On explaining “Explanations”

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Abstract
What is an explanation? The popular responses are: We can explain what a word means, how to run a computer programme, why John decided to marry Jane, and even historical facts like the extinction of the dinosaurs. But what about explananda such as the linguistic entity “Who saw John?” The paper surveys a spectrum of responses, some theory-free, others theory-bound. For all of these, we employ the six Dimensions of explanation.

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1. Introduction
The Induction/ Deduction dichotomy runs right through the story. Successive Induction results in Universals/ Typology. Postulating Universals leads to Deduction (from Popper to Duhem, assuming the near victory of Deduction). For some, the Methodology of contemporary science is NOT applicable to language, which needs only inductive procedures e.g. under structuralism. For others, YES, it is applicable, and the winner is the (bio)-linguistic one. But the winner doesn’t take it all! Other orientations produce other insights; e.g., from Stratification to Cognition (which requires another paper!). Another question that arises concerns the merger of models, e.g. Optimality Theory and Minimalist Program, which potentially deepens explanation. Finally, we could consider the revision of the “Language is well-designed” hypothesis, by adding the question “primarily for what?”.

2. The Dimensions of explanation
2.1 Theme 1. Early views: The beginning of the long-term swings of the pendulum, Induction versus Deduction
If we begin with hidden Universals (recall Plato’s Cave analogy/ allegory), we can deduce from them the observables. The priority of such Universals is re-asserted in the Middle Ages by Thomas Aquinas, and also the Modistae. Alternatively, we reach
Universals by successive induction from the surface forms, as in Aristotle, going from particulars to surface Universals or Typology. Induction is re-asserted under Nominalism in the Middle Ages, championed by William of Occam (see below).

Medieval accounts include: (a) Friar Roger Bacon who supposedly introduced the empirical study of the sciences, breaking with the then-current slavish adherence to authorities. (b) The Modists: The Modists were Speculative/ Universal grammarians, in late C13 in Northern Europe, centered on Paris. Systematized by Thomas of Ehrfurt (early C14), Modism replaced traditional descriptive/ pedagogical grammars (Thrax for Greek, Prician for Latin). The three Modes are: of being, of understanding, and of signifying. (i) First are the Modes of being: Ontological hierarchies of the things themselves – a very rich system, partly derived from Aristotle. (ii) Then, the Modes of understanding/ thinking – the mental acts of signifying. (iii) Finally, the Modes of signifying encode properties/ meanings into language. Here falls grammar (almost) as we understand the term. Modism was itself replaced by (again, inductivist) Nominalism, represented here by William of Occam (yes, the monk with the famous razor).

Jumping to the Renaissance, the pendulum swings again. From Galileo we see a new rejection of Inductivism, in favour of hidden universals. Add to that Descartes’ Rationalism and influence on the Port Royal Grammar. Cf. also the (ambiguous) stance of Isaac Newton (1687): (a) “I don’t invent hypotheses”; but (b) “I deduced that...”.

The pendulum swings back with Sir Francis Bacon’s insistence on induction and the dominance of experimentation as the basis of scientific method (cf. Roger Bacon, above). For C18-C19, one can mention only W. von Humboldt (1836) (Chomsky’s ‘last Cartesian’ – but perhaps not!). Characteristic for this period are: (a) Comparative studies (cf. later in the Neo-Grammarians); (b) Foundations of Structuralism; (c) Language diversity is taken back to Universal types; (d) The influence of language on the mentality of its speakers.

Jumping to the Neogrammarians and de Saussure down to Bloomfield: Here we revert to Induction again, with their resultant surface, true Typologies. Note that, so far, apart from the hints in the (Descartes-influenced) Grammaire general, we have grammars, but no theory of language or even of syntax, until the C20, below.
2.2 Theme 2. The interaction with C.20 Philosophy of Science

The spectrum runs from Popper to Duhem, each contributing specific offerings, often problems too! The first, chronologically, and the most famous of them all, is Karl Popper (See Popper 1935, 1963). Popper replaced Inductivism (“we can never prove a theory is correct by simply adding more data”), and introduced the notion Falsification. Two important Popperian criteria are the following (assuming a deductive theory, followed by testing the validity of what is predicted): (a) ONE test is enough to falsify a theory (but see Lakatos and Duhem on crucial experiments, below); (b) The new theory must cover ALL the previous explicanda! (but: contradictions drawn from idealisations, new priorities, etc., in Chomsky, elaborated in Drachman 1981). Perhaps there are real cases of Popperian refutation, e.g. the fall of phlogiston (Lavoisier 1777) and Vitalism (Woehler 1828), each case presumably depending on falsifying a single claim. Simply put: for Phlogiston (Priestley 1774-1776), “to be combustible, a material must contain phlogiston”. However, in fact, combustion simply needs an oxygen-rich environment. Lavoisier proved this in 1777. For Vitalism, take the single claim: “you can’t make urea from non-organic stuff”. (But Woehler (1828) did just that).

For my second “hero”, I take Kuhn (1970) on revolution, an end-case in the evolution of a science towards higher degrees of explanation. Lavoisier changed the paradigm of explanation for chemistry at a blow. Chomsky did the same for linguistics (See Newmeyer 1986 for a positive appraisal).

My third “hero” is Lakatos (1970), on Research programs as the background for explanation, (Cf. Boeckx 2006). These consist of theory plus auxiliary hypotheses. Useful ‘ad hoc’ hypotheses temporarily protect a theory from falsification, provided it is not already degenerate (progress-less!). For the phlogiston saga (see above): for some metals, combustion resulted in diminished weight (by loss of phlogiston), but for other metals it resulted in increased weight (crucially, of course, not by a loss of phlogiston). Its supporters held that phlogiston can have negative weight, so its loss by burning leads to an increase in weight. On the other hand, Lavoisier showed the gain to result from the absorption of oxygen from the air. Cf. also Seuren (1998) who accuses Chomsky of deliberately immunizing his theory with ad hoc hypotheses.

1 Note also (a) Koyre’s influence on his students Kuhn, Lakatos and Feyerabend (see Koyre 1957), and (b) Psychologist Lewin’s (1935) (Cassirer 1923 inspired) contrast between Galileo’s ‘hidden’ laws/ universals and Aristotelian ‘observables’. 
As a fourth example, one can refer to Hempel (1965) and the still-current four part formalized model of explanation. The Deductive-Nomological (D-N) model includes Laws, Boundary conditions, derivations, outputs (Cf. 2.4 where we will come to an application to linguistics).

Fifth, we could recall Laudan (1977) on evolution by jettisoning and thus making explanation more transparent. He claimed: “The unrejectable core of a research tradition evolves when apparently essential elements can be jettisoned without compromising the problem-solving success of the tradition”. Cf. Occam’s Razor!

Note that re-orientation may require the sacrifice of earlier-explained data (Drachman 1981). Recall also the way Chomsky’s Minimalist Program (1995) jettisoned (e.g.) Phrase-structure (X-bar), the levels of Deep and Surface Structure, traces and co-indexing, even c-command, while introducing the more principled elements such as Merge, Agree and Phase (for efficient computation), and the two Interfaces – (for sound/gesture and (some of) meaning).

For our last “hero”, take Duhem (1914/1954), again emphasizing holism (“the programme”) as a precondition for explanatory power. Two new points in Duhem’s view: (a) Since, however extensive, the data always underdetermine the possible explanations, recursive induction is again dis-favoured; (b) No single experiment on a single hypothesis is decisive (a consequence of holism in science – vs. Popper (1935, 1963), and resumed from Lakatos (1970)).

2.3 Theme 3. For many, language was NOT an object of scientific enquiry
Chomsky (2012/2013) asserts, citing Joos (1957): By mid-century, many adopted the view that languages can “differ from each other without limit and in unpredictable ways” and therefore the study of each language must be approached “without any preexistent scheme of what a language must be.” For these “many”, there are only reduction-procedures and statistics, as in the following (from those mentioned in Chomsky 2012/2013, here listed chronologically): De Saussure (1916), Sapir (1921), Bloomfield (1933), Trubetzkoy (1969), Harris (1951), Joos (1957), Quine (1960), Greenberg (1963). For these, we will adopt the motto: “No Theory, no Science!”.

2.4 Theme 4. Language IS an object for science
Here we assert the opposite position. We come to the Generative beginnings, even before 1957, adding now the biology paradigm, from Lenneberg (1967) and Chomsky
(1968). Explanation evolved through successive simplifications in Chomsky’s works. We go through the increasing explanatory power in Syntactic Structures, Binding, Principles and Parameters, the expanding biological background under the Minimalist Program.

For explanation, recall that the mid-fifties gave us Chomsky’s (1957) Syntactic Structures, the earliest version of Generative Grammar. As early as the mid-1960s, three levels of adequacy of a theory were mooted, as in Chomsky’s (1965) Aspects. These were: observational, descriptive, and explanatory adequacy. Recall also some of the later mergers and other simplifications leading to increased explanatory power, from the evolution of T-markers and constructions to the part-merger of Morphology with syntax, under Laudan, in Theme 2 above.

(a) T-markers of TG give way to recursive PSG > to X-bar > to bare PS;
(b) Constructions > merge within general functions;
(c) D and S structures disappear. Unification of residues of PSG and TG;
(d) Principles and Parameters (Chomsky & Lasnik 1993);
(e) Minimalist Program;
(f) One place for generation of Syntax and parts of Morphology, viz the syntax – as in Marantz (2001, 2005) and Borer (2005).

Coming now to the linguistic interpretation of Hempel’s model, as promised. Under Chomsky (1995) Minimalist Program, we could mention a 2011 article by Epstein et al. I will present here first the Hempel’s schema, and a sample syntactic derivation, e.g. for “Who saw John?” [Bracketed numbers in (b) are from Epstein et al. 2011 on Derivation].

(a) Formal schema for Hempel (1965).

\[L_1 L_2 L_3 \ldots L_n\] The Universal Laws – at least one must cover the fact involved
\[B_1 B_2 B_3 \ldots B_n\] The Boundary conditions – those relevant must be met
---------------- The Logical Deduction sequence
\[E\] The Explanandum (the fact to be explained)
(b) The derivation of “Who saw John?”.

Phase 1 = v*P cycle, with seven processes [but two (2ii, iii) apply in parallel].

(1) Triple External Merge (EM) makes the following structure:

\[ [v_p \quad \text{who} [v* \ V [VP \text{see John}]]] \]

(2) (i) Feature transmission (unvalued phi from v* to V (see));
(ii) Agree: values unvalued phi on V (see), and unvalued Case on NP (John);
(iii) Internal Merge (IM): raises NP (John) to SpecVP;
(iv) Transfer to the interfaces: v*P to SEM, and VP to PHON.

Phase 2 = CP cycle, with 7 processes, [but three (4b, c, d) apply in parallel]

(3) Double EM: Merge T, Merge C (makes CP structure)

(4) (i) Feature transmission (unvalued phi from C to T);
(ii) Agree: values unvalued phi on T, and unvalued Case on NP (who);
(iii) IM: raises NP-who to SpecTP;
(iv) IM: raises NP-who to SpecCP, giving:

\[ [\text{CP who}_3 [C_{TP} \text{who}_2 [T \text{who}_1 [v_p [v* \ --]]]]]] \]

(v) Transfer to the interfaces: CP* to SEM, and CP to PHON.

(c) Initial/ Boundary conditions.

We illustrated the Laws (e.g. Merge, Agree, Phase) in the derivations above. We should add the relevant Boundary conditions under Minimalist Program, e.g. Merge is binary, No Tampering, No New Features, Full Interpretation, Phase Impenetrability. Epstein et al. raise the question, whether we can justify such a high degree of complexity for such a simple sentence as “Who saw John?” The authors confidently respond: “A principled system, being explicit and falsifiable, may well yield intricate-looking derivations, i.e. simple (explanatory) laws can give rise to complex phenomena (= science)”.

Reasonably assuming that Chomsky is basically the winner, now consider the caveat under Theme 5 below.

2.5 Theme 5. A Caveat: Explanations from alternative theories

Does the winner (Chomsky) take it all? Not necessarily, according to Feyerabend (1975). To justify this caveat, we would have to look for explanatory insights
derivable from (e.g.) Stratification (in Lamb 1966), Formal Logic (in Montague 1970), Function (in van Dijk 1972), Construction (in Croft 2001), Cognition (in Langacker 1990) [but that would take another paper!].

But we must even consider a further possibility, that of program-merger. The three such accounts that follow in fact seek to formulate Minimalism-compatible hybrid programs, as their titles indeed indicate:

(a) Smolenskly (2000): Connectionism and Optimality Theory;

(b) Samek-Lodovici (2006): Optimality Theory and Minimalism. One can maintain Minimalist Program goals, yet pursue an Optimality Theory perspective of human grammar. Invoking Optimality Theory allows for the interaction of constraints at the interface with PF and LF as explanation of language variation.

(c) Broekhuis & Woolford (2013): Minimalism and Optimality Theory. Chomsky asserts that Minimalism is a research program – not a theory – investigating to what extent the language faculty is optimally design to satisfy conditions at the interface with the sensory-motor system (PF) and the system of thought (LF). Optimality Theory is a theory of how universal constraints of grammar interact. The last-mentioned authors assume, however, that Minimalism lacks a well-developed Evaluation mechanism, while Optimality Theory lacks a well-developed Generator; they then propose to merge the two well-formed elements, the resulting hybrid taking advantage of the explanatory powers of both research programs.

2.6 Theme 6. Enter language design and explanation! Is language optimally designed, and for what?

For Chomsky (1995) the grammar IS the explanation — so far so good. But now, in his 2013 paper he adds “Is language optimally designed for Communication?” There are arguments against communication. Output constraints are in fact an extra burden on perception. Chomsky now remarks on some of the elements relevant to this anti-communication claim:

“In general, so it appears, structurally ambiguous, garden path, and island structures result from free functioning of the simplest rules, yielding difficulties for perception.”

(Chomsky 2013: 41)
We must also countenance diversity in surface morpheme order, e.g. of derivational versus inflectional affixes, not to forget phonology-sponsored Tense-to-Root morpheme movement in Modern Greek, for which consider the set of forms:

\[(5)\]  
(i) √káno ‘I do/make’, Past √é-kana ‘I did/made’;  
(ii) √para-káno ‘I overdo’, Past ∗e-parákana √par-é-kana ‘I overdid’

3. Conclusions

The dimensions of explanation reviewed: We witnessed the basic methodological contrast between (a) Induction, the derivation from the data to (surface-true) Universals, in science and language (from Aristotle to Harris, from de Saussure to Trubetzkoy), and (b) Deduction, the derivation from ‘hidden’ Universals to the data (from Plato to Modists, Descartes, von Humboldt, Chomsky).

Is language an object of science? (a) many said NO! Languages are unendingly disparate (Joos) – no theory, no science! (b) Others said YES, with Chomsky. Merger of Minimalism and Optimality may result in deeper explanatory adequacy. For Chomsky (1995), language IS well-designed for the satisfaction of conditions at the interface with the sensory-motor system (PF) and the system of thought (LF).

References


