

# Information Coding in Language: Some insights from Indian Grammatical Tradition

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# Outline

Pāṇini's Grammar

Śābdabodha

Constituency Analysis

Dependency Analysis

Ākāṅkṣā

Yogyatā

- ▶ Language is a means of communication.
- ▶ Communication is a two way process.
  - ▶ Speaker expresses his thoughts through a language string
  - ▶ Listner deciphers this language string into underlying encoded thoughts

- ▶ Language is a means of communication.
- ▶ Communication is a two way process.
  - ▶ Speaker expresses his thoughts through a language string  
(**Generation**)
  - ▶ Listner deciphers this language string into underlying encoded thoughts (**Analysis**)

Indian grammarians were intrigued by the questions:

- ▶ How is it that natural language is used by speakers to convey information to the hearers?
- ▶ How is it that on hearing an utterance, the hearers are able to get the intended information?

This led to the development of

- ▶ Pāṇini's grammar: Aṣṭādhyāyī
- ▶ The theories of verbal cognition (Śābdabodha)

# Pāṇini's Grammar

- ▶ Circa 500 B.C.E.
- ▶ Extant Grammar of the then prevalent Sanskrit Language

*One of the greatest monuments of human intelligence (Bloomfield) is only beginning to claim its rightful position in linguistics. Many of the insights of Panini's grammar still remain to be recaptured, but those that are already understood constitute a major theoretical contribution.*

Paul Kiparsky, Emeritus Prof. Stanford University

'The encyclopedia of Language and Linguistics', Asher, pp 2923.



*Panini, then, was not an ancient and nebulous precursor of a science in which everything has since been done better, but a distant colleague of genius from whom linguists are still able to learn.*

*Prof. Fritz Staal*

*Pāṇini , 'Encyclopedia of Language and Linguistics', Vol-6, Page no: 2917; Ed: Asher*

Pāṇini's method brought in distinctions such as

- ▶ language and metalanguage
- ▶ theorem and metatheorem
- ▶ use and mention

Fritz Staal, Euclid and Panini, Philosophy East and West, (1965)

András Kornai: Mathematical Linguistics, Springer Verlag

*Mathematical Linguistics is rooted both in Euclid's axiomatic method and in Pāṇini's method of grammatical description.*

*To be sure, both Euclid and Pāṇini built upon a considerable body of knowledge amassed by their precursors, but the systematicity, thoroughness, and sheer scope of the Elements and the Aṣṭādhyāyī would place them among the greatest landmarks of all intellectual history even if we disregarded the key methodological advance they made.*

Aṣṭādhyāyī:

- ▶ Grammar for Sanskrit
- ▶ Concepts useful for language analysis

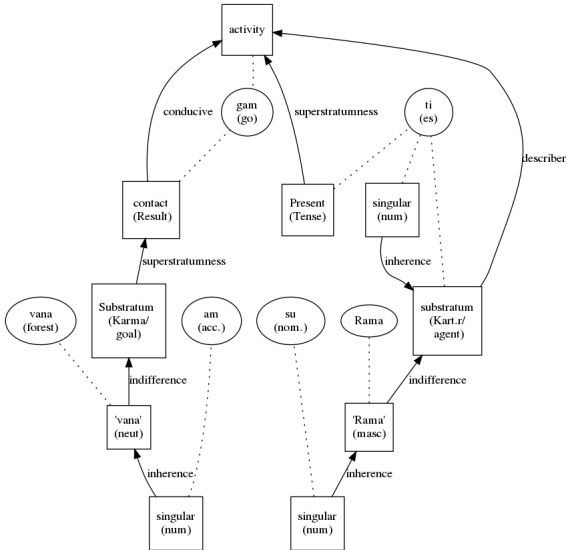


# Śābdabodha

## Śābdabodha: Process of Understanding

Given an utterance, these theories discuss how various elements in the utterance interact with each other leading to the 'meaning' or 'understanding' of the utterance.

# Grammarians's śābdabodha of Rāmaḥ vana.m gacchati (Rama goes to the forest)



## Three schools of verbal cognition

- ▶ Grammarian's
- ▶ Logician's
- ▶ Exegesist's



## Commentary Tradition

According to the *Parāśarapurāṇa*<sup>1</sup> a commentary has the following five components.

1. Segmentation (padaccheda)
2. Word analysis and its meaning (padaparicaya and padārthokti)
3. Compound word analysis (vighraha)
4. Sentential analysis (vākyayojanā)
5. Answers to objections (ākṣepeṣu samādhāna)

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<sup>1</sup>padacchedaḥ padārthoktir vighraho vākyayojanā ||17 ||  
ākṣepeṣu samādhānam vyākhyānam pañcalakṣaṇam  
(*parāśarapurāṇa* 18.17-18)

# Word Analysis

What is a word?

Here are the Pāṇini's sūtras:

*padam*(word)::= *subantam*(nominal form)

| *tiñantam*(verbal form)

(*suptiñantam padam* 1.4.14)

;

*subantam* (nominal form)::= *prātipadikam* (nom stem)*sup*(nom suff)

*prātipadikam*(nominal stem)::= *kṛt* (noun derived from a verbal root)

(*kṛttaddhitasamāsāśca* 1.2.46)

| *taddhita*(noun derived from a noun)

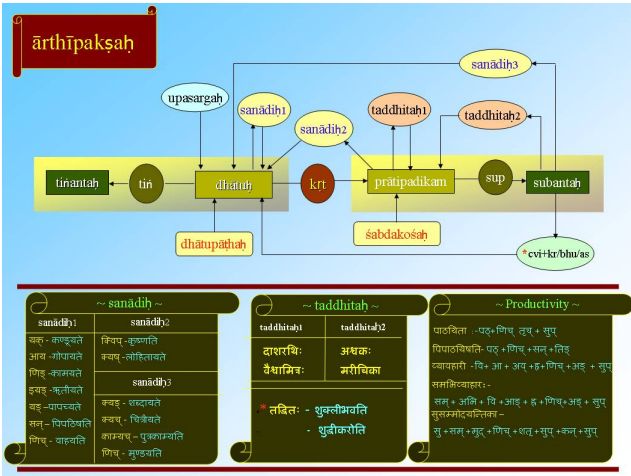
| *samāsa*(compound)

| *underived\_prātipadikam*(nominal stem)

(*arthavat adhātuḥ apratyayam prātipadikam*  
1.2.45)

;

The recursion in word form generation is represented as a FSA



# Compound Word Analysis

## Compound Word Analysis

- ▶ Syntactic Analysis
- ▶ Semantic Analysis

## Syntactic Analysis

- ▶ Which category combinations are allowed ?
- ▶ How do they combine ?

### Syntactic Analysis

- ▶ Which category combinations are allowed ?
  - ▶ Subanta (noun) + Subanta (noun)
  - ▶ Subanta (noun) + Tiñanta (verb)
  - ▶ Subanta (noun) + nāma (nominal base)
  - ▶ Subanta (noun) + Dhātu (verbal root)
  - ▶ Tiñanta (verb) + Subanta (noun)
  - ▶ Tiñanta (verb) + Tiñanta (verb)
- ▶ How do they combine ?

## Syntactic Analysis

- ▶ Which category combinations are allowed ?
- ▶ How do they combine ?
  - ▶ Two at a time;  
with a compound within a compound (garbhita samāsa)
  - ▶ In the case of Co-ordinative: all at a time

## Semantic Analysis

- ▶ Semantics associated with the compound
- ▶ Semantic constraints on the components

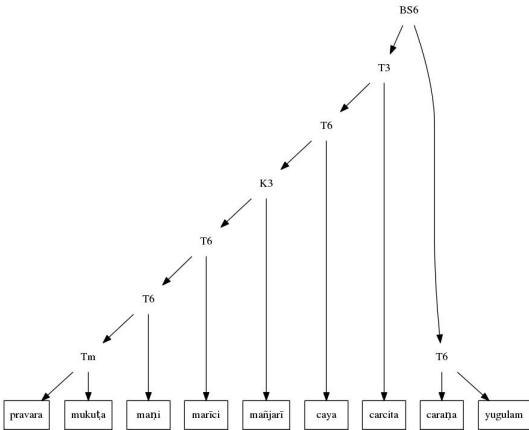


## Semantic Analysis

- ▶ Semantics associated with the compound
  - ▶ Tatpuruṣaḥ: (Endocentric with head typically to the right),
  - ▶ Bahuvrīhiḥ: (Exocentric),
  - ▶ Dvandvaḥ: (Co-ordinative), and
  - ▶ Avyayībhāvaḥ: (Endocentric with head typically to the left and behaves as an indeclinable).
- ▶ Semantic constraints on the components

## Compound Analysis

- ▶ Syntactic Analysis
  - ▶ Which category combinations are allowed ?
  - ▶ How do they combine ?
- ▶ Semantic Analysis
  - ▶ Semantics associated with the compound
  - ▶ Semantic constraints on the components



# Sentential Analysis

In order to understand a text in verse style, two different methods have been followed in Indian commentary tradition and education system viz.,

- ▶ Daṇḍānvaya (also known as anvayamukhī):  
All the words are arranged in prose order.
- ▶ Khaṇḍānvaya (also known as kathambhūtinī):  
The basic skeleton of a sentence is built by asking WH questions.

# Śābdabodha: Essential factors

Kumārila Bhaṭṭa in his *Tantravārttika* mentions 3 factors necessary for the understanding of the correlation between words.<sup>2</sup>

These factors are

- ▶ Ākāṅkṣā (expectancy)
- ▶ Yogyatā (meaning congruity)
- ▶ Sannidhi (proximity)

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<sup>2</sup>Ākāṅkṣā sannidhānam ca yogyatā ceti ca trayam sambandhakāraṇatvena kṛptam nānantaraśrutih.

# Śābdabodha: Ākāṅkṣā

Akāṅkṣā (**Expectancy**)

*Arthakatvāt ekam vākyam sākāṅkṣam cet vibhāge syāt.*

Jaimini's *Mīmāṃsāsūtra* 2.1.46.

A group of words forms a sentence if when separated

- ▶ the words have mutual expectancy, and
- ▶ it serves a single purpose

Akāṅkṣā is the desire on the part of a listener to know  
(*jñātum icchā*)

Desire / curiosity : Syntactic or Psychological?

# Śābdabodha: Ākāṅkṣā

Naiyāyikas(Logicians):

Ākāṅkṣā is the syntactic expectancy a word has in order to correlate with another.

*dvāram* = *dvāra* + *am*

\_ \_ door

*dvāra* :denotes an object in the real world,

*am*: an expectancy for a verb whose karma(goal) can be a *dvāra*

Syntactic expectancy



# Śābdabodha: Ākāṅkṣā

Two types of expectancies

- ▶ utthita ākāṅkṣā (aroused )
- ▶ utthāpya ākāṅkṣā (to be raised )

# Utthita Ākāṅkṣā

Utthita ākāṅkṣā (aroused )

- ▶ mutual, direct, natural
- ▶ as in the case of verb and its arguments

Close the door.  
(dvāram pidhehi)

# Utthāpya Ākāṅkṣā

Utthāpya ākāṅkṣā (to be raised )

- ▶ unilateral, potential
- ▶ as in the case of adjectives and with Genitive case marker

*udayati candraḥ kumudabāndhavaḥ*

Rises the moon, the friend of a lotus

# Significance of Ākāṅkṣā

Ākāṅkṣā: Establishes relations between words

- ▶ Where is the relation coded?
- ▶ How is it coded?
- ▶ Which relations are coded?

# Where is the information Coded?

- ▶ Vibhakti (suffixes)
- ▶ Sāmānādhikaraṇya (g-n-p agreement / concord)
- ▶ Nitya sambandhaḥ (co-relatives)

# How is the relation coded?

Which relations to represent – **Explicit** or **Implicit**?

samānakartṛkayoḥ pūrvakāle (3.4.21)

ktvā marks pūrvakālīnatva or kartṛtva or both?

SKT: **rāmaḥ** dugdhami **pītvā** śālāmi **gacchati**.

Gloss: Rama milk after\_drinking to\_school goes.

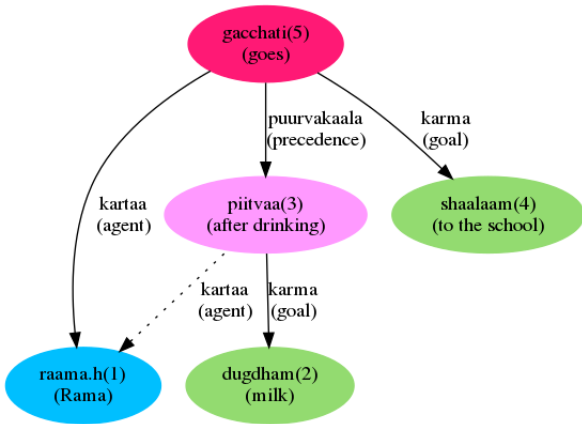
Eng: After drinking milk Rama goes to school.

# Explicit(abhihita) or Implicit(ākṣipta)

Bhartṛhari in Vākyapadīyam states (3.7.81-82),

pradhānetayor yatra dravyasya kriyayoḥ pṛthak  
 śaktir guṇāṣṛayā tatra pradhānam anurudhyate 3.7.81  
 pradhānaviṣayā śaktiḥ pratyayenābhidhīyate  
 yadā guṇe tadā tadvad anuktāpi prakāśate 3.7.82

i.e., in case X is an argument of both the main verb as well as the subordinate verb, it is the main verb which assigns the case and the relation of X to the sub-ordinate verb gets manifested even without any other marking.





# How much information is coded

## Svatantraḥ kartā (1.4.54)

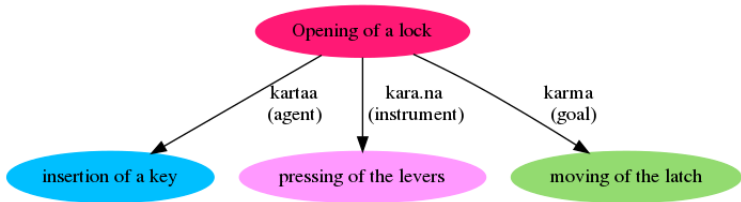
- ▶ **John** opened the lock with a key.
- ▶ **This key** opened the lock.
- ▶ **The lock** opened.

# How much information is coded

## Svatantraḥ kartā (1.4.54)

- ▶ **John** opened the lock with a key. **Agent**
- ▶ **This key** opened the lock. **Instrument**
- ▶ **The lock** opened. **Goal**

In Pāṇinian Framework, all of them are **kartā**!



Insertion of a key: John

Pressing of levers: Key

Moving of the latch: Lock

Greatness of *Pāṇini* lies in identifying **EXACTLY HOW MUCH** information is coded in a language string.

⇒

**Upper Bound** for the possible Analysis using only a language string and grammar.

# Śābdabodha: Yogyatā

Yogyatā (**Congruity**)

Suitability / mutual compatibility / fitness of meanings

- ▶ *Sambandha-arhattvam* (**ability to establish a relation**)
- ▶ *paraspara-anvaya-prayojaka-dharmavattvam* (**a property of promoting the mutual relationship**)
- ▶ *arthābādhaḥ* (**absence of obstruction in meaning**)
- ▶ *bādhaka-pramā-virahaḥ* (**lack of hindrance of valid cognition**)

# Śābdabodha: Yogyatā

- ▶ payasā siñcati  
(He) wets with water
- ▶ Agninā siñcati  
(He) wets with fire

# Indian theories of Word Meaning

Relation between word and its meaning

- ▶ Abhidhā (primary / literal meaning)
- ▶ Lakṣaṇā (secondary / metaphoric usage)
- ▶ Vyañjanā (suggestive meaning)

# Understanding word meaning in Indian Theories

**Lakṣaṇā**: A referent different from its primary one, but related to it.

Comes into play when the primary meaning is incompatible with the meanings of other words in the sentence.

Skt: gaṅgāyāṁ ghoṣaḥ

Gloss: gaṅgā{loc.} city

city on the **banks** of Gaṅgā

Primary meaning: Gaṅga

Implied meaning: On the banks of Gaṅga



# Understanding word meaning in Indian Theories

**Vyaṅgyārtha:** Suggestive meaning

Does not have any boundaries.  
Limited only by the poet's imagination.

Skt: gato'stam arkaḥ  
Primary meaning: The Sun is setting.

Different meanings for different listeners, and also depends on who the speaker is.

# Level of signification

Yogyatā is between the word meanings.

Which meaning is captured by yogyatā?

What is the level of signification?

- ▶ abhidhā (literal meaning)?
- ▶ lakṣaṇā (metaphoric meaning)?
- ▶ vyañjanā (suggestive meaning)?

## Level of signification: Primary meaning

Clue: *barhirnyāya* of Mīmāṃsā<sup>3</sup>

*Of the senses viz. mukhya and gauṇa it is only the mukhya which is to be accepted as being conveyed by the Mantra and it alone has to be connected with the enjoined act, which when applied to similar case means that words, as far as possible, must be understood as conveying their mukhyārtha alone,...*

G. V. Devasthali (1959)

Use

abhidhā (**literary meaning**) by default.

<sup>3</sup>*tasmānmukhyagauṇayormukhye kāryasampratyaya iti siddham* [SB p 751]

## Level of signification: Metaphor

Mīmāṃsā: *yadāñjasyena śabdārtho nāvakalpate tadā lakṣaṇayāpi kalpyamānaḥ sādurbhavati*

*Lakṣaṇā is resorted only as a means to avoid ānarthakya-doṣa (defect of being non-sensical) and that it can be resorted to only if the literal sense is found to be unsuitable in the context; and that to only as the last resort. [G V Devasthali (1959) pp 79]*

Only when abhidhā fails (there is no yogyatā / anvaya-upapatti) go for lakṣaṇā (Metaphorical meaning)

# Level of signification: Metaphor

Essential conditions for lakṣaṇā (**Metaphor**)

- ▶ inapplicability / unsuitability of primary meaning  
(*mukhya-artha-bādhā*)
- ▶ possibility of some relation between primary meaning and the referent (*mukhya-artha-yoga*)
- ▶ sanction for the transferred sense by popular usage (*rūḍhi / prayojana*)

## Level of signification: Suggestive meaning

Skt: gato'stam arkaḥ

Eng: The sun is setting

Impossible to process the suggestive meaning **objectively**.

This meaning is **in addition** to the primary meaning.

# Level of Signification

Use abhidhā (**literal meaning**) for analysis.

In case abhidhā fails to give ANY analysis, use lakṣaṇā (**metaphor**).

It is impossible to process the suggestive meaning objectively.

This puts an **upper limit** on the meaning that can be extracted from a language string.

# Discourse Analysis

## Coherence Relations

- ▶ inter-sentential
- ▶ paragraph level
- ▶ topic level
- ▶ chapter level
- ▶ book level
- ▶ subject level



Thank You

Questions?