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This is based on the handout for my Syntax+ talk "Language Faculty Science as an Exact Science" at USC on 2/24/2014. Two of the three Appendices have been removed from the original 2/24/2014 handout. This is being made available to the potential audience at my 9/11/2014 talk "Language Faculty Science as an Exact Science: an Illustration based on Experimental Considerations" at Kanagawa University, as part of the background information for the talk.

If you are interested in learning more about Language Faculty Science as I am pursuing, please check the postings under:
[44350] "Language Faculty Science"
at: http://www.gges.org/hoji/discussions/public1j/bbs-f.cgi
That is part of my Homepage.

Language Faculty Science as an Exact Science

1. Main claims

(1)   **Language faculty science as an exact science** is possible.

(2)   We can pursue language faculty science as an exact science by adopting the **EPSA** method.
        (**EPSA**: **E**valuation of **P**redicted **S**chematic **A**symmetries)

(3)   The two starting points of this research:
    a. The **Internalist** approach to language
    b. The **Methodological Naturalist** approach (to the study of the language faculty)

   ✓ The methodological proposal I put forth for language faculty science as an exact science is, mostly, a consequence of (3).[1]

2. Clarification questions that I expect to hear and want to address about the main claims

(4)   What is meant by the **language faculty**?
           Key concepts:
           The **initial state** and the **steady state** of the language faculty
           I-language: the **I** of I-language stands for *internal* and *individual*.

(5)   What is meant by an **exact science**?
           Key concept:
           "Guess-Compute-Compare"
           (= the *hypothetico-deductive* method)

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[1] The only thing about my proposal that is not a logical consequence of (3), as far as I understand, is the adoption of Chomsky's 1993 model of the Computational System and its specific implementation in Ueyama's 2010 model of judgment-making by the informant, which I also adopt.

3. Main claims, stated somewhat differently, based on the answers to (4) and (5)

What is stated in (6) is among the consequences of taking (3) seriously.

(6)   In language faculty science as an exact science:
   a.   we deduce *definite* predictions about an *individual* speaker of a particular language based on (i) hypotheses about *universal* properties of the language faculty and (ii) hypotheses about properties of the steady state of the language faculty (=the *individual* speaker's I-language)
   b.   we expect our *definite* predictions to be supported by experimental results.

4. Data in language faculty science

Data in language faculty science: What can we take as evidence for or against our hypotheses about the language faculty?

There are no a priori restrictions as to what can be regarded as evidence for or against our hypotheses about any subject matter. This applies to the study of the language faculty. But, no matter what kind of evidence we might consider, it should be revealing about the subject matter—in our case about universal properties of the language faculty. Since the language faculty is, by hypothesis, what underlies our ability to relate linguistic sounds and meaning, it seems reasonable to consider the informant judgment on the relation between linguistic sounds and meaning as something that we can use to test the validity of our hypotheses about the properties of the language faculty. We leave open, of course, the possibility that other types of evidence may serve the same purpose and provide converging evidence for our hypotheses.

5. Consequences

(7)   The main consequence of taking the *internalist* approach seriously:
   ✓ Predictions are about *individual* speakers.

(8)   The main consequence of taking the *methodological naturalist* approach seriously:
   ✓ Our predictions must be as *definite* as possible; they must be *deduced* from our hypotheses; and we should be able to *compare them* with our *experimental results*.

6. Big questions

(9)   a.   How can we make *definite* predictions about the judgment of an *individual speaker* of a *particular language* as a reflection of *universal* properties of the language faculty?
   b.   How can we expect to obtain experimental results in accordance with such *definite* predictions?

7. My answer to (9a):

The first step toward regarding the *individual* informant's judgments on *particular* sentences of a *particular* language as a reflection of *universal* properties of the language faculty is to understand that the *particular* sentences we have our informants judge are *instantiations of a*

schema.

> This, combined with our desire to pursue as much generality and as much testability as possible, leads to the recognition of the **fundamental asymmetry** between a **Schema*-based prediction and its corresponding ^{ok}*Schema*-based prediction.

(10) a. The **Schema*-based prediction:
Every example sentence instantiating a **Schema* is unacceptable with the specified interpretation pertaining to two expressions.

    b. The ^{ok}*Schema*-based prediction:
Some example sentences instantiating an ^{ok}*Schema* are acceptable at least to some extent with the specified interpretation pertaining to two expressions.

> The combination of these two types of predictions is called a **predicted schematic asymmetry**. When we obtain experimental results in line with the *predicted schematic asymmetry*, we obtain a **confirmed predicted schematic asymmetry**. I have suggested that in language faculty science as an exact science *confirmed predicted schematic asymmetries* are the minimal units of facts.

If it helps, you can think about (11) and (12) below as specific examples, remembering, however, (i) that each sentence is meant to be an instantiation of a *schema*, and (ii) recognizing—though that has not yet been addressed—that what we are interested in is not the informant judgments on these particular examples but what they tell us about the validity of our hypotheses about the language faculty.[2]

(11) (Intended as: for every individual x that is a boy, x praised x's father)
    a. *Every boy* praised *his* father.
    b. *His* father, *every boy* praised.

(12) (Intended as: for every individual x that is a boy, x's father praised x)
      His father praised *every boy*.

With regard to (13) and (14), (11a) instantiates Schema A1, of Schema group #1; (11b) instantiates Schema A2, of Schema group #2; and (12) instantiates Schema B1 (=Schema B2) in (13), all for Lexical group #1.

(13) Schema Groups in EPSA [31]-4:

Schema group #1		
Schema A1	ok NP V [... B ...]	(with BVA(NP, B))
Schema B1	* [... B ...] V NP	(with BVA(NP, B))
Schema C1	ok [... B ...] V NP	(with B being referential)
Schema group #2		
Schema A2	ok [... B ...] NP V	(with BVA(NP, B))
Schema B2	* [... B ...] V NP	(with BVA(NP, B))
Schema C2	ok [... B ...] V NP	(with B being referential)

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[2] I leave open for now how acceptable sentences in (11) and (12) are with the intended interpretations indicated in the parentheses.

(14) Lexical groups in EPSA [31]-4:

Lexical group #1   *every boy* as A of BVA(A, B)
Lexical group #2   *no boy* as A of BVA(A, B)

The considerations that lead us to accept (10) also lead us to accept (15) instead of (17), where the "not *" judgment covers both the "??" judgment and the "ok" judgment in (17), with the content of the "ok" prediction being as stated in (10b).

(15)

Prediction\Judgment	*	not *
*		
ok		

(16)

Judgment	*	??	ok

(17)

| Prediction\Judgment	*	??	ok
*			
??			
ok			

We recognize the fundamental schematic asymmetry in (10), regardless of how the predictions are given rise to, as long as we "work with schemata," which has been necessitated by (3). Our predictions about an *individual* informant's judgment are concerned with *universal* properties of the language faculty. The deduction of such a prediction thus requires, minimally, a *universal* hypothesis (i.e., a hypothesis about *universal* properties of the language faculty) and a *language-particular* hypothesis (i.e., a hypothesis about language-particular properties); see (6) above. In addition, we must have a hypothesis about what formal property underlies a particular interpretation that is detectable by the informant. Such hypotheses will be called a *bridging hypothesis*.

In order to deduce from hypotheses predictions about the informant judgment—on the relation between sounds and meaning—as a reflection of properties of the language faculty, we must have a general theory or conception of the language faculty, in the terms of which we can formulate our universal and language-particular hypotheses and *bridging hypotheses*. I adopt Chomsky's (1993) model of the Computational System (=CS) of the language faculty because it allows us to formulate hypotheses that would lead to *definite* and *categorical* predictions.

(18)

Model of the Computational System
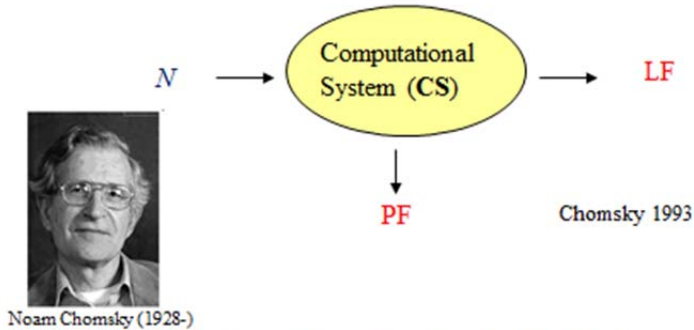
N: a set of items taken from the Mental Lexicon
LF : a representation based on **N** that serves as the CS-based meaning
PF : a representation based on **N** that serves as the basis of "sounds/signs"

According to this model of the CS, what underlies the meaning is the mental representation called an LF representation. The only structure-building operation allowed in this model of the CS takes two syntactic objects and forms one (called *Merge*). The structural relation among two syntactic objects at LF can thus be defined in terms of a basic and *universal* structural relation (of *c-command*) directly definable in terms of *Merge*. We can now formulate hypotheses about what surface phonetic sequence corresponds to what LF representation(s), or more specifically, about the c-command relation between two syntactic objects at LF corresponding to two expressions in the surface phonetic sequence.

We can thus make *testable* predictions about an *individual* informant's judgment on the relation between sounds and meaning by specifying (i) a universal hypothesis about a formal object/relation at LF with specific condition(s) imposed upon it, (ii) a language-particular hypothesis that allows us to determine the structural relation between two LF syntactic objects corresponding to two expressions in the surface phonetic sequence, and (iii) a *bridging hypothesis* that specifies what interpretation pertaining to two expressions *must* be based on the formal object/relation at LF alluded to in (i).

It will be hypothesized that there is a formal object/relation at LF, called *FD*(a, b), with the structural condition that *a* must c-command *b*. For the interpretation alluded to in (iii), we consider a particular dependency interpretation pertaining to two expressions *A* and *B*. A *bridging hypothesis* states that such a dependency interpretation must be based on FD(LF(A), LF(B)) with particular choices of A and B.[3]

8. My answer to (9b)

One of the keys to obtaining *definite* and *categorical* experimental results in accordance with our predictions is to accept concepts such as *Main-Hypotheses* and *Sub-Hypotheses*, and *Main-Experiment* and *Sub-Experiments*. These concepts will serve as a basis for informant classification, which will be crucially used in interpreting the result of our *Main-Experiment* with regard to the validity of the *Main-Hypotheses*. It is by recognizing the fundamental asymmetry between the two types of predictions and by analyzing our experiments in terms of notions such as *Main-Hypotheses* and *Sub-Hypotheses*, and *Main-Experiment* and *Sub-Experiments* that we can expect to obtain *definite* and *categorical* experimental results.

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[3] *LF(A)* and *LF(B)* stand for LF syntactic objects that correspond to expressions *A* and *B*, respectively.

The key to obtaining *definite* and *categorical* experimental results is the reliability of the experimental device. Unlike a physical science, we do not have a physical experimental device the reliability of the design, construction and operation of which we can check, at least at the moment. Our informants and our instructions to the informants are part of our experimental device. We can consider the result of our *Main-Experiment* revealing about the validity our *Main-Hypotheses* only if we focus on the informants for whom the instructions are effective and for whom the *Sub-Hypotheses* seem valid, judging from the results of the *Sub-Experiments*. Interpreting the result of the *Main-Experiment* without reference to those of its *Sub-Experiments* would be like conducting experiments without taking necessary care and without doing necessary checks, as addressed in the following Feynman quote given in the Appendix, starting with "Because of the success of science.,"

9. Replication of the experimental results

A *confirmed predicted schematic asymmetry* is based on a *predicted schematic asymmetry*. *Predicted schematic asymmetries* are given rise to by universal hypotheses, along with language-particular hypotheses and *bridging hypotheses*. It is in this sense that an *individual* informant's judgments is revealing about *universal* properties of the language faculty. It is also in this sense that facts in language faculty science as an exact science are closely related to our hypotheses about *universal* properties of the steady state of the language faculty.

It may not be an easy matter to obtain an experimental result that constitutes a *confirmed predicted schematic asymmetry* in a *single-researcher-informant experiment*. But, it is, ultimately, the replication of a *confirmed predicted schematic asymmetry* obtained in a *single-researcher-informant experiment* in *multiple-non-researcher-informant experiment*s that makes us confident about the validity of our hypotheses that have given rise to the *predicted schematic asymmetry*. It is also such replication that would prompt us to pay serious attention to the empirical and "factual" claims put forth by others dealing with a language about which we do not have native intuitions. One may in fact suggest that it is the replication of a *confirmed predicted schematic asymmetry* in *multiple-non-researcher-informant experiments* that would make us hopeful that language faculty science as an exact science may indeed be possible.

It must be stressed that the replication of particular judgments by informants on a set of particular sentences is not our concern. We are concerned ultimately with the replication of our experimental results at a more abstract and general level. We are interested in finding out universal properties of the language faculty. We choose to work with a dependency interpretation as a probe for that purpose because we have adopted Chomsky's model of the CS, along with (3). What type of dependency interpretation can be a good probe for the purpose may differ among languages, and even among speakers of the "same language."

In our experiments dealing with *individual* speakers of a *particular* language, we check *predicted schematic asymmetries* given rise to by *universal* hypotheses, *language-particular* hypotheses and *bridging hypotheses*. It is the *universal* hypotheses among them that would help us see what *universal* properties underlie *individual* informant judgments on Examples of "different constructions," with "different dependency interpretation," in "different languages." Before we begin to be able to address reproducibility of our experimental result at such an abstract and general level, however, a great deal of work has to be carried out dealing with *particular* languages, starting with the establishment, and the accumulation, of *confirmed predicted schematic asymmetries*, first in a *single-informant experiment* and ultimately in *multiple-non-researcher-informant experiment*.

10. The concluding paragraph of the draft of my CUP book

What I envisage is a time when we will be able to deduce *hard predictions* (*predicted schematic asymmetries)* in various languages, will be able to evaluate by experiments the validity of our universal and language-particular hypotheses, and will be able to formulate hypotheses of a successively more

general nature, without losing rigorous testability. When something like that has become the norm of the research program, an experiment dealing with one language can be understood *clearly* in terms of the universal hypotheses (along with language-particular hypotheses) in question so that the implications of the result of an experiment dealing with a particular language can be transparent with respect to other languages. Researchers "working with" different languages will at that point share (many of) the same puzzles and issues pertaining to universal properties of the language faculty. They will know precisely what necessary care and checks they need to do in order to design effective experiments for testing the validity of the same universal hypotheses. That will enable us to proceed in a way much more robust than what has been presented in the preceding chapters, still on the basis of *confirmed predicted schematic asymmetries*. The field will at that point be widely regarded as an exact science, and everyone will take that for granted. And I also suspect that, at that point, other fields of research that deal with the brain and the mind pay close attention to the research results and methodology in language faculty science as an exact science because they find it useful to try to learn from the categorical nature of the experimental results in language faculty science and its methodology that has guided its research efforts.[4]

11. Appendix: Some quotations

Feynman on the principle of science, on seeking new laws, and on social sciences:

"The principle of science, the definition, almost, is the following: *The test of all knowledge is experiment.* Experiment is the *sole judge* of scientific "truth." (*The Feynman Lectures on Physics*: 1-1, reproduced in Feynman 1963: xx)[5]

"In general, we look for a new law by the following process. First we guess it. Then we compute the consequences of the guess to see what would be implied if this law that we guessed is right. Then we compare the result of the computation to nature, with experiment or experience, compare it directly with observation, to see if it works. If it disagrees with experiment, it is wrong. In that simple statement is the key to science. It does not make any difference how beautiful your guess is. It does not make any difference how smart you are, who made the guess, or what his name is—if it disagrees with the experiment, it is wrong. That's all there is to it." (Feynman 1965/94: 150)[6]

"Because of the success of science, there is, I think, a kind of pseudoscience. Social science is an example of a science which is not a science; they don't do [things] scientifically, they follow the forms—or you gather data, you do so-and-so and so forth but they don't get any laws, they haven't found out anything. They haven't got anywhere yet—maybe someday they will, but it is not very well developed, … I may be quite wrong, maybe they do know all these things, but I don't think I'm wrong. You see, I have the advantage of having found out how hard it is to get to really know something, how careful you have to be about checking the experiments, how easy it is to make mistakes and fool yourself. I know what it means to know something, and therefore I see how they get their information and I can't believe that they know it, they haven't done the work necessary, haven't done the checks necessary, haven't done the care

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[4] This reminds us of Chomsky's (1975: 5) remark that "it is not unreasonable to suppose that the study of … the ability to speak and understand a human language … may serve as a suggestive model for inquiry into other domains of human competence and action that are not quite so amenable to direct investigation."

[5] Feynman, Richard. 1986. *Six Easy Pieces.* New York: Basic Books.

[6] Feynman, Richard. 1965/1994. *The character of physical law*. New York: The Modern Library. (The page references are to the 1994 edition.)

necessary. I have a great suspicion that they don't know, that this stuff is [wrong] and they're intimidating people. I think so. I don't know the world very well but that's what I think." (Feynman 1999: 22)[7]

Newmeyer on likening generative grammar to physics:
"My personal experience, sad to say, is that it is difficult to convince my colleagues in philosophy and the physical sciences that grammatical theory in ANY shape or form is—or has the potential to be—scientific. And nothing leads them to tune out faster than to hear grammatical theory compared to physical theory." (Newmeyer 2008: section 1)[8]

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[7] Feynman, Richard. 1999. *The Pleasure of Finding Things Out*.

[8] Newmeyer, J. Fredrick. 2008. A review of linguistic minimalism: origins, concepts, methods, and aims. by Cedric Boeckx. *Language* 84: 387-395.