Linguistics Behavior Of 'Hindi Verb Collator' In Machine Translation

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ABSTRACT.

This paper introduces the behavior of Hindi Verb Collator (HVC) for Machine Translation. For this purpose, we used a set of linguistics analysis and see it's important behavior of the Hindi verbs in syntactic-semantic perspective. Verbs are the most important grammatical category in a natural language. The main objective of this paper is to create a position and identification of Hindi verb Groups (HVGs) in natural language which will prove to be indispensable for various NLP applications. We also hope this resource to help us better understand about complication of Machine Translation.

KEYWORDS:

Linguistics Behavior , Machine Translation , Hindi Verb Collator , grammatical.

INTRODUCTION:

Verbs are the most important grammatical category in a human language. Action, activities and states are denoted with the help of the verbs. The agreements of the verb specify various participants required by the verb. Verbs play a major role in interpreting the sentence meaning therefore the study of verb argument structure and their syntactic-semantic behavior will provide the necessary knowledge base for intelligent NLP and Hindi language.

The study of Hindi verb collator process in Hindi phenomena is so complicated because "The conjunct verbs in Hindi pose a problem with respect to the agreement. Shapiro has observed that when the nominal element of a conjunct verb functions as a direct object of the conjunct verb then the verb shows an agreement with its nominal element". There are certain verbs that need other words in the sentence to represent an activity or a state of being. Such verbs are known as conjunct verb. The conjunct verb is a kind of predicate that is formed with either a noun or an adjective and a verb (the light verb). The function of the CV that has a noun and verb is descriptively and theoretically complicating. And now question is what is the complex predicate (CP)? A 'Complex predicate' by definition is a grammatical category which is formed by the mutual sharing of semantic features and co-occurrence of two lexical items e.g. a 'host' and a 'light verb'. In such a combination of two lexical items, the light verb can take a 'host', which could be nouns, adjectives, infinitival or stem from of the verbs.

The examples are given here:

a) raam   achaanak   gA   uthA.

(V1) + (V2) - Combination

(Compound Verb Construction)

b) raam nE SitA kO pYar kiyA.

(N)m + (Light Verb) - Combination

(Conjunct Verb Constructions)

c) LadkO   nE   pAAni   jmA   kiyA.
               (adj.)   (V) – Combination
(Conjunct Verb Constructions)

Here, A 'CP' that is formed with two verbs such as in (a) is referred as a 'Compound Verb' in the example and if the 'host' in a 'CP' is a nominal element, the 'CP' is called a 'Conjunct Verb' e. g. in (b & c).

This paper presents an ongoing effort of syntactic-semantic behavior of conjunct/Main verbs for Hindi language and defines about combination of conjunct verb with (Noun / Adjective) + verb. In this paper we give the syntactic-semantic criterion to decide whether the nominal element of a verb is an argument of a conjunct verb or not and give rules for agreement decisions in such cases.

This paper is arranged as follows: section

1. Motivation
2. Structure of `HVC` for Hindi Language
3. Complex predicate structure in Hindi
4. Identification of V_1+V_2 Sequence in Hindi
    4.1 Combination of V_1+V_2
    4.2 Testing rule for identifying Cps
5. `HVC` : Implement & Result
6. Conclusion

1.   MOTIVATION
   - Motivation of the paper is analyzed the complex predicate of Hindi and Improving the accuracy of specially `Rule Based machine Translation system`.
   - We have identified the compound verb and the conjunct verb from different multi-verb constructions and proposed that these verbs are formed in the lexicon.
   - This Paper `HVC` has defined for Hindi verb construction where two verb coming together and giving one single semantic unit and there is no possibilities for insertion. This is the main motivation of the `HVC`.
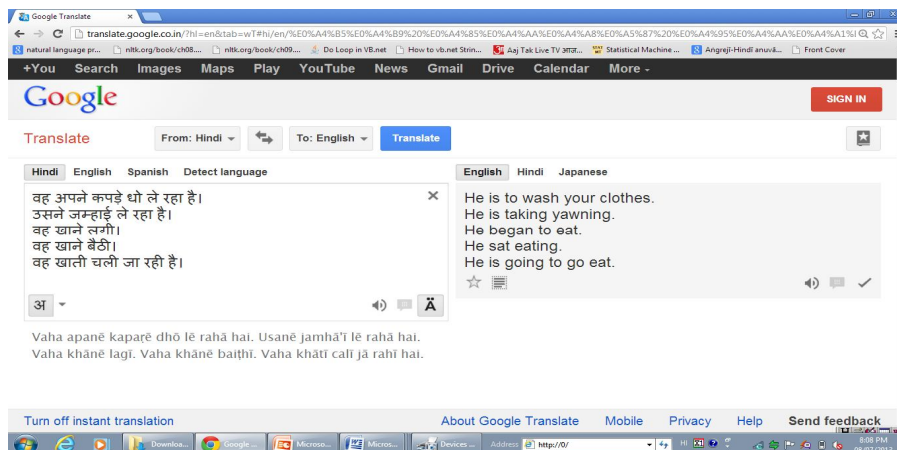
2. FUNCTIONAL CLASSIFICATION OF HVC IN HINDI LANGUAGE
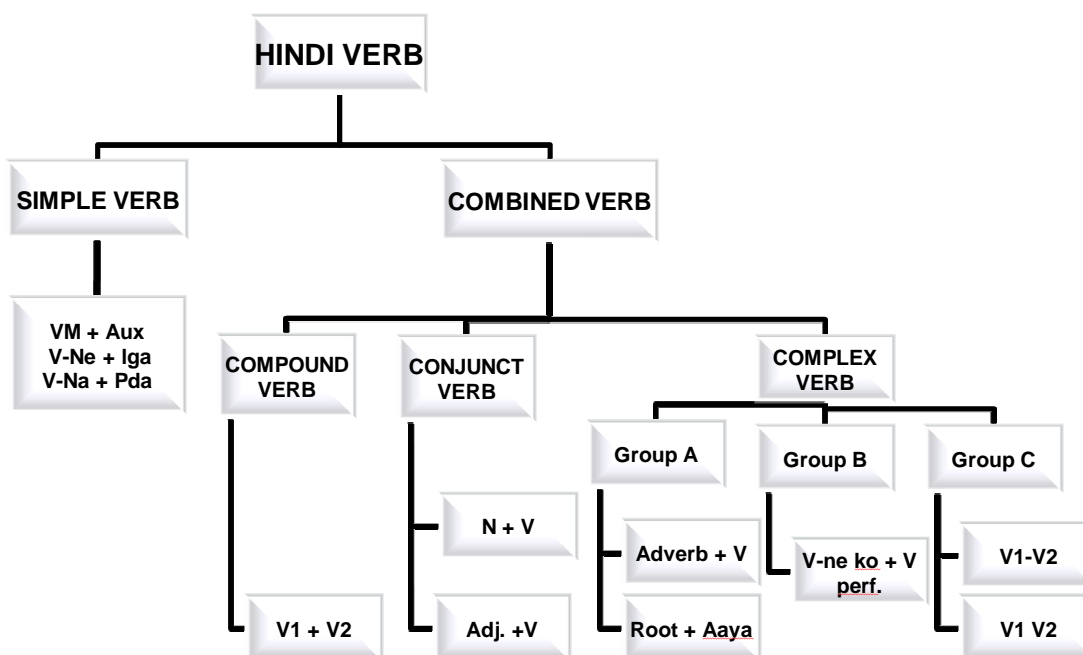
Figure: **'HVC' functional** *classification*

Cutting across the classification of Hindi verbs in terms of transitivity is the categorization of verb in terms of internal complexity. In addition to the simple one-word verbs discussed so far there are verbs which are complex in that they are made up of more than one word. In traditional accounts, these HVC process have been described under three categories of verbs-

    A- Simple Verb ---------- (VM + Aux combination)
    B- Compound Verb ------ (V_1+V_2 Combination)
    C- Conjunct Verb------- (Noun/Adj + Verbalizers)

Simple Verb consist of two words verb (Main verb + Auxiliary verb), Compound verbs consist of two verbs (V_1+V_2) and conjunct verbs are made up of a Nominal followed by a verb. Explicator compound verb, also know as `modified verbal expressions`, serial verbs and simply compound verb have long since been identified as a

major areal feature of South Asian Language. By explicator compound verb we mean a sequence of atleast two verbs $V_1 + V_2$, where the first member of verb always giving the lexical meaning and the second member of verb V_2 only occurs in the sequence to mark the main verb V_1 for certain grammatical features. And about Hindi conjunct verb construction comprise a small set. The member of this set are *'hona', 'ker' 'dena', 'aana', 'leg'* and something etc. the process is very productive any noun or adjective can be used in this construction to yield a corresponding verb. In CPs, 'Noun /Adj. + Verbalizers' combination are called Conjunct verb and $V_1 + V_2$ Combination are called Compound Verb.

Conjunct verb in Hindi is formed by combining a noun or an adjective with a verb. These verbs have the following structure.

> Noun/Adjective + Verb (Verbalizer)

A conjunct verb consists of a noun or and adjective and a Verbalizers, which takes all the verbal inflections. The verb may be transitive (tr.) or intransitive (intr.) the most frequent verbs are used in conjunct verbal are *'krna'*(करना) and *'hona'*(होना). *'krna'*(करना) and *'hona'*(होना) are the universal Verbalizers but some Verbalizers of Hindi used with Conjunct verb in different Context. For Examples we can see that.

(1) mohan   ne   siitA   kA   intajAr   kiyaa.
(2) mere   sAre   paise   khAtma   ho   gye   hain.

3.   COMPLEX PREDICATES STRUCTURE IN HINDI

In Hindi there are huge numbers of multi word constructions. It is necessary to study these constructions carefully in order to store them systematically. A CPs in Hindi is a syntactic construction consisting of either a verb, a noun, an adjective or an adverb as main predicator followed by a light verb (LV). Thus, a CP can be a noun + LV, an adjective + LV, a verb + LV or an adverb + LV. Further, it is also possible that a CP is followed by a LV (CP+LV). The light verb carries the tense and agreement morphology. In V+V CPs. In this Paper specially classifying the rule of V+V combination. CPs are also referred as the complex or compound verbs. Given below are some examples:

(1)   CP = Noun + LV
       Noun = *ashirwad* {blessings}
       LV = *denaa* {to give}
       usane mujhe ashirwad diyaa.
       ### उसने मुझे आर्शीवाद दिया
       {he   me blessings gave}
       he blessed me.
(2)   No CP
       usane mujhe ek pustak dii.
       ### उसने मुझे एक पुस्तक दी
       {he me one book gave}
       he gave me a book.

In (1), the light verb *diyaa* (gave) in its past tense form with the noun *ashirwad* (blessings) makes a complex predicate verb form *ashirwad diyaa* (blessed) in the past tense form. The CP here is *ashirwad denaa* and its corresponding English translation is 'to bless'. On the other hand in example (2), the verb *dii* (gave) is a simple verb in past tense form and is not a light verb. Although, same Hindi verb *denaa* (to give) is used in both the examples, it is a light verb in (1) and a main verb in (2). Whether it acts as a light verb or not, depends upon the semantics of the preceding noun. However, it is observed that the English meaning in case of the complex predicate is not derived from the individual meanings of the constituent words. It is this observation that forms basis of our approach for mining of CPs.

(3)   CP = adjective + LV
       Adjective = khush {happy}
       LV=*karanaa* {to do}
       usane mujhe khush kiyaa.
       ### उसने मुझे खुश किया

{he me happy did}
he pleased me.

Here the Hindi verb *kiyaa* (did) is the past tense form of a light verb *karanaa* (to do) and the preceding word *khush* (happy) is an adjective. The CP here is *khush karanaa* (to please).

(4) CP=verb+LV
   Verb = *paRhnaa* {to read}
   LV = *lenaa* {to take}
   usane pustak paRh liyaa.

   उसने पुस्तक पढ़ लिया

{he book read took}
 he has read the book.

Here the Hindi verb *liyaa* (took) is the past tense form of the light verb *lenaa* (to take) and the preceding word *paRh* (read) is the verb *paRhnaa* (to read) in its stem form. The CP is *paRh lenaa* (to finish reading). In such case the light verb acts as an aspectual /modal or as an intensifier.

4.   IDENTIFICATION OF V₁+V₂ SEQUENCE IN HINDI

We have designed and used different syntactic tests to identify the CPs. The aim of these tests is to see whether these V+V sequences function as a simple predicate, (i.e., if they have a single subject and no clausal embedding) which is an essential property of a CP as given by Butt. The tests used including here:

   4.1 Movement test
   4.2 Adverb test
   4.3 Negation test
   4.4 PPs Test

4.1 Movement Test

1.   **क्रिया-ताताते+रहता: पढ़ता रहता(Read-live)'keep reading'**

   ✓   **वह पढ़ता रहता है।**
      He keeps on reading.
      * **पढ़ता वह रहता है।**
      * **वह है पढ़ता रहता।**

2.   **क्रिया-ने+लगना:निकलने लगना(Cry-feel)'Started crying'**

   ✓   **उसके शरीर से खून निकलने लगा।**
      Blood started to ooze out from his/her body.
   ✓   **निकलने उसके शरीर से खुन लगा।**
   ✓   **लगा उसके शरीर से खुन निकलने।**

3.   **क्रिया-ना + पड़ा: करना पड़ा (Do-lie) 'Do'**

   ✓   **मुझे यह काम करना पड़ा।**
   ✓   I had to do this work.
      * **करना यह काम मुझे पड़ा।**
      * **पड़ा यह काम करना मुझे।**

4.   **क्रिया-ने+ क्रिया: पढ़ने बैठा (Read-sit) 'Sat to read'**

   ✓   **वह अपने घर पर पढ़ने बैठा।**
   ✓   He sat to read at house.

- ✓ वह <u>पढ़ने</u> अपने घर पर <u>बैठा</u>।
- ✓ <u>पढ़ने</u> वह अपने घर पर <u>बैठा</u>।
- ✓

4.2 Negation Test

1. **क्रिया-तातातेे+रहताः खाता रहता (Eat-live) 'keep eating'**
   - ✓ वह <u>खाता रहता</u> है।
   - ✓ He keeps on eating.
     - * वह <u>खाता</u> नही <u>रहता</u> है

2. **क्रिया-ने+लगना : निकलने लगना (Start-feel)'Started Crying'**
   - ✓ उसके शरीर से खून <u>निकलने लगा</u>।
   - ✓ Blood started to ooze out from his/her body.
   - * उसके शरीर से खुन <u>निकलने नही लगा</u>।

3. **क्रिया-ना+ पड़ा: करना पड़ा (DO-lie) 'Do'**
   - ✓ मुझे यह काम <u>करना पड़ा</u>।
   - ✓ I had to do this work.
   - * यह काम मुझे <u>करना</u> नही <u>पड़ा</u>।

4. **क्रिया-ने+क्रिया: पढ़ने बैठा (Read-sit) 'Sat to study'**
   - ✓ वह अपने घर पर <u>पढ़ने बैठा</u>।
   - ✓ वह अपने घर पर <u>पढ़ने</u> नही <u>बैठा</u>।

4.3 Pps Test

1. **क्रिया-तातातेे + रहताः खाती रहती (Eat-live) 'keep eating'**
   - ✓ वह <u>खाता रहता</u> है
   - ✓ He keeps on reading.
     - * वह <u>खाता</u> के लिए <u>रहता</u> है

2. **क्रिया-ने + लगना: निकलने लगना (Start-feel) 'Started crying'**
   - ✓ उसके शरीर से खून <u>निकलने लगा</u>।
   - ✓ Blood started to ooze out from his/her body.
   - * उसके शरीर से खुन <u>निकलने</u> के लिए <u>लगा</u>।

3. **क्रिया-ना+ पड़ा: करना पड़ा (DO-lie) 'Do'**
   - ✓ मुझे यह काम <u>करना</u> पड़ा।
   - ✓ I had to do this work.
   - * यह काम मुझे <u>करना</u> के लिए <u>पड़ा</u>।

4. **क्रिया-ने + क्रिया: लिखने बैठा (Write-sit) 'Sat to study'**
   - ✓ वह अपने बिस्तर पर <u>पढ़ने बैठा</u>।
   - ✓ वह अपने बिस्तर पर <u>पढ़ने</u> के लिए <u>बैठा</u>।

4.4 Adverb Test-

1. **क्रिया-ताताते + रहता: खाती रहती (Eat-live) 'keep eating'**
   - ✓ वह धीरे-धीरे <u>खाता रहता</u> है।
   - ✓ He keeps on reading.
   - * वह खाता धीरे-धीरे रहता है।

2. **क्रिया-ने + लगना: निकलने लगना (start-feel) 'Started crying'**
   - ✓ उसके शरीर से खून तेजी से <u>निकलने लगा</u>।
     Blood started to ooze out from his/her body.
   - * उसके शरीर से खून <u>निकलने</u> तेजी से <u>लगा</u>।

3. **क्रिया-ना+ पड़ा: करना पड़ा (DO-lie) 'Do'**
   - ✓ मुझे यह काम जल्दी से <u>करना पड़ा</u>।
   - * मुझे यह काम <u>करना</u> जल्दी <u>पड़ा</u>।

4. **क्रिया–ने + क्रिया: पढ़ने बैठा (Read-sit) 'Sat to Read'**
   - ✓ वह अपने घर पर जल्दी से <u>पढ़ने बैठा</u>।
   - ✓ वह अपने घर पर <u>पढ़ने</u> जल्दी से <u>बैठा</u>।

🞦 **All the above tests are summarized in Table 1.1**

Verb Group	Test	Result
क्रिया-ता/ती/ते + रहता	Movement Test	There is no Movement between two verbs =CP
क्रिया-ने + लगा	---	There is possibilities of Movement between two verbs, but this is Stylistics Movement= CP
क्रिया-ना + पड़ा	---	There is possibilities of Movement between two verbs, but this is Stylistics Movement= CP
क्रिया-ने + क्रिया	---	There is possibilities of Movement between two verbs, but this is not Stylistics Movement= N-CP
क्रिया-ता/ती/ते + क्रिया	Negation Test	There is no possibilities of Insertion of Negation between two verb unit = CP
क्रिया-ने + लगा	---	There is no possibilities of Insertion of Negation between two verb unit = CP
क्रिया-ना + पड़ा	---	There is no possibilities of Insertion of Negation between two verb unit = CP
क्रिया-ने + क्रिया	----	There is possibilities of Insertion of Negation between two verb unit = N-CP
क्रिया-ता/ती/ते + क्रिया	Adverb Test	There is no possibilities of Insertion of Adverb between two verb unit = CP
क्रिया-ने + लगा	---	There is no possibilities of Insertion of Adverb

		between two verb unit = CP
क्रिया-ना + पड़ा	---	There is no possibilities of Insertion of Adverb between two verb unit = CP
क्रिया-ने + क्रिया	----	There is possibilities of Insertion of Adverb between two verb unit = N-CP
क्रिया-ता/ती/ते + क्रिया	PSP Test	There is no possibilities of Insertion of any Pps between two verb unit = CP
क्रिया-ने + लगा	---	There is no possibilities of Insertion of any Pps between two verb unit = CP
क्रिया-ना + पड़ा	---	There is no possibilities of Insertion of any Pps between two verb unit = CP
क्रिया-ने + क्रिया	----	There is possibilities of Insertion of any Pps between two verb unit = N-CP

Table- 1.1

The syntactic tests that we have applied in this section exhibit a clear cut distinction among the five V-V sequences. In one case it shows that the V-V sequences function as a single constituent. It resists movement, the adverbial and negative scope is over the whole sequence, morphological operations like, nominalization, passivization and causativization operates over the entire sequence. In another instance it demonstrates that the part of V-V sequence can be moved, the scope of negation and adverb depend upon the syntactic position of the adverb and the negative particle, morphological operation are subject to individual verbs.

5. `HVC` : Implement & Result

In this system has been included 2 steps for accuracy:

- Hindi POS Tagger
- `HVC` system.

Hindi POS-Tagger Accuracy Report

- **Corpus (1)- Trained Data**

✓ **POS-Tagger: Each Word output statistic Report**

- **Tag:**_PDM   Word: Search **"_PDM"** (263 hits in A file)
- **Tag:**_ADJ   Word:Search **"_ADJ"** (2 hits in A file)
- **Tag:**_ADV   Word:Search **"_ADV"** (9 hits in A file)
- **Tag:**_ADV/2 Word:Search **"_ADV/2"** (1 hits in A file)
- **Tag:**_NCM   Word:Search **"_NCM"** (92 hits in A file)
- **Tag:**_VITF Word:Search "**_VITF**" (40 hits in A file)
- **Tag:**_PSP   Word:Search "**को_PSP**" (5 hits in A file)
- **Tag:**_PSP   Word:Search "**से_PSP**" (19 hits in A file)
- **Tag:**_PSP   Word:Search " **में_PSP**" (8 hits in A file)
- **Tag:**_VBG   Word:Search "**_VBG**" (33 hits in A file)
- **Tag:**_VMAIN Word:Search"**_VMAIN**"(240 hits in A F)

- **Tag:**_VMAIN2Word:Search"**_VMAIN2**"(132 hits in A F)
- **Tag:**_AUX1 Word:Search "**_AUX1**" (95 hits in A file)
- **Tag:**_AUX   Word:Search "**_AUX**" (26 hits in A file)
- **Tag:**_ MAUX Word:Search "**_ MAUX**" (11 hits in A file)
- **Tag:**_TAUX Word:Search "**_TAUX**" (211 hits in A file)
- **Tag:**_RDP: Word:Search "**_RDP**" (1 hits in A file)
- **Tag:**_NCD: Word:Search "**_NCD**" (21 hits in A file)
- **Tag:**_ITF: Word:Search "**_ITF**" (11 hits in A file)

✓ **POS-Tagger: Each word output accuracy report**

- **_PDM Correct:263 Errors:15 Total:**263 **Accuracy:100%**
- **_ADJ Correct:02 Errors:00 Total:02 Accuracy:100%**
- **_ADV Correct:09 Errors:00 Total:09 Accuracy:100%**
- **_ADV2Correct:01 Errors:00 Total:01 Accuracy:100%**
- **_NCM Correct:73 Errors:19 Total:92 Accuracy:79%**
- **_VITFCorrect:40 Errors:00 Total:40 Accuracy:100%**
- **_PSP Correct:05 Errors:00 Total:05 Accuracy:100%**
- **_PSP Correct:19 Errors:00 Total:19 Accuracy:100%**
- **_PSP Correct:08 Errors:00 Total:08 Accuracy:100%**
- **_VBG Correct:19 Errors:14 Total:**33 **Accuracy:57%**
- **_VMAIN Correct:196 Errors:44 Total:**240 **Accuracy:81%**
- **_VMAIN2 Correct:56 Errors:76 Total:**132 **Accuracy:42%**
- **_AUX1 Correct:93 Errors:02 Total:**95 **Accuracy:97%**
- **_AUX Correct:26 Errors:00 Total:**26 **Accuracy:100%**
- **_MAUX Correct:06 Errors:05 Total:**11 **Accuracy:100%**
- **_TAUX Correct:209Errors:00 Total:**209 **Accuracy:100%**
- **_NCD Correct:21 Errors:00 Total:**21 **Accuracy:100%**
- **_ITF Correct:11 Errors:00 Total:**11 **Accuracy:100%**

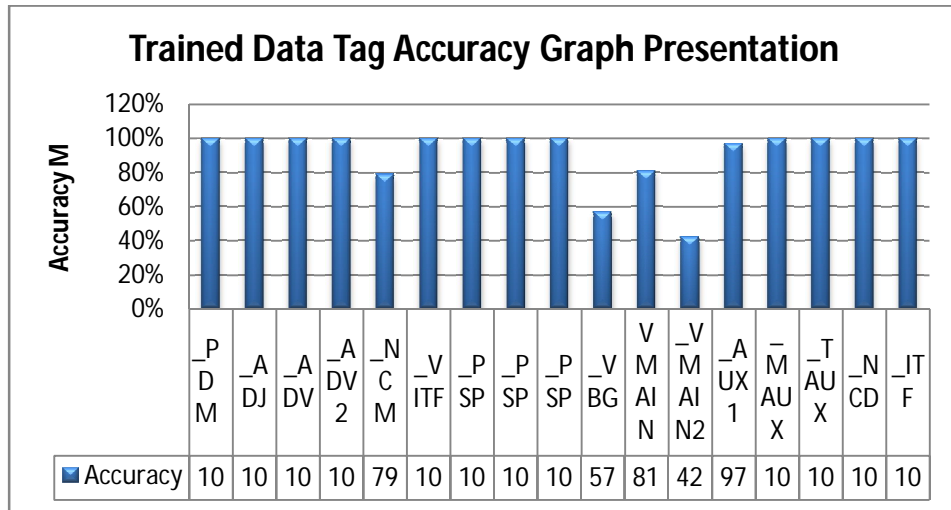✓ **POS-Tagger: Graph Presentation of Each word Accuracy Report**

Trained Data Tag Accuracy Graph Presentation

	_P D M	_A DJ	_A DV	_A DV 2	_N C M	_V ITF	_P SP	_P SP	_P SP	_V BG	V M AI N	_V M AI N2	_A UX 1	̅ M AU X	_T AU X	_N CD	_IT F
■ Accuracy	10	10	10	10	79	10	10	10	10	57	81	42	97	10	10	10	10

Table: 1.2

✓ **POS-Tagger: Accuracy Report on Trained Data**

Data Set	Total No of Sentences	Total Words	Unknown Words	Total no of Tag Words	Total Correct Tag Words	Total Error Tag Words
Train Data	260	1304	71	1233	1058	175

Table: 1.3

- **Total No of Train Data Sentences = 260**
- **Total No of Train data Words = 1304**
- **Total No of Unknown TAG Words = 74**
- **Total No of TAG Words = 1233**
- **Total No of Correct TAG Words = 1058**
- **Total No of Error TAG Words = 175**

HVC Accuracy Report
  ▪ <mark>Corpus (1)- Trained Data</mark>
✓ **HVC : Output verb-group statistic Report**

- **VG:_SMV** VerbGroup:Search **"_SMV"** (00 hits in 1 file)

- **VG:_CPV** VerbGroup:Search **"_CPV"** (50 hits in 1 file)

- **VG:_CNV** VerbGroup:Search **"_CNV"** (18 hits in 1 file)

- **VG:_ADJ** VerbGroup:Search **"_ADJ"** (00 hits in 1 file)

- **VG:_ADV/1**VerbGroup:Search**"_ADV/1"**(14hits in 1 file)

- **VG:_VGF** VerbGroup:Search **"_VGF"**(357 hits in 1 file)
- **VG:_VGNF**VerbGroup:Search **"_VGNF"**(00 hits in 1 file)

✓ **HVC : Output Each Verb-Group Accuracy Report**

- **_SMV Correct:00 Errors:00 Total:00 Accuracy:DNM**
- **_CPV Correct:50 Errors:00 Total:50 Accuracy:100%**
- **_CNV Correct:11 Errors:07 Total:18 Accuracy:61%**
- **_ADJ Correct:00 Errors:00 Total:00 Accuracy:00%**
- **_ADV/1 Correct:13 Errors:01 Total:14 Accuracy:92%**
- **_VGF Correct:287 Errors:70 Total:357 Accuracy:80%**
- **_VGNF Correct:00 Errors:00 Total:00 Accuracy:DNM**

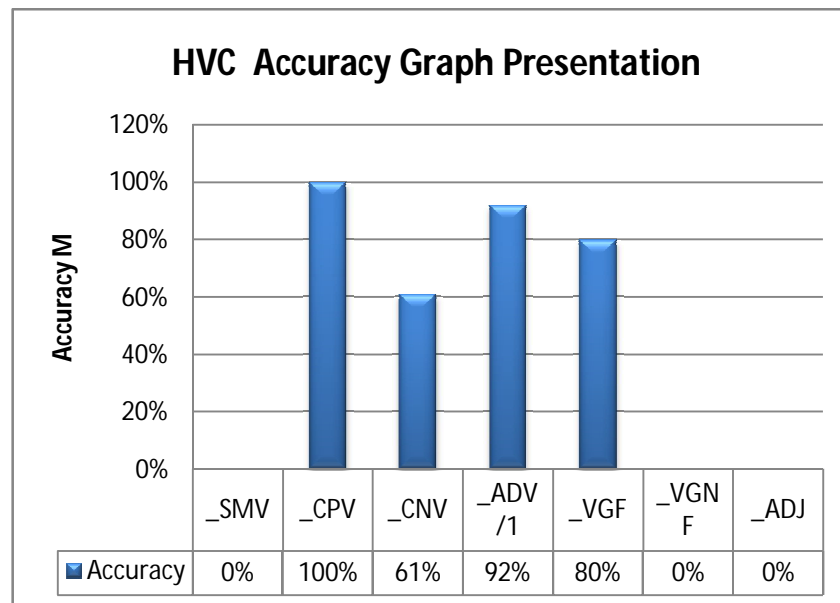✓ **HVC : Graph presentation of verb-group Accuracy report**

HVC Accuracy Graph Presentation

	_SMV	_CPV	_CNV	_ADV/1	_VGF	_VGNF	_ADJ
Accuracy	0%	100%	61%	92%	80%	0%	0%

Table: 1.4

✓ **HVC: Accuracy report on Trained data**

Data Set	Total No of Sentences	Total No Words	Total no of VG	Total no Correct VG	Total no Error VG
Train Data	260	1304	439	361	78

Table: 1.5

- **Total No of Sentences = 260**
- **Total No of Words = 1304**

- **Total No of HVC = 439**
- **Total No of correct HVC = 361**
- **Total No of Error HVC = 78**

$$`HVC` \ Accuracy = \frac{Total \ no \ of \ Correct \ VG}{Total \ no \ of \ VG} \times 100$$
$$`HVC` \ Accuracy = \frac{361}{439} \times 100$$
$$`HVC` \ Accuracy = 82.65\%$$

6.   CONCLUSION

We have analyzed some of the test for manual identification of CPs and there relevance in automatic identification. We successfully showed the importance of these diagnostics in rule based techniques by observing the significant increase in overall accuracy of Hindi POS Tagger and `HVC` system. This paper presented a seed bank for a complete reference dependency bank for CPs cross linguistically. Furthermore, the CP dependency bank is meant as a reference resource that NLP researchers can consult when working on a new language and can use for tasks such as figuring out an appropriate POS tag set for the language, constructing analyses for tree banking, chunking or extracting lexical resources.

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