Modeling Case Marking System of Urdu-Hindi Languages by using Semantic Information

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Abstract – **Rule based modeling of the grammar of a language is important for various natural language processing chores. In this paper, formulation of Urdu/Hindi case marking system based on Lexical Functional Grammar (LFG) is presented. In this paper, semantic information associated with nouns is incorporated to better classify grammatical roles adopted by each case. Especially, the versatile case marker 'sey' has found to adopt different roles depending upon semantic information associated with nouns. The agent role of 'sey' found by such classification helped identifying subject and indirect subject roles of tetravalent causative verbs found in Urdu/Hindi languages.**

Keywords: *Language Modeling, Case Marking System, Lexical Functional Grammar (LFG), Urdu, Hindi.*

I. INTRODUCTION

Urdu and Hindi have large common vocabulary and these are structurally so close to each other that frequently these are referred to as the same language. Although writing system of both of these languages is quite different yet as the spoken language these are same. When we count together these languages, these are spoken by around 400 million people around the world and thus treated as the world's second most spoken language [1]. Therefore, whatever presented here for the modeling of Urdu is also for Hindi.

This paper presents implementation of case marking system of Urdu-Hindi using Lexical Functional Grammar (LFG) formalism [2, 3]. LFG is a formalism that models variations across various language structures by separating surface phrase structure (called c-structure) from the underlying grammatical functional structure (called f-structure). Here we give lexical functional equations for each case that are used to generate parse tree and attribute-value matrices. In particular, we formulated case marked with '*sey*' by involving semantic information of nouns involved to achieve better resolution of role adopted by this case marker. The agent case thus formulated, which is linked with animated nouns is shown to act as indirect subject in tetravalent causative verbs of Hindi-Urdu, in addition to subject marked with ergative case. Other two objects appear in dative and nominative cases respectively.

II. CASE MARKING

The following are case markers in Urdu along with example sentences. The nominative, ergative, dative and accusative case has been discussed extensively [4, 5]. I briefly present these with some difference of opinion in ergative and accusative cases.

A. Nominative Case

If there is no case marker with the noun (or the noun phrase), the noun is said to be in nominative case, which is the default case of noun, as shown in (1) below. Here both 'boy' and 'book' are in nominative form, which assume subject and object functions respectively.

(1) لڑکا کتاب خریدے گا
> *laRk-aa ketaab xareed-ey=g-aa*
> boy=*nom* book=*nom* buy
> The boy will buy a book

B. Ergative Case

Marked with case marker, *ney*, expresses actor/ agent/ subject in perfective tenses for transitive verbs, as shown in sentence (2).

(2) لڑکے نے کتاب خریدی
> *laRkey=ney ketaab xareed-ee*
> boy=*erg* book=*nom* buy
> The boy bought a book.

LFG based lexical Entry of '*ney*' has following structure:

```
ney   (↑ CASE) = ergative
      (↑ N-SEM NCONCEPT) =c animate
      ((SUBJ ↑) V-FORM) =c perfect
      { ((SUBJ ↑) V-VAL) =c 2
      | ((SUBJ ↑) V-VAL) =c 3 }
      (SUBJ ($) ↑)
```

The entry shows that it marks ergative case to animate nouns. Non animate nouns are not marked with ergative case. The perfect verb form is required for divalent or trivalent verbs. The noun marked with ergative case fills the subject argument of the verb.

C. Dative Case

Marked with case marker, *kao*, expresses indirect object/ recipient/ beneficiary/ receiver for ditransitive verbs, the example sentence showing dative case is shown in (3). For the argument structure of some verbs that do not take ergative or nominative subjects, dative case is used for subjects as shown in (4).

(3) میں نے لڑکے کو کتاب دی

mayN=ney laRk-ey=kao ketaab d-ee
I=*erg* boy =*dat* book=*nom* give
I gave the book to the boy.

(4) لڑکے کو سردی لگ رہی ہے

laRkey=kao sardee lag rahee hay
boy =*dat* cold.*nom* touch
The boy is feeling cold.

Lexical Entry of '*kao*' for dative case thus has following features:

```
kao   (↑ CASE) = dative
      (↑ N-SEM NCONCEPT) =c animate
  {   ((OBJgoal ↑) V-VAL) = 3
      (OBJgoal ($) ↑)
  |   " or "
      ((SUBJ ↑) V-VAL) ~= 3
      (SUBJ ($) ↑)
  }
```

D. Accusative Case

Marked with case marker, *kao*, expresses direct object/ undergoer/ patient usually for transitive verbs. This object typically becomes subject under passivisation. This marker is phonetically same case marker used to mark dative case. But it marks a different grammatical function and therefore is a separate case. One example of it is given in sentence (5), in which 'the boy' is in accusative case and occupies the patient, *mafAool*, grammatical function position in the argument structure of the verb. It is found, mostly, with the transitive verb as opposed to dative case found, usually, in the argument structure of ditransitive verbs. If we use the 'boy' in sentence (5) in nominative form, as shown in sentence (6), then for the well formed sentence the verb, *maar-aa*, is not the same verb used in (5). In sentence (5) it means 'beat', while in sentence (6) it means 'kill'. Now both 'beat' and 'kill' have different argument structures and 'beat' requires accusative case and 'kill' requires nominative case.

(5) اکمل نے لڑکے کو مارا

aakmal=ney laRk-ey=kao maar-aa
Akmal=*erg* boy =*acc* beat
Akmal beat a boy.

(6) اکمل نے لڑکا مارا

aakmal=ney laRk-aa maar-aa
Akmal=*erg* boy=*nom* kill
Akmal killed a boy.

The accusative, *kao*, is also known for indicating 'specificity' [6], particularly for inanimate nouns as shown in (7). We have found by presenting this sentence to native speakers of Urdu in Lahore and Islamabad that in this sentence the specifier is missing or implied by default (or may be the pro-drop phenomenon). The more acceptable form of sentence (7) is shown in (8). For unspecified objects, the sentence (9) is more acceptable form. Thus I feel that, *kao*, itself is not a marker for 'specificity' but there is missing or implied pronoun which is actually responsible for 'specificity'.

(7) لڑکے نے کتاب کو خریدا؟

? *laRk-ey=ney ketaab=kao xareed-aa*
? boy =*erg* book =*acc* buy
? The boy bought the/this/that (particular) book.

(8) لڑکے نے اس کتاب کو خریدا

laRk-ey=ney aes ketaab=kao xareed-aa
boy =*erg* this book =*acc* buy
The boy bought this (particular) book.

(9) لڑکے نے کتاب خریدی

laRk-ey=ney ketaab xareed-ee
boy=*erg* book=*nom* buy
The boy bought a book.

LFG based Lexical Entry:

```
kao   (↑ CASE) = accusative
      ~[((OBJ ↑) V-VAL) = 3]
      (OBJ ($)↑)
  {   (↑ N-SEM N-CONCEPT) =c animate
  |   " or "
      (↑ N-SEM N-CONCEPT) =c thing
      (↑ SPEC) =c definite }
```

Moreover, if there is no nominative verb argument as in (5) and (7), then the default verb agreement, i.e., singular and masculine is adopted.

E. Case Marked with 'sey'

The noun (or noun phrases) marked with case marker, *sey* are characterized as an instrumental case in most of the literature [4, 5] on Urdu and Hindi. Actually, the '*sey*' is too versatile and noun cases marked with '*sey*' occupy different grammatical relations. They are sometimes subject, object, oblique arguments controlled by verb argument structure and also as adjunct in a post-positional phrase or as an adverbial phrase. Sometimes '*sey*' is used for comparison between two things and sometimes it is used with adjectives. Thus use of post-position '*sey*' is quite versatile and beyond bare instrumental case marker. Thus, we are trying here to classify marking of this post position in different situations.

F. Agent Case

The animate noun (or noun phrase) marked with case marker, *sey*, is categorized as agent case and occupies 'subject' position in the verb's argument structure. In sentence (10) the inability of the agent is shown for

performing an action. Sentence (11) shows agent in passive voice form.

(10) لڑکے سے کھانا کھایا نہیں جاتا

   laRk-ey=sey khaanaa khaa-yaa naheeN ja-taa
   boy=*agent* food=*nom* eat not go
   The boy is not able to eat food

(11) لڑکے سے خط لکھا گیا

   laRk-ey=sey xatt lekh-aa ga-yaa
   boy =*erg* letter=*nom* write go
   The letter is written by the boy

There is another agentive form of animate noun in the argument structure of causative verb forms, where noun marked with '*sey*' appears as actor. That will be discussed later in greater details.

Lexical Entry:

```
sey (↑ CASE) = agent
    (↑ N-SEM N-CONCEPT) =c animate
    ((SUBJ ↑) V-VAL) = 2
    { ((SUBJ ↑) NEG) = +
      ((SUBJ ↑) TNS-ASP MOOD) = inability
    | ((SUBJ ↑) TNS-ASP VOICE) = passive }
    (SUBJ ↑)
```

More intuitive use of subject case and evidence of indirect subject are given in this paper in the discussion of Urdu causatives.

G. Mutual Case

The case marker '*sey*' is also used to mark animate nouns as 'object' position in the verbal argument structure. Here the marked noun is undergoer or experiencer of the action involved and thus occupies object position. The example sentences are shown in (12), (13), and (14). Again it is the argument structure of the verbs which governs the requirement of object marked with case marker '*sey*', instead of nominative or accusative case.

(12) حامد نے حمید سے بات کی

   haamed=ney hameed=sey baat k-ee
   Hamid=*erg* Hameed=*obj* talk=*nom* do
   Hamid talked to Hameed.

(13) حامد نے حمید سے مدد مانگی

   haamed=ney hameed=sey madad maang-ee
   Hamid=*erg* Hameed=*obj* help=*nom* demand Hameed for help.

(14) حامد نے حمید سے وعدہ کیا

   haamed=ney hameed=sey waAdah kee-aa
   Hamid=*erg* Hameed=*obj* promise=*nom* do
   Hamid promised Hameed.

LFG based Lexical Entry is as follows:

```
sey (↑ CASE) = mutual
    ((OBJ ↑)SUBJ N-SEM N-CONCEPT) =c animate
    ((OBJ ↑) OBJ N-SEM N-CONCEPT) =c animate
    (OBJ ↑)
```

Moreover categorization frames of verbs require object case as mutual to make sentence well formed. In these examples the verb is neither causative nor it is in the passive mode, therefore it has ergative case for subject. The verbs involved depict some activity which is performed mutually between two animate, particularly between human subjects and objects.

H. Instrumental Case

For the inanimate nouns (or noun phrases) known as the instrumental nouns in Urdu: *aesm-e-aalah*, when marked with case marker, *sey*, are categorized as instrumental case. For instrumental case the nouns are inanimate, classified as instrumental nouns and typically used by some agent or actor as an aid to accomplish some task. Example sentences are given in (15) and (16). The grammatical function assigned to this instrumental case is adjunct to the sentence and usually translated in English as prepositional phrase containing 'with'.

(15) لڑکے نے پنسل سے خط لکھا

   laRk-ey=ney pencel=sey xatt lekh-aa
   boy=*erg* pencil=*inst* letter write-*perf.sg.masc*
   The boy wrote with the pencil

(16) ماں نے چھری سے سیب کاٹا

   maaN=ney chhoor-ee=sey seyb kaat-aa
   mother=*erg* knife=*inst* apple=*nom* cut
   The mother cut the apple with the knife

Lexical Entry:

```
sey   (↑ CASE) = instrument
      (↑ N-SEM N-CONCEPT) =c instrument
      (OBL-sey-inst ↑)
```

I. Movement / Passage / Path / Spatial Case

The verbs that convey movement of noun (or noun phrase) and marked with case marker, *sey*, are classified here. (17)shows an example in which someone traveled by boarding on some vehicle while (18) shows movement along the path. The grammatical function assigned to this case are adjunct to the sentence and usually translated in English as prepositional phrase containing preposition 'by'. So whenever there is a verb showing movement, an optional adjunct showing means or way of movement may be attached in the sentence.

(17) وہ جہاز سے امریکہ گیا

   woh jahaazz=sey amreekah ga-yaa
   He/She=*nom* plane=*transport* America=*nom* go
   He went to America by plane

(18) اس نے سڑک سے سفر کیا

aos=ney saRak=sey safar kee-aa

He/She=*erg* road=*path* travel=*loc.in* do

He traveled by road

The sentence in (19) and (20) show movement through a passage and path respectively.

(19) وہ دروازے سے کمرے میں آئی

woh darwaaz-ey=sey kamrey=meiN aa-ee

He/She=*nom* door=*passage* room=*loc.in* come

She came to room through the door

(20) وہ سیڑھیوں سے اوپر آیا

woh seeRh-eeoN=sey aoopar aa-yaa

He/She=*nom* stair=*path* up come

He came up through stairs

The nouns representing 'space' in Urdu are known as spatial nouns, and when these accompany marker '*sey*', they represents spatial case as shown in (21) and (22).

(21) وہ لاہور سے آیا ہے

woh laahaor=sey aa-yaa hay

He/She-*sg*=*nom* Lahore=*spatial* come be.*pres*

He came from Lahore.

(22) تیل زمین سے نکلتا ہے

teyl zzameen=sey nekal-taa hay

oil-*sg-masc*=*nom* earth=*spatial* come out be.*pres*

The oil comes out from the earth.

J. Temporal Case

The nouns representing 'time' in Urdu are known as temporal nouns, and when these accompany marker *sey*, they represents temporal case as shown in (23) and (24). These are translated in English by using prepositional phrases 'since' and 'for'.

(23) وہ صبح سے مقالہ لکھ رہا ہے

woh SobaH=sey maqaalah lekh rahaa hay

He/She=*nom* morning=*temporal* paper=*nom* write

He is writing a paper since morning

(24) وہ دو دن سے تمہارا انتظار کر رہی ہے

woh dao den=sey tomhaaraa aenteZaar kar rahee hay

He/She=*nom* two days=*temporal* your=*nom* wait

She has been waiting for you for two days.

Lexical Entry:

```
sey     (↑ CASE) = temporal
        (↑ N-SEM N-CONCEPT) =c temporal
        (OBL-sey-temp ↑)
```

K. Source Case

(25) کتاب سے سبق پڑھو

ketab=sey sabaq paRhao

earth=*source* lesson=*nom* read

Read the lesson from the book

L. Adverbial Case

The nouns representing 'concepts' in Urdu are known as conceptual nouns, when these accompany marker '*sey*', they represents conceptual or adverbial case as shown in (26)

(26) وہ جلدی سے سکول پہنچی

woh jaldee=sey pohanch-ee

He/She=*nom* hurriedly=*adverbial* reach

She reached school hurriedly.

(27) ظفر شوق سے سبق پڑھتا ہے

Zafar shaoq=sey sabaq paRh-taa hay

Zafar=*nom* interest=*adverbial* lesson read be

Zafar reads the lesson with interest.

Lexical Entry:

```
sey     (↑ CASE) = adverbial
        (↑ PRED) = 'sey<(↑ OBJ)>'
        (↑ P-CASE) = OBL-sey-adv
        (ADJUNCT ↑)
```

M. Infinitival Case

This uses infinitives marked with case marker '*sey*':

(28) اسے پڑھنے سے نفرت ہے

aosey paRh-ney=sey nafrat hay

He/She=*acc/dat* read=*Inf* hatred=*nom* be.*pres*

He/She has hatred for reading

(29) مجھے گرنے سے چوٹ لگی

mojhey ger-ney=sey chaoT lag-ee

I=*acc/dat* fall=*Inf* injury=*nom* touch

I got injury from falling.

Lexical Entry:

```
sey     (↑ CASE) = infinitive
        (↑ PRED) = 'sey<(↑ OBJ)>'
        (↑ P-CASE) = OBL-sey-inf
        (ADJUNCT ↑)
```

N. Comparison Case

The data given in the following sentences (30) and (31) shows that '*sey*' marking in declarative or indicative sentences is also used to show comparison of two nominals.

(30) یہ جوتا اس سے بہتر ہے

yeh joohaa aos=sey behtar hay

this shoe=*nom* that.*pro*=*comp* better be.*pres*

This shoe is better than that.

(31) ظفر مظفر سے بڑا ہے

Zafar moZafar=sey baRaa hay

Zafar=*nom* Mozafar=*comp* bigger be.*pres*

Zafar is bigger than Mozafar.

Lexical Entry:

```
sey     (↑ CASE) = comparison
        ((OBJ ↑) SUBJ N-SEM N-CONCEPT) =
          ((OBJ ↑) OBJ N-SEM N-CONCEPT
        (OBJ ↑)
```

III. CAUSATIVES

In Urdu-Hindi, morphological formation of causatives exists for many verbs. There are two causative forms in Urdu-Hindi. We refer to them by numbers 1 and 2. Causative form 1, is formed by adding suffix -aa to the stem form of the verb. It requires that the causee is in accusative case marked with case marker 'kao'. Causative form 2 is formed by using suffix -waa to the verb's stem form. The causee is required in agent case marked with case marker 'sey'. There are examples (32) to (35) taken from [5], which show that accusative is compatible with causative form 1, while agent is associated with form 2.

(32) انجم نے صدف کو/*سے کھانا کھلایا

aanjom=ney Saddaf=kao/*sey khaanaa khel-aa-yaa
Anjum=*erg* Saddaf =*acc/*agent* food.*nom* eat.*caus1*
Anjum made Saddaf eat food (gave Saddaf food to eat).

(33) انجم نے صدف* کو/سے پودا کٹوایا

aanjom=ney Saddaf=*kao/sey paodaa kat-waa-yaa
Anjum=*erg* Saddaf=*acc/agent* plant=*nom* cut.*caus2*
Anjum had Saddaf cut a/*the plant.

Causative form 1, *kat-aa-yaa*, is also sometimes used to mean the same semantics, but actually it does not exist, because 'cut' is not an action which can take an accusative.

(34) انجم نے صدف کو مصالحہ چکھایا

aanjom=ney Saddaf=kao meSaalHah chakh-aa-yaa
Anjum=*erg* Saddaf=*dat* spice=*nom* taste.*caus1*
Anjum had Saddaf taste the seasoning.

(35) انجم نے صدف سے مصالحہ چکھوایا

aanjom=ney Saddaf=sey mesaalaa chakh-waa-yaa
Anjum=*erg* Saddaf=*ag* spice=*nom* taste.*caus2*
Anjum had Saddaf taste the seasoning.

There is a lot of semantic difference in the meanings of sentences (34) and (35). In (34), it is the Anjum who is performing bulk of steps involved in the process of taste. It is Anjum who picks 'gravy' from the pot, say in the spoon, and even it is anjum who is putting that gravy in the mouth of Saddaf, while Saddaf just tastes a thing being put into her mouth. While in (35), Anjum has just ordered or requested Saddaf to do the whole job of 'taste the seasoning'. Anjum has initiated the action but not involved directly in any of the steps of action 'taste'. The person who tasted the seasoning could be Saddaf herself or someone else. Thus the argument structure of verbs is as follows:

chakh-aa-yaa `<SUBJ, OBJ2, OBJ>`
chakh-waa-yaa`<SUBJ, SUBJ2, OBJ2, OBJ>`

Such a verbs of causative forms 2 in Urdu-Hindi, which take two objects with an animate noun marked with 'sey'. We argue that they appear functioning as tetravalent verbs due to following reasons:

1. Noun marked with 'sey' is not optional; if it is missed it is implied.

2. Noun marked with 'sey' case is the actual actor or agent of action performed;
3. Noun marked with 'sey' is not actually an instrument, but is an animate noun having full capability to perform action itself;
4. Noun with ergative case marked with 'ney' causes someone, forcefully or by request, to perform action but is not the actual actor of the action performed;

In addition to causer and causee nouns phrases, two more noun phrases are involved in the action, one indirect object in dative case and one direct object. Thus tetravalent verbs have four noun phrase arguments directly controlled by one verbal predicate. These arguments of verb are shown in Table 1.

TABLE 1
ARGUMENTS OF A TETRAVALENT VERB IN (35)

Ergative NP	causer/ initiator	subject
Agent NP	causee/ agent	indirect subject
Dative NP	beneficiary	indirect object
Nominative NP	object	object

(36) ماں نے باپ سے بچے کو کھانا کھلوایا

maaN=ney baap=sey bachch-ey=kao khaanaa khel-waa-yaa
mother=*erg* father=*ag* child=*dat* food=*nom* eat.*caus2*
The mother caused (asked, requested) the father to give food to the child.

Thus for the sentence having tetravalent predicate shown in (36), *khel-waa-yaa*, we can distinguish four noun phrases as shown in Table 2:

TABLE 2
ARGUMENTS OF A TRIVALENT VERB IN (36)

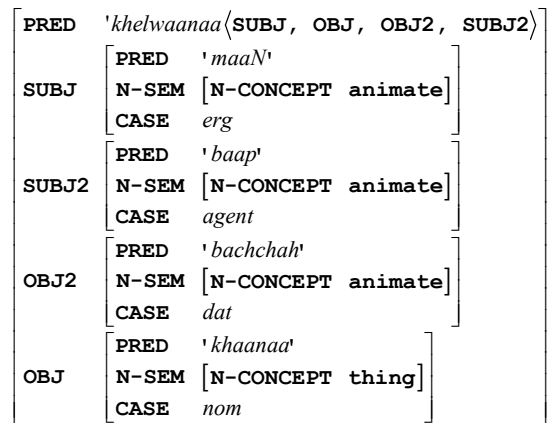| subject	causer	*maaN=ney*	mother=*erg*
indirect subject	causee	*baap=sey*	father=*agent*
indirect object	beneficiary	*bachch-ey=kao*	child=*dat*
object	object	*khaanaa*	food=*nom*

Fig. 1. Feature Structure of Tetravalent Verb

(37) ماں نے چمچے سے بچے کو کھانا کھلایا

maaN=ney chamchey=sey bachch-ey=kao khaanaa khel-aa-yaa

mother.*erg* spoon.*inst* child.*dat* food.*nom* eat.*caus1*

The mother gave the food to the child by using spoon

However for the sentence (37) having same construction and same case markers with trivalent predicate, *khel-aa-yaa*, we can distinguish four noun phrases as shown in Table 3:

TABLE 3: ARGUMENTS OF A TRIVALENT VERB

subject	agent	*maaN=ney*	mother.*erg*
adjunct	instrument	*chamchey=sey*	spoon.*inst*
indirect object	beneficiary	*bachch-ey=kao*	child.*dat*
object	object	*khaanaa*	food.*nom*

The noun: spoon marked with '*sey*', cannot be the agent performing the action, it is not animate to perform the action on its own, it can only be used as an instrument. The mother is the actual performer of the action, making child to eat foot. The spoon is used by the mother to perform the action. The instrumental argument 'spoon' is optional, and therefore not controlled by the predicate and act as an adjunct.

khel-aa-yaa **<SUBJ, OBJ, OBJ2>**

khel-waa-yaa **<SUBJ, SUBJ2, OBJ, OBJ2>**

```
sey  (↑ CASE) = agent
     (^ N-SEM N-CONCEPT) =c animate
     { {((SUBJ2 ↑) V-VAL) = 3
      |((SUBJ2 ↑) V-VAL) = 4}
       ((SUBJ2 ↑) V-FORM) = Caus2
       (SUBJ2 ↑) }
```

```
┌ PRED      'khelaanaa⟨SUBJ, OBJ, OBJ2⟩              ┐
│          ┌ PRED    'maaN'                 ┐        │
│ SUBJ     │ N-SEM  [N-CONCEPT animate]     │        │
│          └ CASE     erg                   ┘        │
│          ┌ PRED 'sey<OBJ>'                       ┐ │
│ ADJUNCT  │       ┌ PRED    'chamchah'          ┐ │ │
│          │ OBJ   │ N-SEM  [N-CONCEPT instrument]│ │ │
│          └       └                             ┘ ┘ │
│          ┌ PRED    'bachchah'             ┐        │
│ OBJ2     │ N-SEM  [N-CONCEPT animate]     │        │
│          └ CASE     dat                   ┘        │
│          ┌ PRED    'khaanaa'              ┐        │
│ OBJ      │ N-SEM  [N-CONCEPT thing]       │        │
│          └ CASE     nom                   ┘        │
└                                                    ┘
```
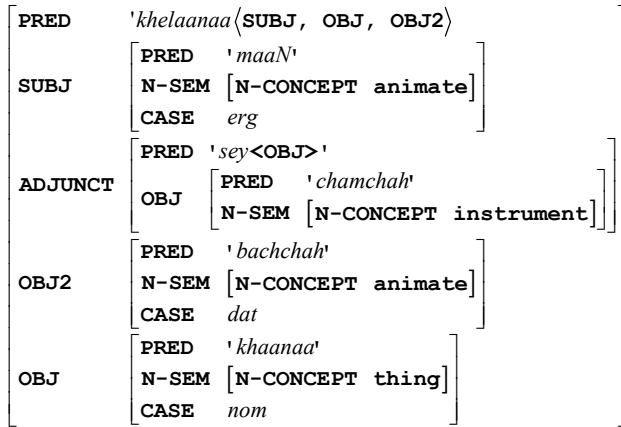
Fig. 2. Feature Structure of Trivalent Verb

The difference in the f-structures of trivalent and tetravalent verbs is shown in Fig. 1 and Fig. 2. For trivalent verb '*sey*' marks instrumental object as adjunct to sentence, while for tetravalent verb indirect subject is correctly picked for animate noun.

IV. CONCLUSIONS

We have used the LFG based formalism with semantic features of Urdu-Hindi nouns to classify various noun cases by inserting constraints on the lexical entries of case markers. The case marker '*sey*' is quite versatile and the use of semantic features presented in this paper is valuable in correct classification of noun phrases and for correct assignment of grammatical roles needed for verbal arguments. Moreover, this paper shows evidence and formalism of tetravalent verbs in Urdu-Hindi, which otherwise require two verbs in English and other languages for translation. For tetravalent verbs, which are termed as causative form 2, the novel notion of '*indirect subject*' is presented for the causee marked with '*sey*' which acts the actual agent of the action described by verbal predicate. The rule based formulation presented is valuable for various NLP tasks and especially for accurate machine translation between natural language.

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