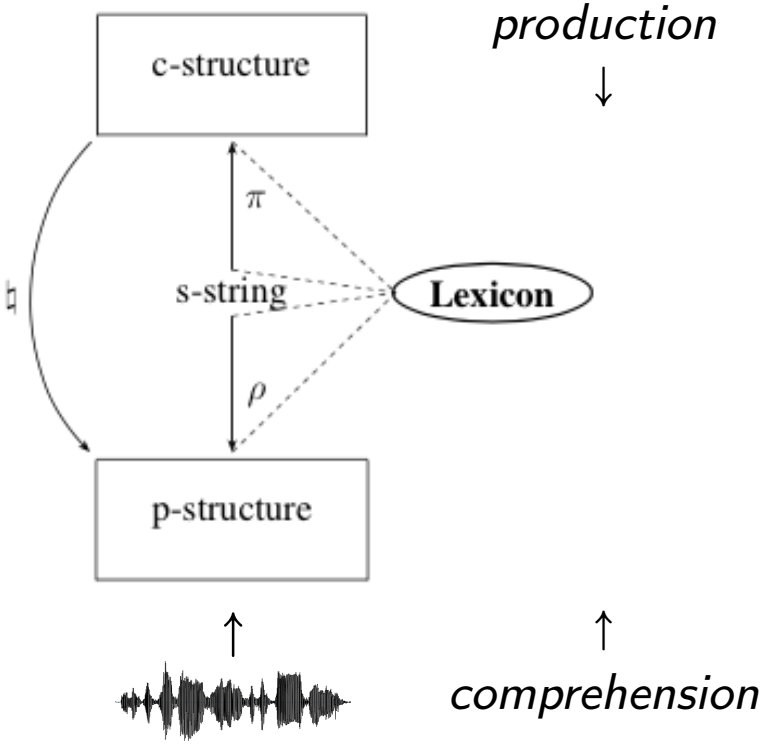
The Prosody-Syntax interface - the theory

Two perspectives:

(Roughly following models as proposed by, a.o., Levelt (1999) and Jackendoff (2002)

- *Production*: from meaning to form (syntax → prosody)
- *Comprehension*: from form to meaning (prosody → syntax)



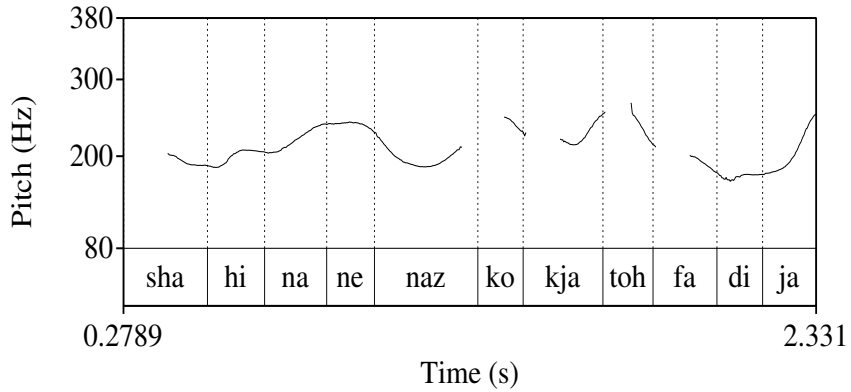
ϧ: The *Transfer of structure* → Exchanges information on (larger) syntactic and prosodic phrasing, and on intonation

ρ: The *Transfer of vocabulary* → Associates morphosyntactic and phonological information of lexical elements via the multidimensional lexicon

During *comprehension*, information from the speech signal feeds into p-structure

P-structure: the p-diagram - signal level

- Linear syllablewise representation of the speech signal over time.



- 'Raw' (acoustic) information is stored at the *signal* level

DUR.	0.25	0.17	0.18	0.14	0.31	0.13	0.24	0.15	0.19	0.14	0.16	SIGNAL
F_{0_mean}	193	200	222	241	198	231	248	224	193	174	205	↓
VALUE	[sha]	[hi]	[na]	[ne]	[naz]	[ko]	[kja]	[toh]	[fa]	[di]	[ja]	
INDEX	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	...

⇒ Each syllable is part of a vector associating the syllable with relevant values:
→ F_0, *duration*, *intensity*, ...

P-structure – from signal to interpretation

- **Input:** The 'raw' speech signal information:

DUR.	0.25	0.17	0.18	0.14	0.31	0.13	0.24	0.15	0.19	0.14	0.16	SIGNAL
F_{0_mean}	193	200	222	241	198	231	248	224	193	174	205	↓
VALUE	[sha]	[hi]	[na]	[ne]	[naz]	[ko]	[kja]	[toh]	[fa]	[di]	[ja]	
INDEX	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	...

→ Pauses, patterns in F_0 and other acoustic indicators can be further interpreted

- **Interpretation:** Categorical interpretation on the basis of 'raw' information:

PHRAS.	$(_\iota\ (_{ap}$	...	...	...	...	...	...	...	...	...	$)_{ap})_\iota$	INTERPRETATION
TONES	...	...	...	...	...	...	(L)H*	...	...	...	...	↓
DUR.	0.25	0.17	0.18	0.14	0.31	0.13	0.24	0.15	0.19	0.14	0.16	SIGNAL
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→ Includes language-specific prosodic/phonological readjustments

At the interface

The information stored in p-structure is communicated to syntax via two transfer levels:

- The Transfer of Structure (larger prosodic units, intonation)
- The Transfer of Vocabulary (segmental/lexical information)

During the Transfer of Vocabulary, p-structure is matched against the **multidimensional lexicon**.

The Transfer of Vocabulary

- Associates morphosyntactic and phonological information on lexical elements

→ via the multidimensional lexicon (cf. Levelt et al. 1999), which projects them to their respective structures

s(yntactic)-form				**p(honological)-form**	
tOfA	N	(↑ PRED)	= 'tOfA'	P-FORM	[tofa]
		(↑ NUM)	= sg	SEGMENTS	/t o f a/
		(↑ GEND)	= masc	METR. FRAME	$('\sigma\sigma)_\omega$
kyA	Q	{ (↑ QUESTION-TYPE)	= polar	P-FORM	[kja]
		| (↑ QUESTION-TYPE)	= const}	SEGMENTS	/k j a/
		...		METR. FRAME	$(\sigma)_\omega$

- Each lexical dimension can only be accessed by the related module

→ Modular: strict separation of module-related information

→ Translation function: Once a dimension (here: p-form) is triggered, the related dimensions can be accessed as well.

⇒ Associated syntactic form is selected and made available to c-structure.

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The Transfer of Vocabulary II

c-structure

↑

Lexicon:

syn(tactic)-form	
(↑ PRED)	= 'ShahInA'
(↑ NUM)	= sg
(↑ GEND)	= fem
p(honological)-form	
P-FORM	[shahina]
SEGMENTS	/sh a h i n a/
METR. FRAME	$(\sigma'\sigma\sigma)_\omega$

↑

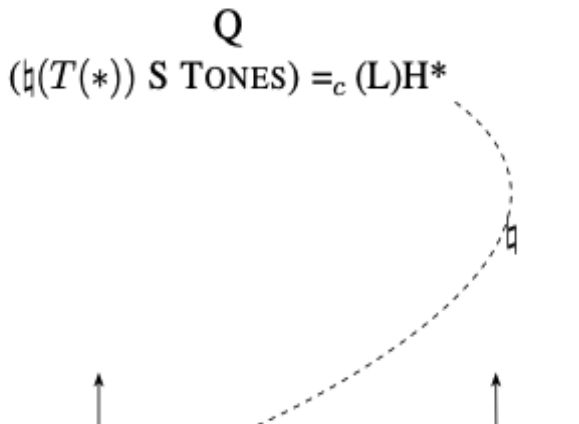
P-structure:

DURATION	0.25	0.17	0.18	...
F_0 (mean)	193	200	222	...
VALUE	[sha]	[hi]	[na]	...
V. INDEX	S_1	S_2	S_3	...

The Transfer of Structure (during comprehension)

For constituent *kya*:

C-structure:



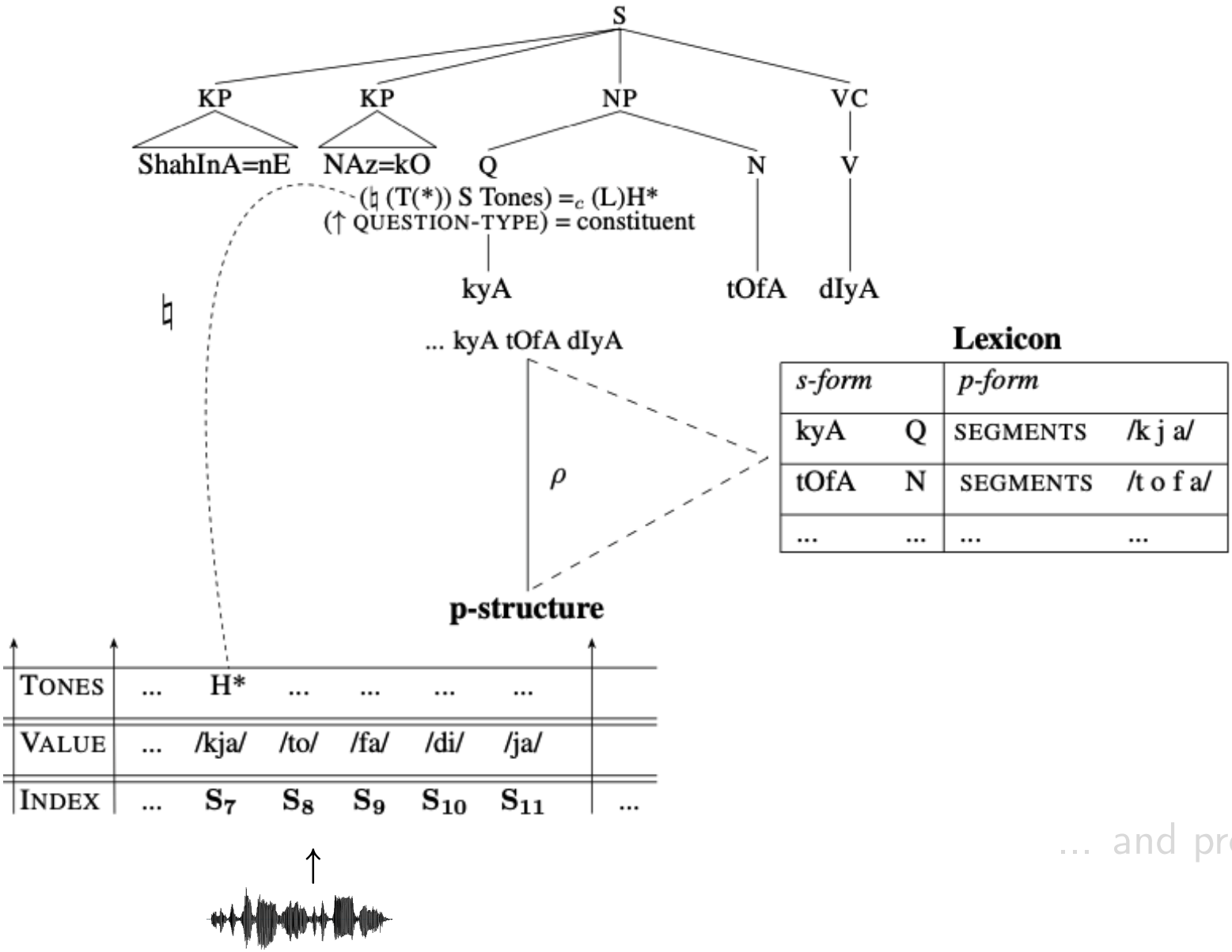
P-structure:

TONES	...	H*	...	...	
...	...	...	...	...	
VALUES	[...]	[...]	[...]	[...]	
V.INDEX	S_3	S_4	S_5	S_6	

Translate as:
for each terminal node **T** *under the current node (*=Q), for the syllable* **S** *the value for the attribute* **Tones** *must be* $(=_c)$ **(L)H***.

→ For polar *kya*: (↯ (T(*)) S Tones) ≠ (L)H*

Overall framework - during comprehension



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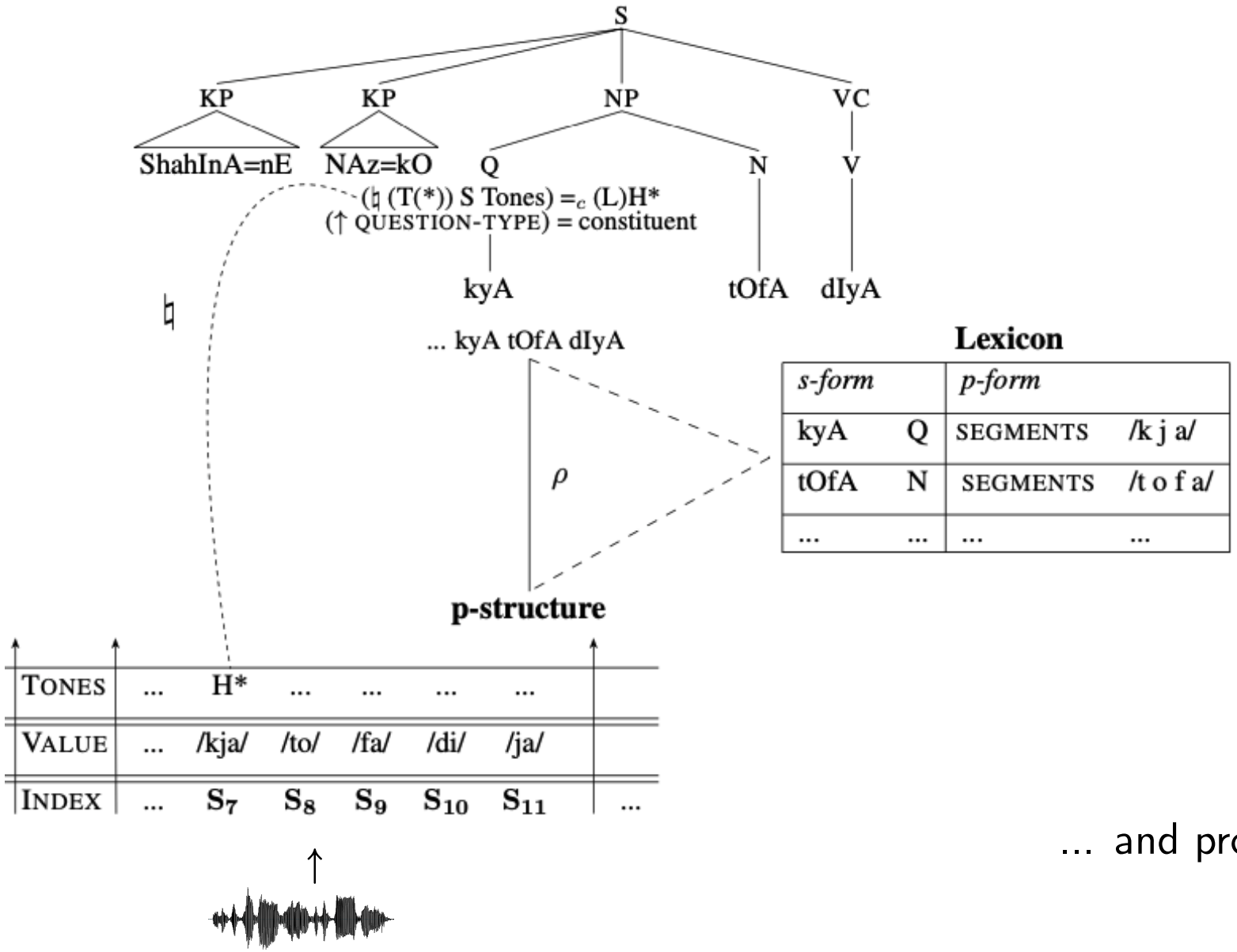
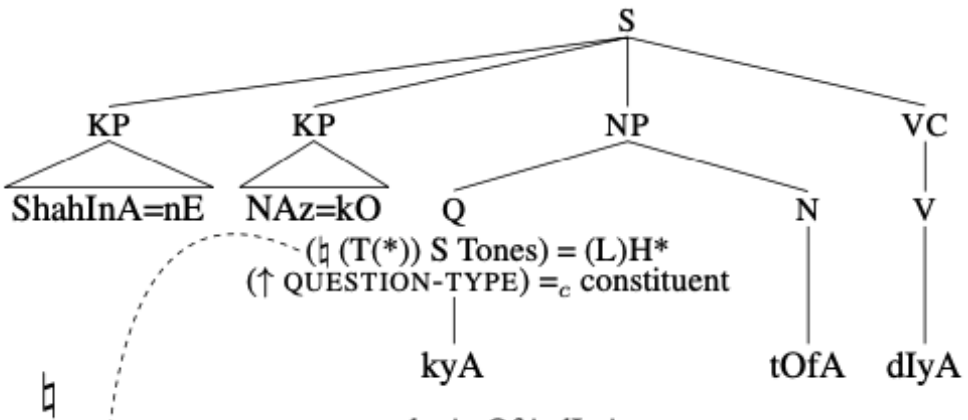
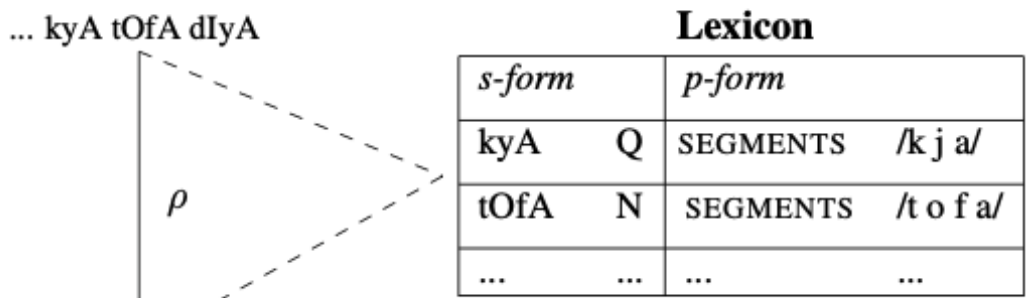
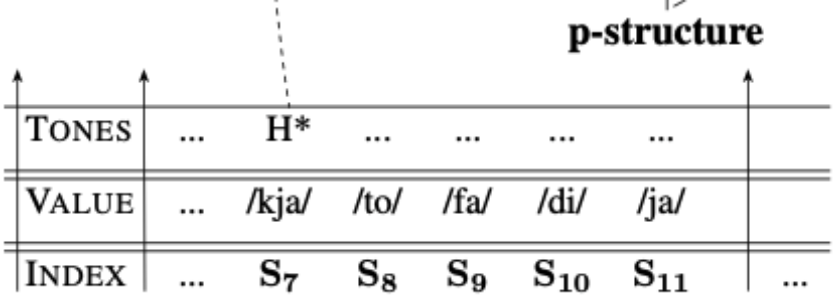


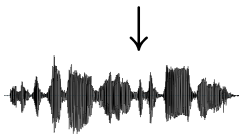
... and production...

Overall framework - during production (quick walk ...)









Input to p-structure from:

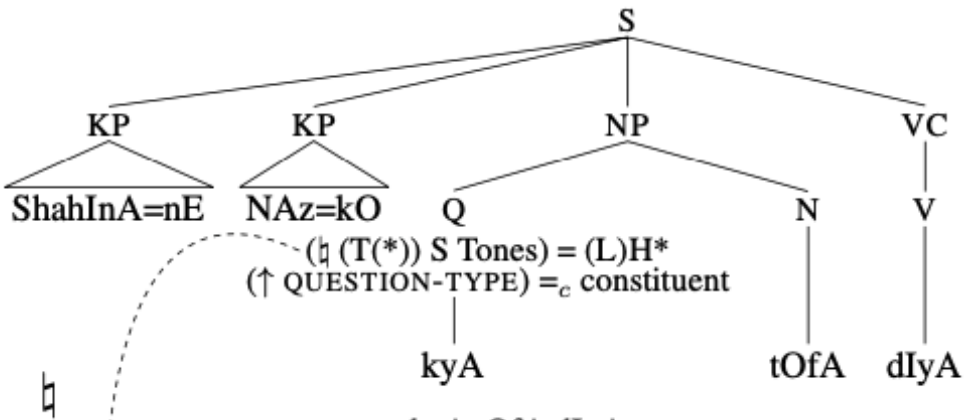
– syntactic-to-prosodic phrasing (e.g., 'match')

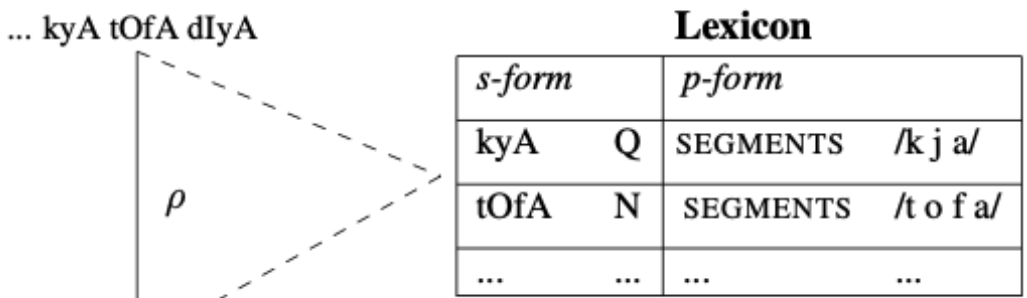
– lexical p-form information

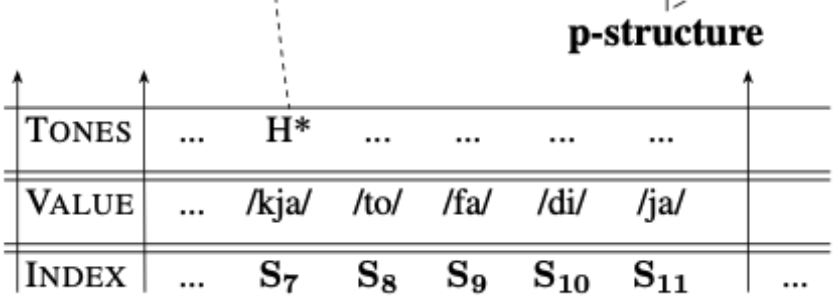
– subject to postlexical phonology and prosodic well-formedness constraints

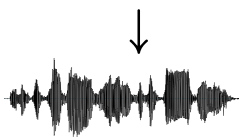
→ Foundation for the interface to phonetics

Overall framework - during production (quick walk ...)









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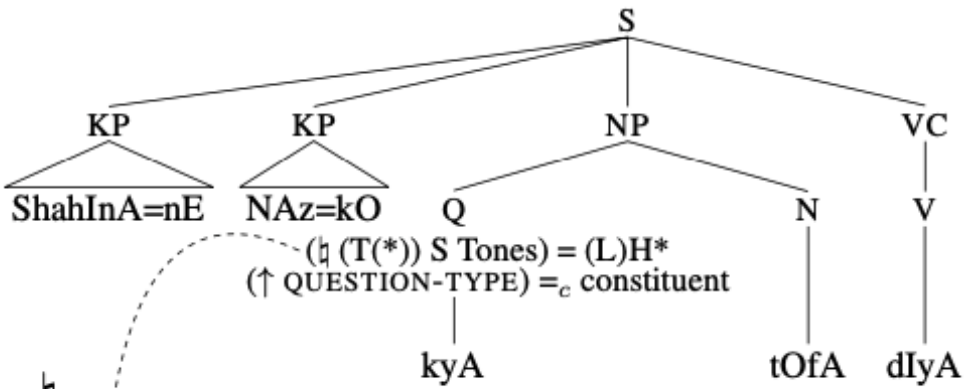

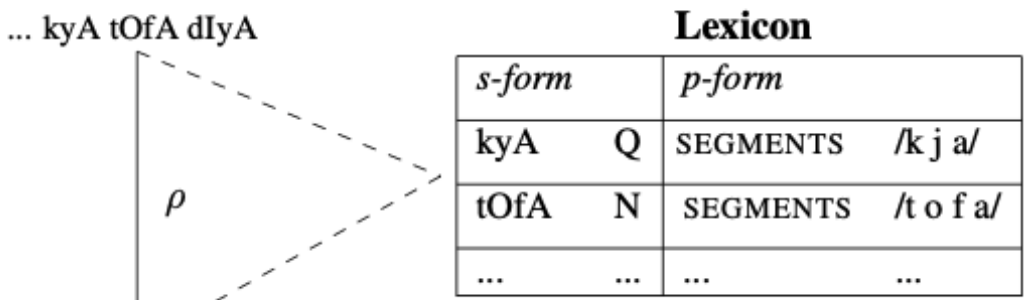

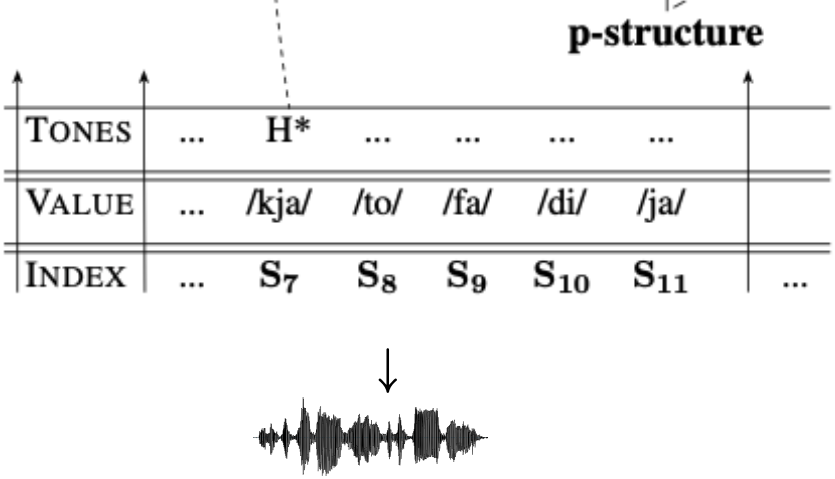

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Taking stock II

- Urdu *kya* can be syntactically ambiguous between a constituent and a polar interpretation
- However, there is a prosodic difference:
  - constituent *kya* is indicated by an (L)H*
  - polar *kya* has a flat or falling pitch
- At the prosody-syntax interface, the syntactically ambiguous structures can thus be resolved with reference to prosody
- We can formally analyze this process in the theoretical LFG framework.
- **... and we can even implement it computationally!**

Computational grammars in the ParGram project

- Great with syntactic and semantic analyses
- Some fragmentary computational approaches to p-structure exist (like the Butt and King approach to Bengali)
- But none have tried to integrate the 'raw' speech signal

Computational implementation of the prosody–syntax interface

- Work in progress: comments are VERY welcome!
- Blue-print; large-scale evaluation in progress
- 5 Steps:
  1. Extraction of the speech signal information
  2. Pitch interpretation
  3. Lexical matching (*Transfer of vocabulary*)
  4. Assembling the p-diagram
  5. Disambiguating syntactic structure (*Transfer of structure*)

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- Work in progress: comments are VERY welcome!
- Blue-print; large-scale evaluation in progress
- 5 Steps:
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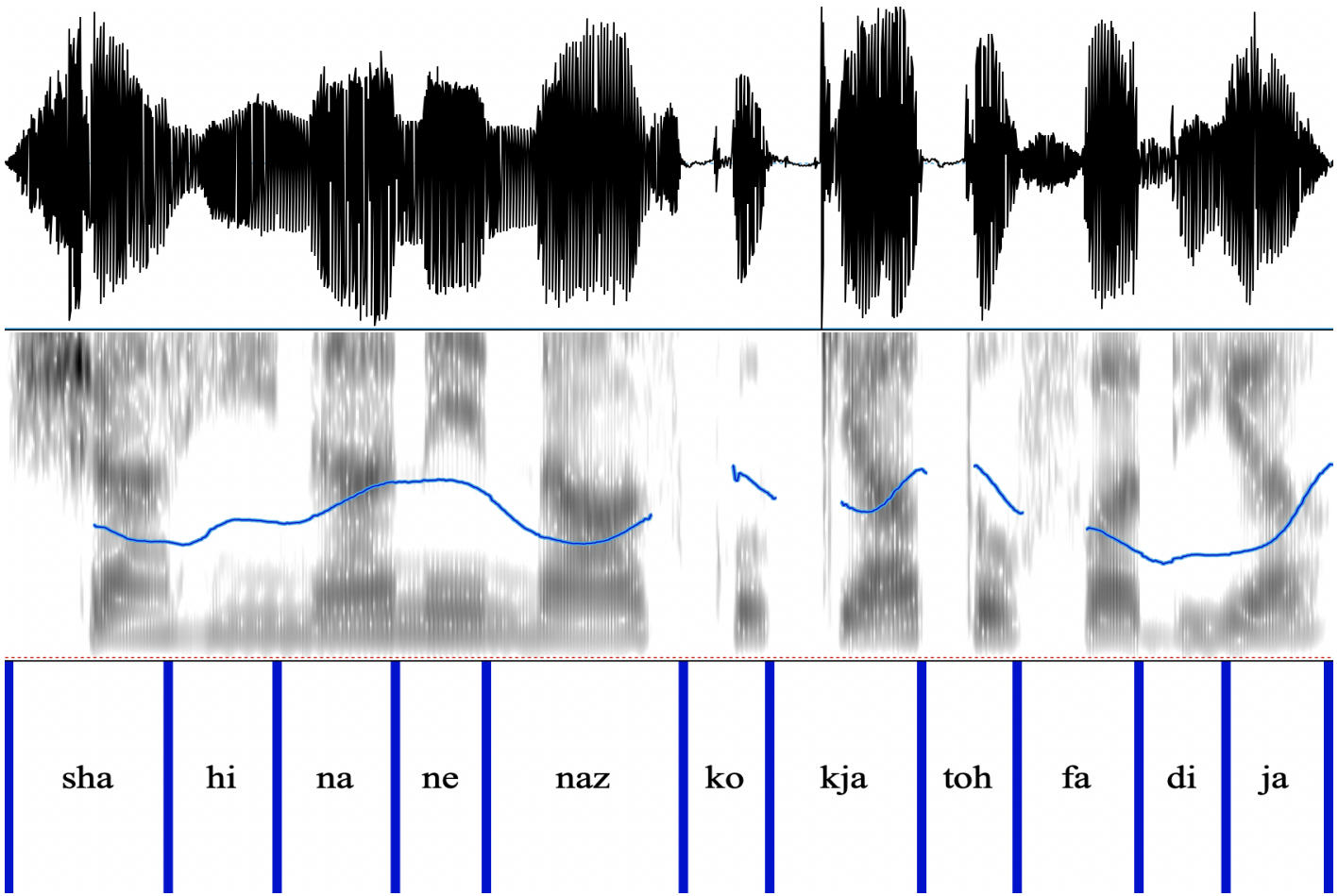
Input

A sound-file annotated with syllables



1. Extract raw signal information

(via Praat (Boersma and Weenink 2013))

- Syllable segments
- Duration for each syllable
- Mean F0-values for each syllables
- ↑ These go into the **signal level** of the p-diagram
- ↓ These are used for the (more fine-grained) analysis
- Divide each syllable into 5 even-spaced subintervals (time-normalization)
- Normalize the pitch by converting all F0 mean values of the subintervals into semitones

SyllNr	Syll	SubInt	F0mean	Semitone
...	...	...	...	....
2	hi	8	208.51	12.72
2	hi	9	210.51	12.89
2	hi	10	211.10	12.94
3	na	11	212.66	13.06
3	na	12	219.86	13.64
...	...	...	...	....

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2. Interpret the pitch

(i.e., determine categories that are 'meaningful' for other modules of grammar)

- Different measures are used to support the pitch interpretation

a) Semitones and residuals of a linear regression

→ Determine minimums (L) and maximums (H)

b) Semitone differences and distance between these minimums and maximums

→ Determine slopes (lead and tail)

- Taken together:

Category	Min/Max	lead	tail
H4	Max	strong	strong
H3	Max	strong	normal
H2	Max	normal	strong
H1	Max	normal	normal
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Two aims:

1. **Create the s(yntactic) string:**
   - Using an xfst transducer .... (Beesley and Karttunen 2003)
   - Take the p(honological) string ... *sha.hi.na.ne.naz.ko* ...

   a) Match the p-string exhaustively (i.e. all possible linear combinations) against the p-forms in the lexicon, until all syllables are accounted for

   b) Match the resulting p-forms against their respective s-forms

Input (p-string) | **Lexicon** | **Output (s-string)**

... sha.hi.na.ne.naz ... →

p-form	s-form
sha.hi.na	ShahInA
ne	ne
naz	NAz
...	...

→ ... ShahInA ne NAz ...

→ Output is the syntactic string: *ShahInA ne NAz kO kyA tOfA dIyA*

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- *tOfA* ...
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  - has two syllables
  - and the stress pattern X –
- *kO* ...
  - is not a prosodic word
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4. Building up the p-diagram

Based on all of the information, the p-diagram is completed:

pros_phrase	i((σ	σ	σ)	=σ)ap	((σ)	=σ)ap	((σ))ap	((σ	σ)	(σ	σ))ap)i
pitch_tones	–	L2	–	H2	L4	H2	LH4	–	–	L4	H%
F0_mean	192.56	199.53	222.49	241.15	197.91	242.31	228.82	237.82	193.23	174.04	204.87
duration	0.25	0.17	0.18	0.14	0.31	0.13	0.24	0.15	0.19	0.14	0.16
syllables	sha	hi	na	ne	naz	ko	kja	toh	fa	di	ja
Vector_index	1	2	3	4	5	6	7	8	9	10	11

→ Things to note:

- All L followed by H combinations are determined to be APs
- But how abou *kya*? Can it form an AP by itself? Or should it be phrased with the following material?

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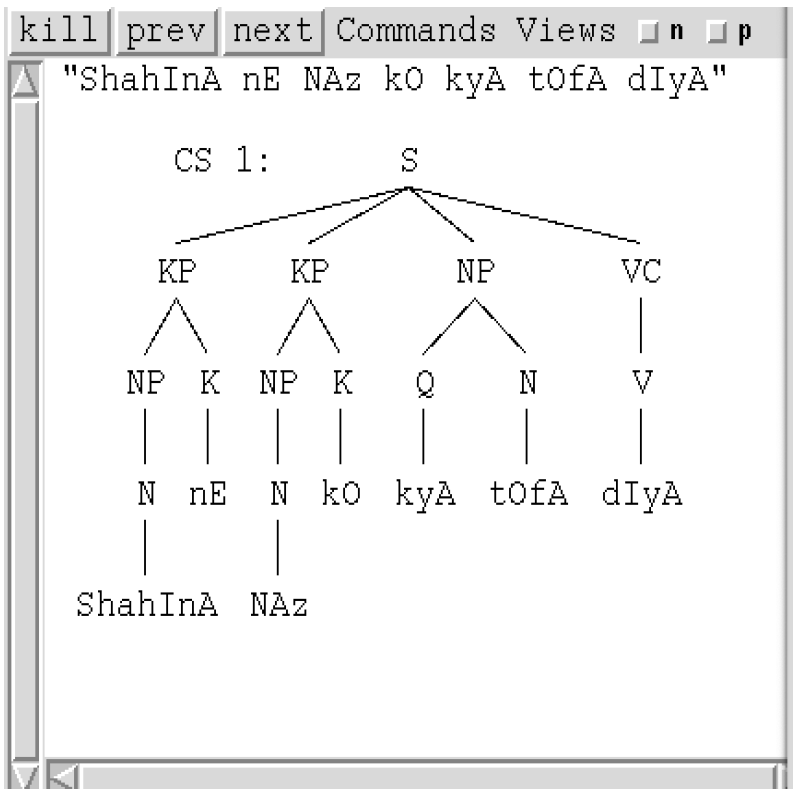
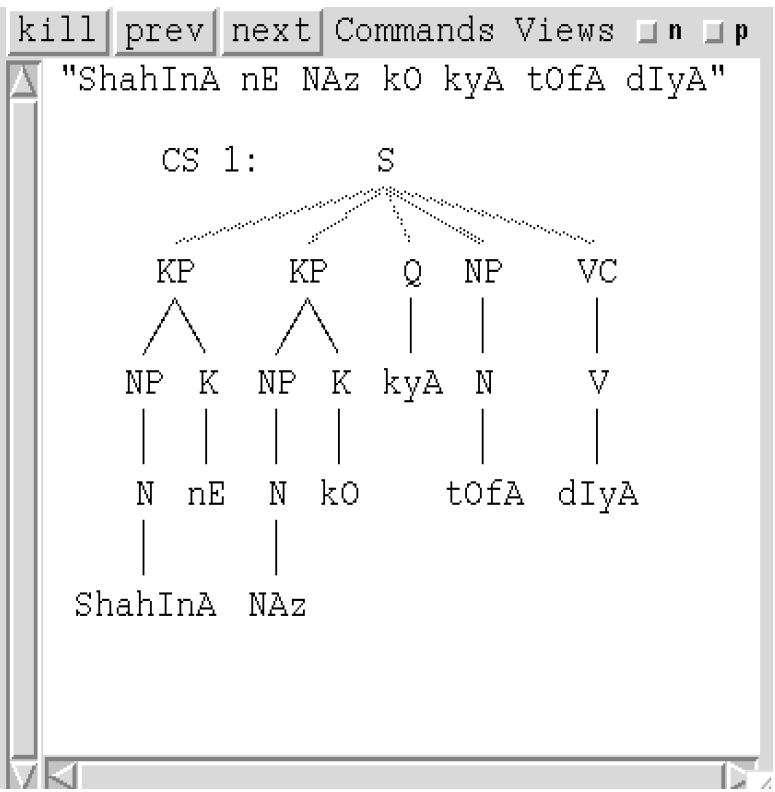
5. Syntactic Parsing attempt 1

Feeding the newly created syntactic string into the Urdu XLE-grammar results in two possible parses:

Constituent



Polar



5. Disambiguation and the fchart

But: the ambiguity is encoded in the so-called fchart (Representation of the syntactic information in Prolog)

```
% Choices:
  [
choice([A1,A2], 1)
  ],
% Constraints:
  [
cf(1,eq(attr(var(10),'QUESTION-TYPE'),var(11))),
cf(A2,eq(var(11),'const')),
cf(A1,eq(var(11),'polar'))
  ],
% C-Structure:
  [
cf(1,subtree(10,'Q',-,9)),
...
cf(1,terminal(9,'kyA',[9])),
  ]
```

Left to do: Check whether there is a (L)H* associated with *kya* in p-structure. If yes, choose option A2 (= const); if no, choose option A1 (= polar)

```
'hostname'('MacBook-Pro-7.fritz.box')
],
% Choices:
[
choice([A1,A2], 1)
],
% Equivalences:
[
select(A1, 1)
],
% Constraints:
[
cf(1,eq(attr(var(0),'PRED'),semform('dE',4,[var(6),var(5),var(1)],[]))),
cf(1,eq(attr(var(0),'SUBJ'),var(6))),
cf(1,eq(attr(var(0),'OBJ-GO'),var(5))),
cf(1,eq(attr(var(0),'OBJ'),var(1))),
cf(1,eq(attr(var(0),'TNS-ASP'),var(7))),
cf(1,eq(attr(var(0),'CLAUSE-TYPE'),'interrogative')),
cf(A1,eq(attr(var(0),'QUESTION-TYPE'),'polar')),
cf(1,eq(attr(var(6),'PRED'),semform('ShahInA',0,[],[]))),
cf(1,eq(attr(var(6),'CASE'),'erg')),
cf(1,eq(attr(var(6),'GEND'),'fem')),
cf(1,eq(attr(var(6),'NOUN-TYPE'),'name')),
cf(1,eq(attr(var(6),'NUM'),'sg')),
cf(1,eq(attr(var(6),'PERS'),'3')),
cf(1,eq(attr(var(5),'PRED'),semform('NAz',1,[],[]))),
cf(1,eq(attr(var(5),'CASE'),'dat')),
cf(1,eq(attr(var(5),'GEND'),'masc')),
cf(1,eq(attr(var(5),'NOUN-TYPE'),'name')),
cf(1,eq(attr(var(5),'NUM'),'sg')),
cf(1,eq(attr(var(5),'PERS'),'3')),
cf(1,eq(attr(var(1),'PRED'),semform('tOfA',3,[],[]))),
cf(A2,eq(attr(var(1),'SPEC'),var(2))),
cf(1,eq(attr(var(1),'GEND'),'masc')),
cf(1,eq(attr(var(1),'NOUN-TYPE'),'common')),
cf(1,eq(attr(var(1),'NUM'),'sg')),
cf(1,eq(attr(var(1),'PERS'),'3')),
cf(A2,eq(attr(var(1),'QUESTION-TYPE'),'const')),
cf(A2,eq(attr(var(2),'DET'),var(3))),
cf(A2,eq(attr(var(3),'PRED'),semform('kyA',2,[],[]))),
cf(A2,eq(attr(var(3),'NTYPE'),var(4))),
cf(A2,eq(attr(var(3),'PRON-TYPE'),'int')),
cf(A2,eq(attr(var(4),'NSYN'),'pronoun')),
cf(1,eq(attr(var(7),'ASPECT'),'perf')),
cf(1,eq(attr(var(7),'TENSE'),'past')),
cf(1,eq(proj(var(8),'o::'),var(9))),
cf(A2,in_set('const',var(9))),
cf(A1,in_set('polar',var(9))),
cf(A2,eq(var(10),var(1))),
cf(A1,eq(var(10),var(0))),
cf(1,eq(attr(var(10),'QUESTION-TYPE'),var(11))),
cf(A2,eq(attr(var(10),'SPEC'),var(2))),
cf(A2,eq(var(11),'const')),
cf(A1,eq(var(11),'polar'))
],
% C-Structure:
[
cf(A2,subtree(50,'S',44,48)),
cf(A2,phi(50,var(0))),
cf(A1,subtree(50,'S',59,48)),
cf(A1,phi(50,var(0))),
cf(A1,subtree(59,'S',39,58)),
cf(A1,phi(59,var(0))),
cf(A1,subtree(58,'NP',-,12)),
cf(A1,phi(58,var(1))),
cf(1,subtree(48,'VC',-,14))
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– demo –

Anticipated challenges

- Hard to judge how the fchart-p-diagram interface can be applied to different phenomena (2 are implemented so far)
- There are a lot of open questions in prosodic research

→ state of the art is rapidly changing

- Prosody is gradient; categories are used, but disagreement is widespread
- Much more variation compared to your standard syntactic problem

⇒ Challenging, but also promising with respect to future insights

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- Prosody is gradient; categories are used, but disagreement is widespread
- Much more variation compared to your standard syntactic problem

⇒ Challenging, but also promising with respect to future insights

Anticipated challenges

- Hard to judge how the fchart-p-diagram interface can be applied to different phenomena (2 are implemented so far)
- There are a lot of open questions in prosodic research

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⇒ Challenging, but also promising with respect to future insights

Summing Up

- One underlying lexical entry for *kya*.
- Disambiguated by prosody.
- PRED value postulated for both polar and wh-versions: tight connection between these two uses.

kyA Q (↑PRED) = 'kyA'

Disjunct 1 — polar kyA
(↑UNCERTAINTY-OP) = ↓
(↑QUESTION-TYPE) = polar

Disjunct 2 — wh-kyA
(↑QUESTION-TYPE) = constituent
(↑NTYPE NSYN) = pronoun
(↑PRON-TYPE) = int
(↑CASE) = nom

- Question:
  - Will the polar *kya* change into a separate question particle?
  - Or will this type of ambiguity prove to be pertinacious?

AltQs

Recall that Bhatt&Dayal posed a puzzle:

- Clause initial polar *kya* allows for both a polar and AltQ reading.
- Clause final polar *kya* only permits a polar question reading.

(39) **kya** candra=ne kofi ya cai p-i?
what Chandra.F=Erg coffee.F.Nom or tea.F.Nom drink-Perf.F.Sg
'Did Chandra drink tea or coffee?'
Alternative Question Reading: Did Chandra drink tea or did she drink coffee?
Polar Question Reading: Is it the case that Chandra drank either tea or coffee?'

(40) candra=ne kofi ya cai p-i **kya**?
Chandra.F=Erg coffee.F.Nom or tea.F.Nom drink-Perf.F.Sg what
'Did Chandra drink tea or coffee?'
*Alternative Question Reading: Did Chandra drink tea or did she drink coffee?
Polar Question Reading: Is it the case that Chandra drank either tea or coffee?'

Looking at our data we find:

- Clause-initial *kya* always takes scope over the verb.
- Clause-final *kya* takes scope over the entire proposition.
- So in (40), *kya* takes scope over the whole disjunct, resulting in only a polar reading.

Summary

- We have developed an end-to-end (complete) analysis of polar *kya*.
- From the speech signal to semantics/pragmatics (and back).
- polar *kya*
  - Is closely related to wh-*kya*
    (though it might develop into more of a focus particle)
    - Can be dealt with via one underlying entry.
    - Though with a differece in prosodic realization.
  - Functions as an expression of uncertainty on the part of the speaker.
    - Only in questions (since it is a Q).
    - Leads to further uses like the expression of sarcasm, surprise, etc.

Acknowledgements

Thanks!

Very many thanks go to Rajesh Bhatt and Veneeta Dayal for the original inspiration and some further discussions, Saira Bano and Ghulam Raza for help with the data, suggestions, general pointers and interesting discussions and to Bettina Braun, Regine Eckardt, Gillian Ramchand, Craige Roberts and Maribel Romero for helping us to come to grips with the phenomena. Mary Dalrymple has been helping us with f-precedence (implementation vs. theory). Many thanks go to Habiba, who has been one of our main informants.

Syntactic Distribution of polar *kya*

Biezma et al. have identified the following patterns:

1. S $\longrightarrow$ *kya* @GF-ADJUNCTS VC
   - Verb (complex) is clause final with default rising prosody.
   - Verb is in focus (by default).
   - Polar *kya* takes scope over the verb and by extension over the GFs and Adjuncts in the verb's f-structure
   - When the verb is in focus, its dependents are also and hence available for polar *kya* to take scope over.
   - This follows naturally within LFG (King 1997).
2. S $\longrightarrow$ @GF-ADJUNCTS VC *kya*
   - Polar *kya* takes scope over the entire proposition.
   - This might sometimes work out to be semantically very similar to clause-initial *kya*.
   - But one can see a difference with respect to alternative questions!

Syntactic Distribution of polar *kya*

Clause-medial polar *kya* is more complex.

- By default it takes scope over the constituent immediately to its right.
- But other targets for uncertainty are also possible: can apply to any focused (generally stressed) element in the clause.

(41)

ram=ne	sita=ko	**kya**	kɪtab	kɑl	d-i	
Ram.M=Erg	Sita.F=Dat	what	book.F.Sg.Nom	yesterday	give-Perf.F.Sg	
t^h-i						
be.Past-F.Sg						

'Had Ram given a/the book to Sita yesterday?

- Possible targets for polar *kya* could be:
  1. book (by position)
  2. Ram, Sita or yesterday (by prosodic or contextual marking)

Analysis

The various possible targets for clause medial polar *kya* can be modeled via LFG's capability for indicating scope at f-structure.

1. Scope ($> s$) to the right via reference to the right sister ($* >$) of polar *kya*:

$$(\uparrow \text{UNCERTAINTY-OP}) > s\ (* > \text{PRED})$$

2. Scope over the item which is prosodically marked.
   - Identify material that is prosodically stressed via a Metarulemacro that checks for each constituent whether it was stressed via the prosody-syntax interface.
   - If this is found, then register for that constituent at f-structure: $(\uparrow \text{PROM}) = +$

$$\begin{array}{c} \text{XP} \\ (\natural(T(*))\text{S}_{any}\ \text{Tones}) =_{\mathbf{c}} \text{H4} \\ (\uparrow \text{PROM}) = + \end{array}$$

   - H4 is the highest value in Bögel's current prosody-syntax interface system (Bögel and Raach 2020).

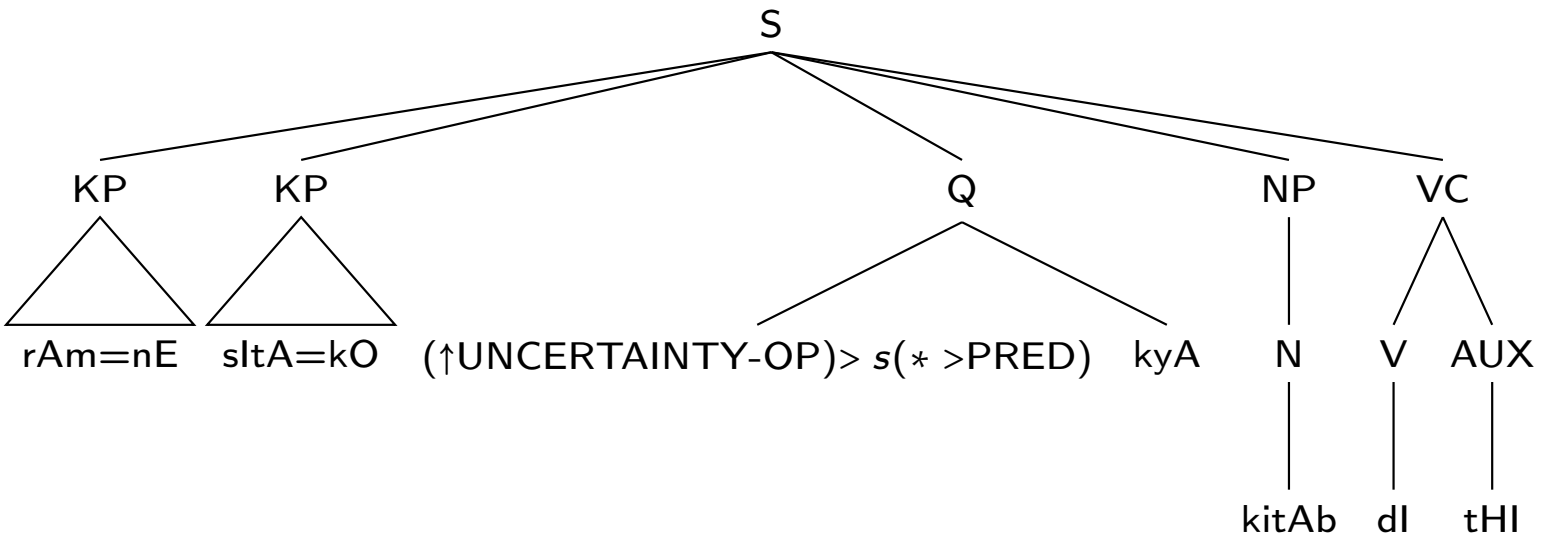
Analysis

- At the clause level, check if a GF or Adjunct contains (↑PROM) = +.
- If so, have the polar *kya* take scope over it.

  (%F @GF-ADJ PROM) =c +
  (↑UNCERTAINTY-OP) > *s* (%F @GF-ADJ PRED)
- The %F is a variable name that ensures one is pointing at the same f-structure across the two annotations.

Clause Medial polar *kya* - Default Interpretation

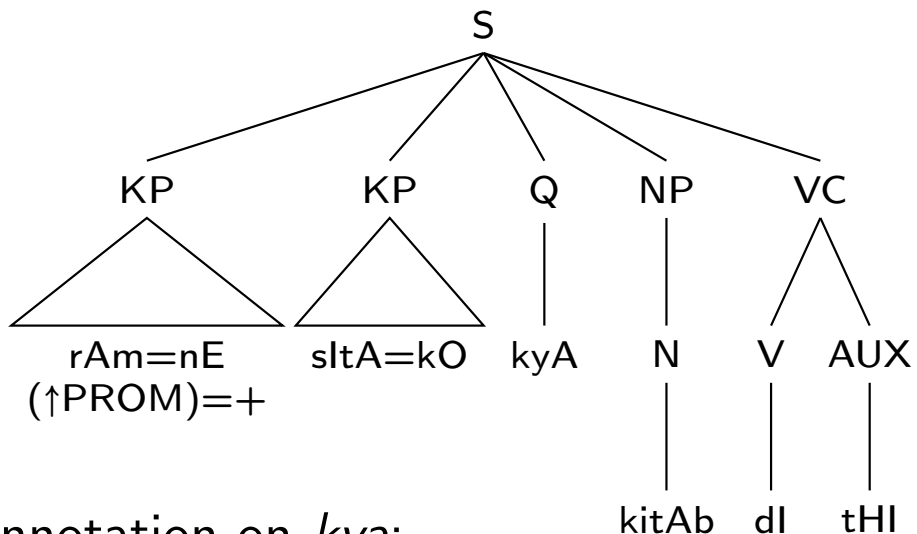
(42) ram=ne sita=ko **kya** kɪtab d-i t^{h}-i
Ram.M=Erg Sita.F=Dat what book.F.Sg.Nom give-Perf.F.Sg be.Past-F.Sg
'Had Ram given a/the book to Sita?



$$\begin{bmatrix} \textbf{PRED} & \text{'}\textbf{dE}\langle\textbf{SUBJ}, \textbf{OBJ-GO}, \textbf{OBJ}\rangle\text{'} \\ \textbf{SUBJ} & [\textbf{PRED } \text{'Ram'}] \\ \textbf{OBJ-GO} & [\textbf{PRED } \text{'Sita'}] \\ \textbf{OBJ} & [\textbf{PRED } \text{'kitAb'}] \\ \textbf{UNCERTAINTY-OP} & \begin{bmatrix} \textbf{PRED 'what'} \\ \textbf{>s [kitAB]} \end{bmatrix} \\ \textbf{CLAUSE-TYPE} & \textbf{INTERROGATIVE} \\ \textbf{QUESTION-TYPE} & \textbf{POLAR} \end{bmatrix}$$

Clause Medial polar *kya* – Scope over Prominent Item

(43) ram=ne sita=ko **kya** kıtab d-i t^{h}-i
Ram.M=Erg Sita.F=Dat what book.F.Sg.Nom give-Perf.F.Sg be.Past-F.Sg
'Had Ram given a/the book to Sita?

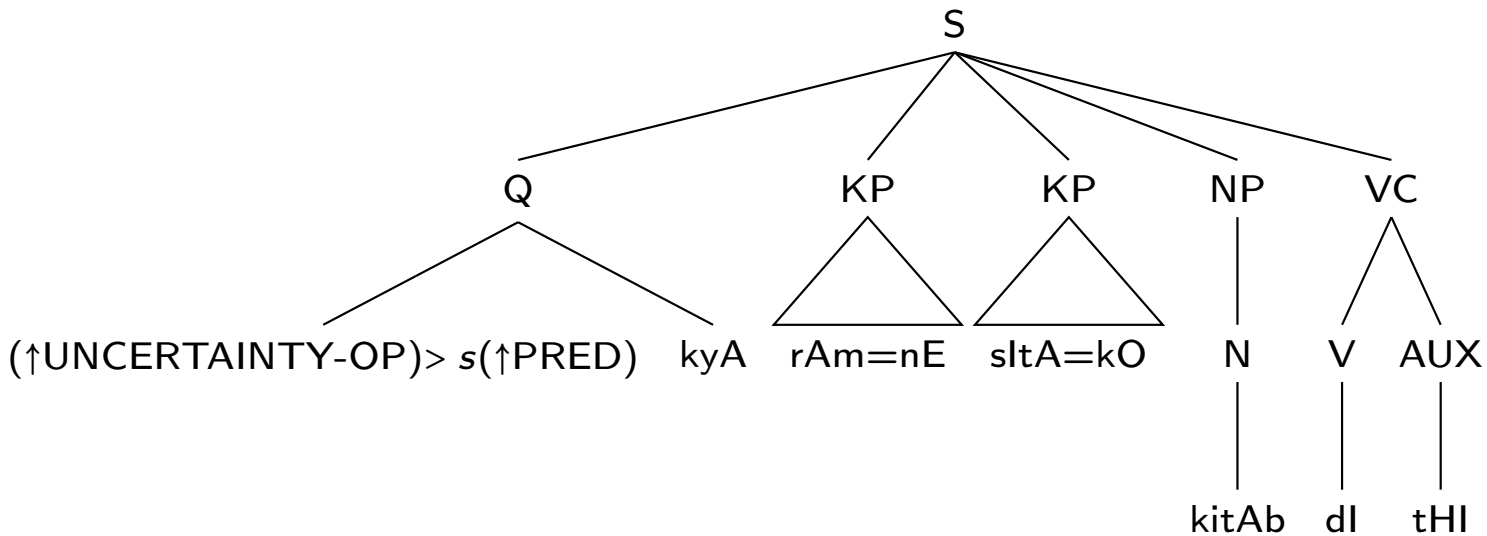


Annotation on *kya*:
(%F @GF-ADJ PROM) =c +
(↑UNCERTAINTY-OP) > *s* (%F @GF-ADJ PRED)

$$\begin{bmatrix} \textbf{PRED} & \text{'dE⟨SUBJ, OBJ-GO, OBJ⟩'} \\ \textbf{SUBJ} & [\textbf{PRED } \text{'Ram'}] \\ \textbf{OBJ-GO} & [\textbf{PRED } \text{'Sita'}] \\ \textbf{OBJ} & [\textbf{PRED } \text{'kitAb}] \\ \textbf{UNCERTAINTY-OP} & \begin{bmatrix} \textbf{PRED 'what'} \\ \textbf{>s [Ram]} \end{bmatrix} \\ \textbf{CLAUSE-TYPE} & \textbf{INTERROGATIVE} \\ \textbf{QUESTION-TYPE} & \textbf{POLAR} \end{bmatrix}$$

Clause Initial polar *kya* – Scope over Verb

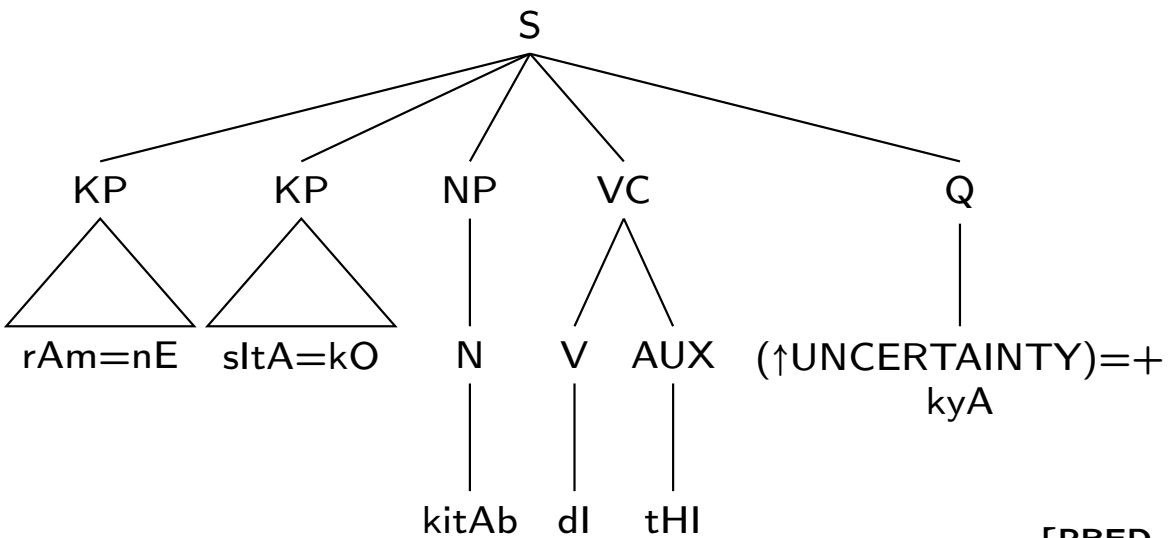
(44) **kya** ram=ne sita=ko kɪtab d-i t^{h}-i
what Ram.M=Erg Sita.F=Dat book.F.Sg.Nom give-Perf.F.Sg be.Past-F.Sg
'Had Ram given a/the book to Sita?



$$\begin{bmatrix} \textbf{PRED} & \text{'}\textbf{dE}\langle\textbf{SUBJ}, \textbf{OBJ-GO}, \textbf{OBJ}\rangle\text{'} \\ \textbf{SUBJ} & [\textbf{PRED } \text{'Ram'}] \\ \textbf{OBJ-GO} & [\textbf{PRED } \text{'Sita'}] \\ \textbf{OBJ} & [\textbf{PRED } \text{'kitAb'}] \\ \textbf{UNCERTAINTY-OP} & \begin{bmatrix} \textbf{PRED } \text{'}\textbf{what}\text{'} \\ >\textbf{s } [\textbf{dE}] \end{bmatrix} \\ \textbf{CLAUSE-TYPE} & \textbf{INTERROGATIVE} \\ \textbf{QUESTION-TYPE} & \textbf{POLAR} \end{bmatrix}$$

Clause Final polar *kya* – Scope over Proposition

- In this case the scope is over the entire proposition.
- So the entire f-structure corresponding to the proposition is marked with the feature UNCERTAINTY +.



$$\begin{bmatrix} \textbf{PRED} & \text{`}\textbf{dE}\langle\textbf{SUBJ}, \textbf{OBJ-GO}, \textbf{OBJ}\rangle\text{'} \\ \textbf{SUBJ} & [\textbf{PRED}\ \text{`Ram'}] \\ \textbf{OBJ-GO} & [\textbf{PRED}\ \text{`Sita'}] \\ \textbf{OBJ} & [\textbf{PRED}\ \text{`kitAb'}] \\ \textbf{UNCERTAINTY-OP} & [\textbf{PRED}\ \text{`}\textbf{what}\text{'}] \\ \textbf{UNCERTAINTY} & + \\ \textbf{CLAUSE-TYPE} & \textbf{INTERROGATIVE} \\ \textbf{QUESTION-TYPE} & \textbf{POLAR} \end{bmatrix}$$

Clause Final polar *kya* – Scope over Proposition

- This information needs to be passed to the semantics (Bobrow et al. 2007, Dalrymple et al. 2020).
- And needs to be interpreted there as follows.
  - $[\![[_Q[\boldsymbol{kya}\ [\sim \Phi]]]]\!]^o = [\![[_Q \sim \Phi]]\!]^o$ defined only if $\exists m_1,\ m_2 \in \text{SalientAlts}(\Phi), m_1 \neq m_2$, $m_i \cap Dox_{x,w} \neq \varnothing$ for $i \in \{1,2\}$, where w is the world of evaluation and x the attitude holder.
- Whereby Φ is furnished by an interpretation of the f-structure in which UNCERTAINTY + is contained.

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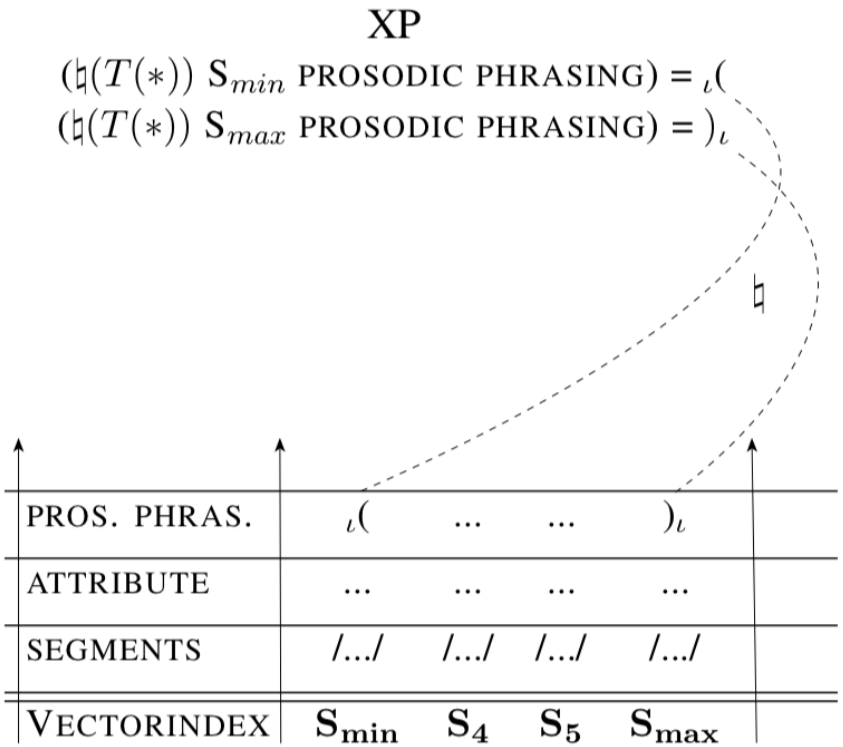
Bollywood Scripts

We have machine readable data (and the movies) for the following scripts:

1. Ankhon Dekhi (2014)
2. Dedh Ishqiya (2014)
3. Dum Laga Ke Haisha (2015)
4. Jab We Met (2007)
5. Lootera (2013)
6. Masaan (2015)
7. NH10 (2015)
8. Queen (2014)
9. Socha Na Tha (2005)
10. Talvar (2015)
11. Titli (2014)
12. Udaan (2010)

The Transfer of Structure ... from syntax to prosody



- where S_{min} refers to the *first* syllable within the scope of a node
- where S_{max} refers to the *last* syllable within the scope of a node, for example: $(ϟ(T(*))S_{max}$ Phrasing$) =)_ι$

→ In the case of constituent *kya*, Q would be annotated with: $(ϟ(T(*))S$ ToBI$)$ = H*