A Semantic Logic for Noun Interpretation for Automatic Text Processing

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Abstract

The main object of this study is to offer a clue for semantic interpretation of nouns to facilitate automatic text processes. Unlike thematic roles lexically registered on verbs, the criterions needed to interpret nouns are not definable by distinctive features. Since nouns in same form can bear both generic and existential meaning, its interpretation rather depends upon logical reasoning. This paper starts with the assumption that nouns can bear generic meaning by themselves thanks to its double functions: Feature Set and Sum of individual objects. This means that bare singular or bare plural nouns are principle carriers of generic meaning if there is no hindering constraint. The determiners like articles, in this sense, play a role of semi-conductive barriers that may block the percolation of generic meaning on nouns to the upper projections. The relevant attributes that activate the barrier hood are \([\text{Predicate } \pm \text{ permanent}], [\text{Article } \pm \text{strong Numb, } \pm \text{limited Numb}], [\text{Time } \pm \text{confined}], [\text{Space } \pm \text{confined}].\) The combination of bare nouns with these features adjoined at syntax decides whether a noun properly bears generic meaning or not.

Keywords: generic meaning, existential meaning, noun, noun forms, cognitive

1. Introduction

Along with the fast development of IT, automatic languages translation is not a daydream any more. This has been one of the most attractive topics for long time in artificial intelligence. And unprecedented hardware evolution, which is still on going, makes phrase-to-phrase type translation possible. But this kind of translation seems to be long away from that a machine understands meaning. As hardware is getting faster and stronger, phrase-to-phrase translation may be a possible solution but it seems not so ideal. Even though it is possible to file up all sorts of possible phrases of target languages in forms of database to select one of them, it is required an interpretation tools that determine the meaning of phrases by machine itself. This is the main motivation of this paper. And to see its possibility, this paper begins with tackling how determine the meaning of nouns.

A noun can refer, inherently, a kind (generic meaning) or a reference (existential meaning). However every each language has its own way of referring them. For some languages such as English and French noun forms and the articles play a large role to while many other languages, like Chinese and Korean, do not rely neither on articles nor forms of nouns. But refereeing a kind or a reference are universal properties of nouns sharing across languages. I believe it is possible to build a semantic logic for the nouns interpretation, which can be applied language universally, with a very simple but redefined concept of totality. In this paper, I assert that not only generic but also existential meaning can be interpreted by redefined concept of totality.

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2. Observations

2.1. Data

Each language has its own way to express generic meaning. And each language has different noun system. Many Indo-European languages use articles before nouns while Asian languages such as Chinese and Korean do not have articles. Generic meaning is kind referring that indicates all and every members belonging to the noun in question. Existential meaning is object referring that indicates one or some individual objects belonging to the noun. Nouns express these two meanings but their forms are different from language to language.

(1) a. The dog / A dog/ Dogs /*Dog is(are) a faithful animal. (English)
b. Le chien/ Les chiens/ *Un chien/ *Chien/ *Chiens est(sont) le meilleur ami de l’homme. (French)
c. O menino/ Os meninos/ *Um menino/ Menino/ Meninos não pode(podem) entrar aqui. (Portuguese)
       boy not can enter here
d. El leopardo/ Los leopardo/ *Un leopardo/ *Leopardo/ *Leopardos es fácil de domesticar. (Spanish)
       c. Il cane/ I cani/ *Uno cane/ *Cane /Cani amano giocare. (Italian)

(2) a. Ren/ *ren-pl shi yiding yao side. (Chinese)
       man is mortal
b. saram-eun/saram-deul-eun jukki mareyn-i-da. (Korean)
       man-subject particle/man-plural marker-subject particle die
c. bemegtei /emegteičüüd ni yer ni čalčaa baina. (Mongolian)
       woman/ women are talkative.
d. hitowa/hitobitowa sinu monoda. (Japanese)n n
       man/ men are mortal

As it is shown here, generic meaning is expressed in different forms of nouns even in a language. The following Table 1 shows possible noun forms to bear generic meaning for each language.

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This table suggests that absence or presence of some functional items like articles are not relevant to express generic meaning. As it is shown above, the presence of articles is not compulsory requirement for nouns to express generic meaning. Asian languages have no problem to form generic meaning without any help of articles. Furthermore, Asian languages do not show any physical difference in noun forms bearing generic and existential meaning. This makes us conclude that a noun itself as bare form has the capability of expressing equally generic and existential meaning.
2.2. Two Basic Logics for Forming Generic Meaning

Nouns have two inherent functions: name and reference. It is believed that these two functions come from inherent features of nouns. Since it is a set of common features of the noun, it represents all and every members belonging to the noun in question and it cannot be pluralized. A noun as a name is a set of features that noun has. It is an abstract concept that only a noun in this case represents all and every nouns that have same properties exists in our mind. However, in this real world, substance nouns fall into this case. It is very natural that substances cannot be pluralized nor divided because it is a set of features that define them.

A noun as a reference is an individual object that is concrete and exists in this real world where we live in. Since it is a concrete individual object, its pluralization is possible. Under this approach, generic meaning of a noun can be expressed by one of following two ways, which means all members of the given noun, namely $\forall(x)$.

(3) \hspace{1cm} a. Noun(α)=$\{ \phi_{α1} \ldots \phi_{αn} \}$

b. Noun(α)=$\{ α_1, α_2 \ldots α_n \}$

If a noun is considered as a set of features, it represents conceptual NOUN by virtue of (3a). And its form should be singular because a set of common feature cannot be added or divided. This is especially true with material nouns. In above-mentioned languages, material nouns bear generic meaning in singular form without exception.

One another strategy to bear generic meaning is summing up all members of individual objects belonging to the noun as shown as (3b). When this option is chosen, the only possible form is plural because it is the set of objects not of features.

3. Constraints on Semantic Interpretation of Generic Meaning

3.1. Predicate Types

First of all, the types of predicate are taken into consideration. According to Diesing(1992) predicates are distinguished into two different types: stage-level and individual-level predicates. What makes them different is [+permanent] feature. According to the study, predicates with [+]permanent feature are individual-level predicates and their subjects have generic meaning. And predicates with [-permanent] feature are stage-level predicates and their subjects bear existential meaning.

(4) \hspace{1cm} a. [The dog] hates the cat.

b. [The dog] is barking all night.

Here, although the forms of nouns at subject position are identical, the first in (4a) is read with generic meaning while the second in (4b) should be read with existential meaning. This difference comes from the different property of predicates. This dichotomy is applicable to all natural languages.

3.2. Blocking Effect of Articles

The reason why some languages have articles while some others do not is not relevant here to our discussion. We simply adopt the Nominal Mapping Parameter of Chierchia(1998) according to which English and Romance languages have article while Asian Languages like Korean, Chinese have not. As it is argued above that nouns can bear or carry generic meaning by nature, articles are regarded as semi-conductive projection that may or may not percolate the semantic properties of nouns. In the light of syntactic theory, when a noun comes with an article, the projection which enters into the semantic interpretation is DP not NP because it is DP that occupies argument position.
The semi-conductive character of DP is determined by [+strong Numb]. Roughly if articles have singular and plural forms, they are considered as having [+strong Numb] feature. On the other hand, if they have only one fixed form, their number feature is considered as [-strong, +weak]. The articles of Romance languages have [+strong Numb] feature. The English articles, by contrast, have [-strong Numb] feature.

If number feature is not strong enough, it is not possible to take (3b) to get a noun bear generic meaning because sum should be always plural. As English articles have [-strong Numb] feature, the plurality of a noun as sum is not compatible with its higher projection DP. In this case the English articles function as delimiters. Contrary to English, articles of Romance languages permit plural noun forms bearing generic meaning because they have [+strong Numb] feature compatible with the concept of sum.

(5)  
   a. The dog/ *The dogs hates the cat.  
   b. Le chien/ Les chiens haitent les chats.

On the contrary to the definite articles, indefinite articles behavior differently vis-à-vis bearing generic meaning of singular nouns. When a singular noun bearing generic meaning is considered as a set of features shown in (3a), singular form of definite article does not block a noun bear generic meaning regardless of its status of number feature.

However, a singular noun as an individual object can be interpreted as having generic meaning in English especially accompanied by an indefinite article.

(6)  
   A dog is a faithful animal.

Here, a dog does not indicate just one dog but all and every dog instead. Lee(2012) explains this is possible thanks to metonymy process of human cognitive ability. And metonymy of a noun is allowed only when it is not specified and limited. If articles have [+strong Numb], expansion from an object to all objects is blocked because they determine and limit the quantity of nouns in specific numbers. In (6), the indefinite article a has [-strong Numb] feature, which does not limit the numbers and does not block metonymy process.

3.3. Individualizers

In the languages that do not have articles, generic meaning will be saturated not only by bare singular but also by bare plural nouns since there are no eventual operators that might block percolation of generic meaning. The most exemplary case of this is found in Korean where bare singular and bare plural nouns bear generic meaning in individual-level predicates.

(7)  
   saram-eun/saram-deul-eun jukki mareyn-i-da.  
   man-subject particle/man-plural marker-subject particle die

Chinese and Korean consider all nouns as substances like material nouns. Since Chinese has no plural morpheme, generic and existential meanings are always expressed in a same singular form. But unlike Chinese, Korean has plural morpheme and not only generic meaning but also existential meaning is expressed both in singular and plural form. Plural morpheme has function of individualizing transforming substances into objects. Then it can be said the bare singular noun in (7a) is a set of features related to the noun and the bare plural noun in (7b) is the sum of all members belonging to the noun.
3.4. Expansion from Generic to Existential Meaning

Generally, nouns at subject position, precisely external argument position, of individual-level predicates are generically interpreted. However, this position can bear existential meaning.

(8)  
   a. Medical cares are available.
   b. Dogs hated cats.

In (8a) medical cares can receive existential and generic meaning according to contexts. It is because English copular be has [± permanent]. However, predicate feature of hated in (8b) is undeniably [+permanent]. But it is a little bit complicated to say dogs and cats here represent all members of them because they are subsets of the whole in the light of timeline.

This question can be solved without modification of the previous assumption about the double functions of noun by introducing a concept of confinement [±confined] to the TIMELINE t.

(9)

Bare plural nouns in (8) receive generic meaning first. But this reading is confined only a given moment \( \{t' - t''\} \) in the whole timeline t. In the sense that a noun is considered as its all and every members, it bears generic meaning. By the way, the existence of all members is confined in a given moment, the all members at the given moment turns into subset of the all members of non-confined moment. In short, existential meaning can be reinterpreted as a variation of generic meaning that can be understood like (10):

(10)  \( \forall(x) = \exists(x)\text{ at } t(y) \)

If time t is not confined, timeline is unlimited. Therefore nouns with generic reading in unlimited timeline are the set of its features or set of its all members. This is the case of the present. Since the present includes some scopes of the past and the future, its time property is not confined neither limited.

(11)

From these observations, it is possible to say that existential meaning is no more than a limited interpretation of generic reading in relation with time property.

One another condition comes to mind, however, is SPACE. There are cases where nouns in capable forms of bearing generic meaning are interpreted as total and existential at the same time.

(12)  
   a. I read the magazines at bank yesterday.
   b. My mom threw away all my stuffs on my desk.

Here, as predicates are stage-level ones, nouns at object position cannot be interpreted as referring all members of the nouns in question. Despite of natural existential reading on nouns at object position, it should be explained how these nouns can indicate the totality.
To answer this question, it is necessary to propose \([\pm\text{confined}]\) to the SPACE. Totality in question can be written like (13):

\[
\forall(x) = \exists(x) \text{ at } S
\]

Here, totality is substituted once again by all. Since definite articles can delimit the scope of nouns, they serve also as a space operator same as locative phrases.

### 4. Noun Interpretation Flow

From the observations above done, the distinctive features relevant to generic reading are classified like followings:

(14) Predicate: \([\text{predicate } \pm \text{ permanent}]\)

Article: \([\text{Article } \pm \text{strong Numb}], [\pm\text{limited Numb}]\)

These features are registered in lexicon. If predicate is marked with \([+\text{permanent}]\) at lexical level, it assigns generic meaning to argument positions. And each language should pick up proper forms of nous to bear generic meaning. As it is discussed above, generic meaning is expressed in two ways in natural languages: feature set and summing up all members. If there is no additional constraint, namely if there is no article, bare singular or bare plural nouns inserted at lexicon are, at least theoretically licensed at final strings as a good output.

But if nouns are accompanied articles, their features must be checked whether they allow appearance of singular or plural nouns at final strings. This process includes two steps: checking \([\text{Article } \pm \text{strong Numb}]\) feature and checking \([\pm\text{limited Numb}]\) of articles.

Following diagram shows decoding flow of generic meaning with relevant noun forms according to the languages observed in this paper.

**Figure 1. Decoding Module of Generic Meaning**
Above flow shows the all-possible output forms of nouns that bear generic meaning across the languages. Nouns forms passed through above decoding module of generic meaning should go through another component where Nominal Mapping Parameter is applied. It is this component that only allowed noun forms are filtered out among possible forms according to particular language.

Once decoding generic meaning is finished, the output goes through a converting module, which checks if generic meaning changes into existential meaning in the light of [±confined] feature of TIME and SPACE. If one of them is confined, the output bearing generic meaning turns into total numbers of the noun at a specific time and in specific place.

5. Conclusion

Lexical features cannot define generic meaning of nouns because a same lexical item bears both generic and existential meaning. It is the reason why decoding logic of generic meaning is necessary for automatic text process. This paper shows what are the relevant lexical and functional features that enter into semantic decoding of nouns: [Predicate ± permanent], [Article ± strong Numb], [±limited Numb], [Time ±confined]. Generic meaning and existential meaning are interpretable by combination of these features, which are definable in lexicon. The distinctive features and logics presented in this paper, however, do not treat the confinement property of definite articles. This remains open in this discussion.

References

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