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UNOBSERVABLES: WHY BOTHER?

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Abstract

This paper discusses the role of unobservable entities in scientific theories. The science used as example is linguistics. It is not one of the hard sciences and those in them may state that the problem of unobservables does not affect it. I think, however, that the use of linguistics is justified as there are fields in it that are natural sciences or at least closely approach them. I begin by discussing the positivists' strict distinction between theory and observation and what happens if a theory never goes beyond observation terms and generalizations over them. Then I turn to difficulties raised by this theory/observation distinction. It turns out that a) unobservables are necessary for construction of possible worlds that generate explanations and predictions, b) the distinction between observables and unobservables should be made. I adhere to M W Wartofsky's and R.Torretti's view of this distinction with the idea of possible worlds added. The paper ends with an appendix on the generative syntax entity PRO used as example in illustrating the adopted point of view.

Keywords: observables; unobservables; entity; generative grammar; "surface grammar"; PRO.

1. Introduction

One of the reasons for the diversity and progress of science is the underdetermination of theories by evidence. Each collection of evidence, be it a series of physical experiments or a corpus of texts, can

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be accounted for by a number of different theories. The most trivial of these would be a conjunction of all observation statements. Others would include so-called theoretical entities which, purely mathematical terms apart, appear to fall into three groups: 1) the “frictionless surface” group - the idealized case of things scientists actually deal with, the “average American family” group - entities that are obviously specially constructed to organize data, 3) the “electron” group - entities also referred to as “unobservables” because, although they manifest themselves, make our instrumentation click or whatever, they are out of the range of our unaided perception. Science can be looked upon as a data processing plant that feeds upon its own results, unobservables included. Therefore, their ontological status is unclear and their use in science needs justification.

The present discussions of the problem can be traced back to the failure of logical positivists’ radical measures to make science what they wanted it be - they assumed a distinction between observable and unobservable entities, observation and theory, and even between the so-called observation and theoretical languages to be clearly drawn and always readily available to establish the validity of a theory. Statements of the observation language were held to be verifiable directly and independently of the other statements of the theory. M. Magnus (Magnus 2001, 17) has recently tried to revive this position and invited linguists to reformulate their theories accordingly, claiming that no loss of explanatory power would occur.

One of the reasons why this reformulation is not advisable is that such restrictions are too powerful: they allow a theory a very narrow domain of application. Consider the following example that shows what happens if a purely observational framework tries to extend its domain of application. The purely observational theory used here is traditional grammar, the setting - its story in the Anglo-Saxon linguistic tradition.

Throughout the Middle Ages the only grammars relevant to education in England were those of Latin. They were dogmas to be learned and passed on to the next generation because the Latin language was thought to be ideal, its grammar was seen as a direct reflection of logic, if not logic itself. Until the end of the 16th century there were no grammars of English. But when Renaissance came, scholars recognized that English was worth describing and set out to write grammars of it. They soon realized, though, that they did not know how to proceed, and they used Latin grammars as models.

Now, Latin is a highly inflected language: it conjugates verbs and declines nouns. English, however, had already lost the bulk of its inflectional system by then. But those scholars were brought up to respect the grammars of Latin and remained faithful to them to the end, so they found in English all the grammatical categories found in Latin. They thought they were being logical, but in fact they were modeling one language on the pattern of another. What I would say happened was the following: an observational account of one language was used to make an observational account of another.

English and Latin are related languages - both are Indo-European, so some success in using Latin grammar for descriptions of English was achieved. A more interesting thing happened next.

Missionaries and other interested folks tried to use the same framework to describe native American languages. And here Latin grammar failed miserably. The necessity to radically revise the approach was noticed by F. Boas, one of the founders of American descriptive linguistics, who proclaimed that every language should be studied on the basis of its own categories. Taken literally, this would mean (it is not necessarily exactly the thing F. Boas meant) a separate theory for each language of the Earth. This approach might be useful for some purposes, but not for science because it makes comparison of languages problematic. This is where relying only on observation and taking a good observational account of one language for a framework for describing them all may take us. This is also the road positivism leaves open for linguistics.

1.1. Literature review

My story about grammar rests on the assumption that the distinction between theory and observation can be drawn, which is in no way certain. First, no one doubts anymore that all observation is theory-laden. Consequently, the existence of two languages in science and the priviledged status of observables an illusory (Churchland 1985, 36). Moreover, the distinction between observable and unobservable entities is obscure. G. Maxwell show that the difference between observable and unobservable entities is one of degree rather than of kind (some are more observable than others, and the degree of observability for those latter ones is changeable: with better instruments, you can detect more things by, for example, making them do something for you, like living tracks in the cloud chamber or making a counter click If observability and detectability are taken to define the same set, all unobservables will become observable sooner or later and the distinction is thus not of crucial significance (Maxwell 2000). J. Faye holds that there is no difference between observable and unobservable entities because "... the fact that perception of ordinary objects is as much theory-laden as observation of so-called unobservable objects seems to question the assumption that there is a genuine epistemic distinction buried in the differentiation of observable and unobservable entities" (Faye 2000, 172). A. Fine concludes that the meaning of descriptive terms is completely determined by the theory they belong to. On his view, theories are meaningful independent of observation, while observations are meaningless independent of theories (Fine 2000).

So shall we hold theory and observation as equivalent, mix observables and unobservables together as equally hopelessly theory-laden and forget the problem? P. Parrini notices that there is danger lying on this path, and this danger is circularity: if the difference between observation and theory is indeed abandoned, experimental and observational results will presupposed theories being tested and will themselves be presupposed by them. To a large extent science really is circular, and it is surprising how it produces valuable results. Part of the answer is probably given by the new experimentalism, the rest of it should lie elsewhere (Parrini 1995, 65).

2. Methods

In the study descriptive, analytical and comparative methods were used, as well as methods of linguo-cognitive, semantic and textual analysis.

3. Results & Discussion

It seems reasonable to a) somehow keep theory and observation, observables and unobservables apart, b) bear in mind that theories containing only observational terms have very narrow domains of application.

It seems that problem (a) cannot be solved once and forever. Rather, flexible guidelines can be suggested for setting the boundary in practically efficient ways. This is done in pragmatic approaches to the problem. For example, M.W.Wartofsky treats this problem as a methodological one; for him, observation and observability are framework-dependent, so that any predicates that are uninterpreted in a given framework can be taken as a basis for this framework: "... what happens to be taken as 'observable' already specifies a framework in which such observables serve as primitive terms" (Wartofsky 1968, 118-119). R. Torretti, who calls his point of view "pragmatic realism," agrees with this suggestion because "the distinction between means and goals is continually shifting from one context to another, so that any goal attained will be used sooner or later as a means, while most means have at some stage been goals" (Torretti 2000, 114). J. Faye would also support this point of view: a term functions as an observational term, whether it stands for something perceptible or not, if its application can be associated with certain canonical experiments and observational situations" (Faye 2000, 174). For a discussion of what it means for a practicing scientist, see I. Hacking (Hacking 2000, 280).

Now, why should clause (b) obtain? One possible answer could be the following. Scientists do not have direct access to the world, do not know what "things in themselves" are. What a scientist does is constructs a possible work that will make the state of affairs represented by observation and experiment follow logically from its basic structure. And this is where unobservables play a major role - they allow for the construction of a possible world that causes the data. The view that the function of unobservables is causality has been formulated, for example, by R.J. Connel. He goes on to say that in this sense unobservables are more basic to science than observables (Connel 2000, 10-11).

As humans have biological limitations and their thinking is largely aided and constrained by language, their theories remain unconnected with the actual world. Compare B.van Fraassen:"Science is a biological phenomenon, an activity by one kind of organism which facilitates its interaction with its environment" (van Fraassen 1980, 30). Each theory is true in the possible world it models; this work may, but does not have to, be the actual world. H. Putnam (as cited by J.R Brown) would say that it has to be the actual world, otherwise the success of science would be a miracle (Brown 2000,

301). But this point of view runs into a serious problem noticed by A. Fine: "... to argue for realism one must employ methods more stringent than in ordinary scientific practice [...] For realism, this must connect theories with the world by way of approximate truth. But no such connections are observable, hence, suitable as the basis for an inductive inference […] ... realism commits one to an unverifiable correspondence with the world" (Fine 2000, 290).

As both the actual world and the possible world account for the given evidence, we may take them to be identical or the same until we come across evidence obviously provided by the actual world (and surely some other possible world, too), but not accounted for by the possible world that has served us until this moment. The necessity of theory change arises and a new possible world is constructed.

Any possible world thus constructed accounts not only for the experimental evidence in question, but also for many other related phenomena other possible states of affaires. In other words, a theory's predictive and explanatory power comes from the fact that it is part of a possible world that is larger than one state of affaires. Now, a framework using only observational terms and generalizations over them is good for only one state of affaires (traditional Latin grammar is a true description of the Latin language only) because it is not part of a possible world. It just describes a state a affaires that can be produced by a number of worlds, it cannot explain anything outside this state of affairs, even phenomena pertaining to it, like it cause and conditions for existence.

Applied to a concrete case, these considerations give us the following M. Magnus in her article shows how Government and Binding theory (GB the dominant version of generative grammar in 1980's -1990's) can be free from some of its unobservable entities and reformulated as "surface grammar" - a grammar that contains only observation terms but will nevertheless capture the regularities of English.

One of the unobservable entities to be eliminated is PRO - the subject of non-finite clauses. It is abstract in the sense that it has no sound image and thus nonexistent from the point of view of perception. In the following sentence

(1) *Bill promised Mary to take care of himself*

the predicate *to take care of himself* has no overt subject, but, surprisingly, the seemingly empty space between *Mary* and *to take care of himself* both infers (*to Bill*) and fixes the reference of *himself* - also *Bill*. GB identifies this 'empty space' as an abstract nominal, PRO, describes its distribution and uses it to account for properties of different constructions. A generative linguist working in the GB framework would rewrite sentence (1) as (2):

(2) *Bill promised Mary PRO to take care of himself.*

M. Magnus suggests accounting for the reference of *himself* in the above example by the semantic consideration that both verb phrases, *promised Mary* and *to take care of himself*, are predicated of the noun *Bill*, and the reflexive *himself* is bound to the subject of the predicate it finds itself in, i.e., to the noun *Bill*. This semantic account postulates no unobservable entities but accounts for the reference of

the reflexive as well as the GB account that postulates PRO, so the semantic account should replace the PRO account as the more empirically adequate one.

One way to support the PRO account would be to prove its existence, but evidence given by GB in favor of PRO is not conclusive for those adhering to other theories. One way to convince them would be to collect evidence from child language acquisition (findings in this field support GB to a surprising extent), but unfortunately no direct evidence is available in this case. The available indirect evidence can be, and has been, interpreted differently. We can postulate a possible world that is quite like our world, but it has the abstract nominal PRO with the characteristics stated by GB. This world can explain the reference of *'himself* in (1). We can also postulate another world that has no PRO and explains the reference of the reflexive though the mechanism of predication. Which of the two shall we take to be identical or the same with the actual world? In other words, can 'surface grammar' serve the purposes of generative syntax better than GB?

I would say the GB world should be preferred to the world of 'surface grammar' because it accounts for evidence other that (1):

- sentences with infinitival subjects:

To be poor is unfortunate,

- other non-finite forms of the verb:

Smoking so much is bad for you.

- possibly noun phrases;
- certain language acquisition facts.

All this diverse theoretical evidence will on the GB account have something in common, which is a very desirable consequence that would be lost in a semantic account. The thing is that generative grammar has been trying to account for learnability of human languages. For a system to be learnable the way a human language is, it should be simple in the sense that the number of underlying principles must be finite, in fact small. Thus, any theoretical advancement that reduces the number of principles, generates different constructions on the basis of the same principle, is preferable to one that is empirically adequate, but increases the number of principles or does not affect it. M. Magnus's reduction of GB to surface grammar does exactly this: the number of principles increases. Also, instead of abstract entities that contribute to the world created by it in a meaningful way, surface grammar introduces others that do capture the observable regularities of English but destroy explanations. Generally, we cannot have both perfect empirical adequacy and sufficient explanatory power - one of the two has to be sacrificed. The two extremes, empirical/observational adequacy and explanatory/predictive power create considerable tension, and linguistics is caught in it: GB and generative grammar generally has considerable explanatory and predictive power in the sphere of syntax, but it does not account for phraseological units ('to paint the town red', 'raining cats and dogs', etc.), for the language of poetry and the impact of prayer, for our ability to 'do things with words', as J. Austin put it. Those branches of the science of language that seek to capture all those

facts of language use, those surface facts do not explain much - they enjoy being in the midst of confusion that may be due to real complexity or to inability to capture the underlying mechanism. It looks like the linguistic Theory Of Everything is further from us in time than regular space shuttle flights to the Andromeda galaxy.

Now, if we decide to look for explanations and not descriptions adequate in minute details as our goal and take PRO as a real entity, shall we describe it as observable or unobservable? If observability is framework-dependent, answers can be different. The story of PRO in generative grammar is much like that of the planet Neptune that was first hypothesized to explain the anomalous orbit of Uranus. Two other abstract elements were already found and their properties were specified. These first two were described on the basis of two characteristics ([+/- anaphor], [+/- pronominal]), so the natural question arose whether the other two could be found:

	+ pronominal	- pronominal
+ anaphor	?	NP-trace
- anaphor	?	WH-trace

So, the characteristics of both elements were specified before they were found; as for the [+anaphor, +pronominal], it was also possible to make a guess as to where it can be found - the characterisation in the table is enough to predict the distribution of the missing element. The bundle of features [+anaphor, +pronominal] was dubbed PRO. So, it was not discovered by observation – it followed from the theory. Actually, its distribution is described by a statement called “the PRO theorem” because it directly follows from some other, primitive statements of the theory. Now it has come to be associated with a number of canonical analyses and is used in syntactic research and research on language acquisition. Since it has gone its way from being a goal to being a means, on the pragmatic view adopted here it should be treated as observable, hence real beyond dispute. Not everything that is observable is a separate entity. Judgments by different theories can differ. For example, the English passive construction, though observable, is not held to be a separate entity in modem generative grammar. Rather, it is an interaction of different principles. Rules for forming passive constructions are artifacts that have nothing to do with the design of language.

4. Conclusions

This story is more like a rule and not like an exception to one - imperceptible things with interesting properties are attractive to scientists. They do not have to prefer theories that are more in accord with the available data and there is always plenty of time to play with Occham’s razor. “Indeed, it is typical of scientists to prefer to explore what is judged to be a theoretically deeper theory, - states C.A. Hooker, - even if it has some empirical alternatives, over less theoretically insightful, if more empirically adequate, alternatives. Scientists aim at interesting or valuable truth, not simply truth” (Hooker 1985, 168).

Generative grammar, though, is not all that sure. In the early 1990's, a new version of it appeared - the Minimalist Program. It is minimalist in the sense that it tries to get rid of all the theoretical apparatus that is unlikely to have counterparts in the makeup of language-as-it-is. A substantial part of GB is abandoned as artifacts, "engineering solutions" of scientists that are not effective in explaining the learnability of language. PRO, as well as the other three abstract elements, has survived the transition to this new framework, but its future is not easy to predict.

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Appendix

Meet PRO

Consider the following sentences:

1. I want to visit you.

2. They want to visit each other.

Who is meant to perform the action of visiting in each of them? For each these sentences you somehow infer that the subject of the second verb is same as the subject of the first one, as compared with.

1'. I want John to visit you.

2'. They want their friends to visit each other,

where the two verbs have different subjects. What if the second verb in (1), (2) has a subject, just as it does in (1'), (2'), only this subject has no sound image? In this case our grammar will not need to postulate two separate rules - one for (1), (2), the other for (1'), (2') - but will have one that co both cases, thus leading to greater simplicity and learnability. For this reasons and a number of other theory internal ones generative grammar postulates that the infinitives in (1), (2) have a subject and calls this subject "PRO."

PRO can appear in the subject position of clauses whose verbs have tense characteristic:

3. [PRO <u>to understand</u> the problem] is important.

4. [PRO <u>running away</u>] would be unwise.

5. [PRO <u>sitting</u> in my office all day], I remembered the solution.

PRO is not interchangeable with overt NP's:

6. I saw John/*PRO (this is to say, I saw is not equivalent to I saw some unspecified person.)

7. John thinks that he/*PRO will win (i.e., John thinks that will win is not a sentence of English at all).

As we saw in sentences (1), (2), PRO refers. How does it do that? Basically, it picks its reference from the subject or the object of the verb in the main clause:

8. **I** want [**PRO** to visit you],

9. I ordered **the servant** [**PRO** to open the door].

If a sentence (or the main clause of the sentence) begins with PRO, PRO has no to pick its reference from, so it refers to an arbitrary person, as in (3) above. PRO can pick reference and pass it on to others who need it. For example, in our sentence (2), the expression *each other* is one of those that depend on other nouns in their clause for reference. They cannot be independent, which can be shown by sentences like:

10. *Each other left.

11. *Mary loves each other.

As sentence (2) now stands, it should be ungrammatical because each other has nothing to depend on for reference. But it is absolutely all right, and the PRO account neatly captures this:

(2) **They** want [**PRO** to visit **each other**].

Step 1: PRO picks its reference from *they*.

Step 2: *each other* picks its reference from PRO.

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