An Approach to Non-Singular Terms in Discourse

Tomek Strzalkowski

School of Computing Science
Simon Fraser University
Burnaby, B.C., CANADA
V5A 1S6

Abstract

A new Theory of Names and Descriptions that offers a uniform treatment for many types of non-singular concepts found in natural language discourse is presented. We introduce a layered model of the language denotational base (the universe) in which every world object is assigned a layer (level) reflecting its relative singularity with respect to other objects in the universe. We define the notion of relative singularity of world objects as an abstraction class of the layer-membership relation.

1. Introduction

Linguistic (and related) literature describes numerous forms of non-singular concepts that can be found in discourse including intensional (or functional) concepts, mass concepts, generic (or general) concepts, attributive concepts, abstract concepts, etc. [1], [2], [3], [4], [6], [10]. Not all of these approaches could properly capture the distinction between singular and non-singular interpretation of linguistic descriptions, and some were originally devised to deal with singular terms only (such as Donnellan's attributive interpretation of definite descriptions [2]). With the exception of intensional concepts, these notions have not been given satisfactory formal representations that would account for their role in natural language discourse. Perhaps the most successful approach to non-singularity thus far has been presented by Montague [4] with his formalised concept of intension. Unfortunately, the concept of intension does not capture all aspects of non-singularity, and the rigid translation system into intensional logic [4] seems to loose the important aspect of subjectivity in interpreting natural language discourse. Also, the enormous complexity of any non trivial system of possible worlds proved to be a bar in developing a computationally-oriented application of Montague's theory.

In this paper we introduce a fragment of a new, and as we believe, computationally feasible Theory of Names and Descriptions that offers a uniform treatment for many types of non-singular concepts found in natural language discourse. Although we limit our presentation to nominal phrase constructions, the approach can be further extended to cover other types of phrases. In our theory we present the formalised definition of non-singularity with respect to a particular discourse situation involving a discourse message, a number of individuals (parties), and their knowledge, beliefs, awareness, etc. We introduce a layered model of reality (the universe) as perceived by a discourse participant, and define the notion of relative singularity of objects in this universe as an abstraction class of the layer-membership relation. Subsequently, linguistic descriptions and names are classified as singular, measurably singular, or non-singular depending on what they are assumed to denote in the universe. The relationship between objects addressed in discourse and classified into different layers (levels) of the universe has a particular significance for resolution of certain types of cohesive links in text. We call these links **remote references** because they cross level boundaries.

2. Non-singular terms in language

Many philosophers and logicians, see [1]-[4], [6], [10], appreciate that the usage of the underlined nominal phrases in the following sentences has a "general" or "generic" character, except for "regular" singular interpretations which are possible only in some cases.

Example 1

(1a) The king *wears a crown.*

(1b) The president *is elected every four years.*

(1c) Gold *is a yellow metal*

(1d) The temperature *is a measure of molecular motion.*

One can imagine hundreds of similar examples involving such non-singular objects as *water, heat, the Pope, the number* etc. Unfortunately, there is no commonly accepted account of these species in philosophical literature. Some authors, see [1] and [10], cautiously called them *generic*, or *general* (for example *the king)*, or *functional* (such as *the number of students, the temperature)* uses of (definite) descriptions. Others, like Kripke [3], were quite close to consider them names (or at least some of them: *heat gold)*. Yet others, see Quine [6, 7], advocate the notion of *abstract terms* as being made of attributes, such as *[being] red* (further abstracted as *redness)*, or *[being] the man drinking the martini* (which cannot be so easily nominalized) which can predicate about "concrete" objects.

There are numerous striking linguistic puzzles involving non-singular definite descriptions, see [1], [4], [5]. The following example illustrates the phenomenon.

Example 2

Consider the following inferences:

(2a) *The temperature is rising.*
The temperature is ninety.

so, *Ninety is rising.*

(2b) *The president met the Soviet leader many times.*
The president is Reagan.

so, *Reagan met the Soviet leader many times.*

(2c) *The tiger lives in the jungle.*
My pet is a tiger.

so, *My pet lives in the jungle.*

The conclusions in (2a) to (2c) are wrong in general case. The explanation given by numerous researchers chiefly amounted to the corroboration that the definite descriptions *the temperature, the president* and *the tiger* in the first sentences of (2a), (2b) and (2c) respectively should be interpreted functionally, i.e., as intensions [4], or functions over situations [1]. Observe that if the descriptions were to be interpreted singularly or as enumerating all instances of a non-singular object (i.e., statements containing them were understood as making claims about each instance), the reasoning would be sound. We claim that unless some two descriptions (or names) are used **singularly** or **measurably singularly** at the **same level** no simple reference can be made between them. In fact, another type of reference that we call **remote reference** can still take place and we shall put this view forward in this paper.

3. The Theory of Names and Descriptions

Initially let us observe that our language deals with singular objects only, no matter how complex their structure happens to be. Suppose somebody is being put into position of the Observer who perceives all these objects and has to use his language to describe them. Some objects are sharply distinguished from others so he chooses to give them names as *John, Mary, Fatsy, Sun, ...* The others have no clearly perceivable boundaries but he still may name them: *tea, water, grass, snow, ...*, and then refer to some measurable quantities of them as *some tea, little snow*, etc. Yet others appear to be numerous, though enumerable, displaying strong similarities to one another. It would be pointless for Observer to give them each a name. Instead, he decides to refer to them as *a cow, the man, this tree*, etc. Still, he prefers to say *the sun* or *the lake* rather than to invent new names if he is not sure how many of them are there, even if he is aware of just one specimen. Later he may find out that some objects were given identical names, so having encountered them together he must refer to one as *the John, the Sun*, or *a Fatsy*. Having completed his job Observer, who is also a part of this world, may name himself *Observer* or *the Observer*, and happily sit down under *a tree* on *the grass*.

Let us call the whole collection of objects he has just described as **the Observer level**, and use the symbol L_0 for it. Suppose then we ask Observer to tell us as much as he can about L_0. Soon he finds

out that his naming has its limits. As he discovers new facts about his world it becomes more and more cumbersome for him to communicate in terms of *every man, some cats, several trees, each president*, etc. He discovers that some things he originally considered distinct appear to be instances of some single object. Also he must admit that the identity of some other objects has to be put into question. Being smart enough, Observer invents two new levels, L_{+1} and L_{-1}, which augment his world. At level L_{+1} he places the new objects he discovered to be generalisations (or abstractions, if you like) of some measurable amount of objects from L_0 which displayed a striking similarity or even identity. From the perspective of L_{+1} he is able to tell us that *The tiger lives in the jungle*, that *The president is elected every four years*, and that *The Morning Star and The Evening Star are actually two appearances of the planet Venus*. The objects at L_{+1} are singular there, but they appear "generic" or "functional" or whatever of that sort as seen from L_0. Observe that these objects may not have straightforward measurably singular descriptions at L_0 (like *every tiger, some president*, etc.), and often it will not be possible to refer to them in the terms of the language available at L_0. In either case one may expect that some undescribable aspect of an L_{+1} object can emerge at L_0, even if they all have been derived from L_0 (which does not have to be the case). Next, Observer invents a new generation of names at L_{+1}, *the president* and *the tiger* may be among those names. On the other hand, Observer might prefer to use definite descriptions here, for the similar reason he frequently decided so at L_0. In fact, we have no means to distinguish between names and definite descriptions in discourse. We can only stick to linguistic conventions.

It probably would not take a long time before a new augmentation for L_{+1} becomes necessary. Two new levels L_{+1+1} and L_{+1-1} can be added in a much the same fashion. The level L_{+1-1} does not necessarily have to be L_0, although it probably will. More or less the same happens at the level L_{-1} where Observer can now say that what he previously considered to be *the atom* actually denotes many different kinds of atoms (H, O, Ca, Fe, etc.), that *tea* is not so uniform and many different teas can be found, and that under the name *Joe Smith* was actually hidden a group of crime story writers. Subsequently the level L_{-1} will expand by L_{-1+1} and L_{-1-1} with the former often different than L_0. Let us now formalize our intuition.

Definition 1
A use of a description will be called **singular** if it denotes or refers to a singular object. A use of a description will be called **measurably singular** if it denotes or refers to some measurable quantity of a singular object. Otherwise we shall talk of **non-singular** use.

Definition 2
A **level** will be an arbitrary collection of singular objects. A **level language** will contain these and only singular and measurably singular uses of descriptions communicating of the level objects.

Definition 3
For any level L_n, all names appearing in the L_n language have singular interpretations.

Definition 4
For any level L_n there will be at least two distinct levels L_{n-1} and L_{n+1} such that L_{n+1} contains the non-singular objects as seen from L_n, and L_{n-1} contains the objects for which the objects at L_n are non-singular.

Definition 5
The Observer level L_0 is an arbitrary chosen level serving as a reference point.

Suppose that we have an object **N** called N at level L_0. Let T be an arbitrary set we shall refer to as a *coordinate*. Suppose further that, for the coordinate T, the Observer discovers that the identity of **N** along that dimension can no longer be accepted. That is, there are at least two $x, y \in T$ such that **N** at $x \neq$ **N** at y. Without losing generality we can assume that the coordinate T has been chosen so that the following non-equation holds:

- $\forall x,y \in T.\ x \neq y.\ (N\ x) \neq (N\ y)$

Let $(N\ x)$ denote an object $\mathbf{N}_x$ for some $x \in T$. The Observer cannot place $\mathbf{N}_x$'s at L_0 without violating definitions 2 and 3. Instead he moves them onto a new level $L_{-1}^{N,T}$ leaving the original object **N** at L_0. **N** may be no longer a "real" object but the concept remains in language. $L_{-1}^{N,T}$ can be attached to any existing level provided that the definitions 1 to 4 will never be violated. It can also give a beginning to a new level. Note that the distribution of **N** over the coordinate T forces other objects from L_0 to be distributed over T as well, and their instances placed at $L_{-1}^{N,T}$. This process may remain mostly implicit until we make an utterance relating $(N\ x)$ to other objects at $L_{-1}^{N,T}$. In general, we shall say that the level $L_{-1}^{N,T}$ is *lower* than the level L_0, and write $L_{-1}^{N,T} < L_0$. Often we shall drop the superscripts N and T over the level symbol assuming some lower level L_{-1} whenever it does not lead to ambiguity. Observe that with the above account the level structure of objects has a dynamic, ever-changing character. Any new empirical fact to be added to our world knowledge bears a potential reveberation in the level structure involving creation of new levels and moving objects between levels. At probably non-frequent idle states the definitions 1 to 4 assure the structure balance.

Moving at level L_{-1} the Observer is aware of an enumerable collection of different objects $\mathbf{N}_x$'s. Extending the description used for **N** over $\mathbf{N}_x$'s the Observer refers to them as *the N, a N, some N(s), every N*, etc. It is possible, of course, that some other object **N**′ found at L_0 is now disclosed to be an $\mathbf{N}_y$ for some $x \in T$. What that means is that we have wrongly placed **N**′ at L_0, because it actually belonged to L_{-1}. But this was right at the time **N**′ was placed there, i.e., it mirrored the state of our knowledge of the world at the time. We may now give names to some $\mathbf{N}_x$'s and **N** can very well happen among them. This time however **N** will not denote the old object from L_0; this will be actually quite a different name referring to one selected $\mathbf{N}_x$, and which may be replaced by a definite description of $(N\ x)$.

On the other hand, suppose we have some objects $\mathbf{N}_1, \mathbf{N}_2, \ldots$ considered distinct at L_0. Suppose then that we discover some resemblance between them along some dimension (coordinate) T, so that we need a generalizing concept to talk about them. We climb to some *higher* level $L_{+1}^{N,T}$, i.e. $L_0 < L_{+1}^{N,T}$, and establish a new object, a superobject, **N** there. Now as seen from $L_{+1}^{N,T}$ all $\mathbf{N}_i$'s are just the occurences of **N** at L_0 at different values of coordinate T. In other words, the following equation holds:

- $\forall i\ \exists x,\ x \in T.\ (N\ x) = N_i$

Observe also that all $\mathbf{N}_i$'s now belong to the level $L_{+1-1}^{N,T}$ which is a part of L_0. As before we shall drop superscripts N and T for simplicity. No matter how we name **N** at L_{+1} the following **Formula of Discovery** summarizes our action:

(FD) $\forall x \forall y.\ x,y \in T.\ (N\ x) = (N\ y)$

Remember that the formula FD is valid only when observed from L_{+1}. At L_0, $\mathbf{N}_i$'s remain distinct, traditionally - so they remain distinct in the language as well. The generalisation of other objects from L_0 onto $L_{+1}^{N,T}$ may follow but, as in the case of decomposition discussed above, the process will remain largely implicit. Once the superobject **N** has been created it begins to live its own life. Some new objects from L_0 different than $\mathbf{N}_i$'s, may now become instances of **N** at some not yet utilized values of coordinate T. Also, we may use descriptions $(N\ x)$ without caring whether they actually refer to any objects at L_0. The latter property of general terms which is widely discussed by Quine [6, 7] gets a formal explanation in our theory. It is important not to confuse a superobject with a set S of lower level instances over some coordinate T as we would obtain a measurably singular concept only. Instead, a superobject can be identified with the function N from T into L_0 such that whenever $s \in S$ then there is a $t \in T$ such that $(N\ t) = s$, and then extended arbitrarily beyond the set S.

Example 3
We have the following distinct object at some level L_0: **V** called Venus, **MS** called Morning Star, and **ES** called Evening Star. Upon discovery that they all are just occurences of the same planet we create a new object **V**′ named Venus at some level $L_{+1}^{V',T}$ and such that for some $x,y,z \in T$, where T is a time coordinate, $(V'\ x) = V$ $(V'\ y) = MS$, $(V'\ z) = ES$. According to the FD formula we conclude from L_{+1} that $V = MS = ES$, while the same conclusion made at L_0 is false.

Example 4
At level L_0 the Observer is aware of the object **TP** named The President. Let T be the time coordinate (different than in the last

example). At L_0 we have according to the FD formula that

- $\forall x \forall y,\ x,y \in T\ (TP\ x) = (TP\ y)$

Later the Observer may dicover that for some $t_1,\ t_2 \in T$, $(TP\ t_1)=N$ and $(TP\ t_2)=R$, and that at some level $L_1^{TP,T}$ where **N** and **R** belong, they are considered distinct and named Nixon and Reagan respectively. But at L_0, $R=N$ is true. The last observation can be made clearer if one imagines that **TP** is some abstract individual which (like Venus) when observed in early 70's is named Nixon, while when observed in 80's is called Reagan. □

Definition 6
An object **N** at a level L_n is said to be *remotely referenced* if the reference comes from some level L_m such that either $L_n < L_m$ or $L_m < L_n$

Typical cases of remote references in discourse have been listed in Example 2.

4. Superobjects

Let us now examine the nature of *superobjects* i.e., the objects placed at level L_{+1}. It turns out that the plural terms, e.g. *presidents, tigers*, etc., are actually prototypes of superobjects, see [6], and they should therefore be placed at the same level as respective superobjects. We will see that the generalization leads naturally to plural terms which may or may not induce equivalent singular superobjects. Conversely, a plural equivalent to a superobject may suggest the most natural coordinate to decompose the latter onto some lower level. When a superobject lacks a plural equivalent, however, we may admit that this object's origin has been traced down. A further decomposition is still possible but this process may often produce objects that will never assume an independent status and will remain recognized only as instances of this general concept scattered over that or another coordinate. This phenomenon is characteristic of the so-called *mass objects* and their corresponding *mass terms*. Quite naturally the question of where one level ends and another begins arises. The following example gives some insight into the problem of level boundaries.

Example 5
Consider the following sentences.

(5a) *Mary brings (some) water every day.*

Let *water* in (5a) be the name of some superobject w at the level L_{+1}. Presumably Mary brings only a part of w but we can say that w is being brought by Mary every day. This is the same w every day, although each time possibly a different part of it is in transit, which leads to the obvious translation (at L_{+1})

(i) $5a \rightarrow (br\text{–}e\text{–}d\ M\ w)$
where *br–e–d* stands for *brings every day*.

On the other hand, suppose that Mary brings some water every day. Except for the above interpretation, we also have the measurably singular reading at L_0 where w is scattered over some coordinate T so that $\exists t \in T$ such that $(w\ t)$ is being brought by Mary, i.e., $(\exists t\ (br\ M\ (w\ t)))$. This clause is, of course, relative to *every day* so at L_0 we could have

(ii) $5a \rightarrow (\forall x\ (d\ x) \supset (\exists t\ (br\ M\ (w\ t))))$ †
where *brings* $\rightarrow$ *br*, *day* $\rightarrow d$

Both translations are essentially equivalent, and this equivalence is by no means accidental. It lends a strong support for our Theory of Names and Descriptions, and explains the intuition underlying its formulation.

5. Conclusion

In this paper we presented a new approach to representing various kinds of non-singular concepts in natural language as the Theory of Names and Descriptions. The major observation of the Theory is that reality, as perceived by an intelligent individual, can be regarded as a partially ordered structure of levels such that each level contains only those objects which are considered relatively singular. Observe that there are virtually no restrictions imposed upon the notion of relative singularity so that the distribution of objects between levels of the world model may differ among different individuals. Non-singular objects, called superobjects, are placed at a number of higher levels which are related to the current level with various coordinates. Conversely, a singular object may be decomposed along a coordinate, and new objects, so obtained, will be placed at some lower level. This same coordinate can be used then to obtain instances of other objects at this lower level, so that the relative singularity of objects within each level is maintained. For more details concerning various aspects of the theory the reader is referred to [8] and [9].

† To be precise we should represent Mary as (M t) here, i.e., as an instance of the L_{+1} object M at some $t \in T$. However, our naming convention discussed in section 3 allows for replacing the definite description by a new name at the level L_0. We shall utilize this option here.

Acknowledgements

The author would like to thank Dr. Nick Cercone and Dr. Jim Delgrande for their comments and suggestions that helped to improve the quality of this paper. This research was supported in part by the Natural Science and Engineering Research Council of Canada under Operating Grant number A4309, by the Office of the Academic Vice-President, Simon Fraser University, and by the SFU's Open Graduate Scholarship. Thank the LCCR for use of facilities.

References

[1] Barwise, J. J. Perry (1983). *Situations and Attitudes*. The MIT Press.

[2] Donnellan, K. (1971). "Reference and Definite Descriptions." In D. D. Steinberg, L. A. Jakobovits (eds.), *Semantics*. Cambridge University Press, 100-114.

[3] Kripke, S. (1972). "Naming and Necessity." In D. Davison, G. Harman (eds.), *Semantics of Natural Language*. Reidel, Dordrecht, 253-355.

[4] Montague, R. (1974). *Formal Philosophy*. (R. Thomason, ed.), Yale University Press.

[5] Partee, B. H. (1972). "Opacity, Coreference, and Pronouns." In D. Davison, G. Harman (eds.), *Semantics of Natural Language*. Reidel, Dordrecht, 415-441.

[6] Quine, W. V. (1960). *Word and Object*. The MIT Press, Cambridge, Mass.

[7] Quine, W. V. (1973). *The Roots of Reference*. Open Court, La Salle, Illinois.

[8] Strzalkowski, T. (forthcoming). *A Theory of Stratified Meaning Representation*. Doctoral Dissertation, School of Computing Science, Simon Fraser University, Burnaby, B.C.

[9] Strzalkowski, T., N. Cercone (1985). "A Framework for Computing Extra-Sentential References." Proceedings of TANLU Workshop, Halifax, Nova Scotia, 107-116.

[10] Vendler, Z. (1971). "Singular Terms." In D. D. Steinberg, L. A. Jakobovits (eds.), *Semantics*. Cambridge University Press, 115-133.