The rise of Optimality Theory in first century Palestine

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Why do some scientific theories gain adherents while others do not? And why do new theories arise when they do, and not at another time? The simple answer—that the successful theories are true, and they arise when the truth is recognized—cannot be sufficient, for two reasons. First, nobody knows at the outset whether a theory is true or not; and second, no theory has yet turned out to be true. Therefore, there must be other factors which account for the rise of a new theory or paradigm. Thomas Kuhn has observed that the “logical history” of a field—the way it is presented in textbooks—represents an idealized version, formulated after the fact, of the actual history. At the very early stages of a new theory, it is quite likely that even many of its adherents cannot articulate exactly what it is that appeals to them about the theory, or why they think that it is the right way to go. “It’s kind of neat” is often enough of a reason at first.

A case in point is the rapid rise of Optimality Theory (OT, Prince and Smolensky 1993) in phonology, the subject of a State-of-the-Article by Luigi Burzio in GLOT 1.6. Burzio advances some arguments of a general nature on behalf of OT, but the one that I suspect is most compelling to him is given early on: “...my own (1994) ‘Principles of English Stress’...while developed independently, reaches rather similar conclusions.” Now, this is a perfectly valid—perhaps the most valid—reason for adopting a theory (outranking even “it’s kind of neat”), but I doubt that everyone who has taken up OT has done so for that reason. A logical history of the rise of OT remains to be written.

Burzio also gives some examples of how OT could be applied to syntax, and suggests that it has the potential to bring linguistics closer to other areas of cognitive science, such as artificial intelligence and neuropsychology. And why not? OT is not so much a theory of phonology or syntax as a philosophy of life. Life makes conflicting demands, and to satisfy some we must violate others. OT proposes that these demands (constraints) are ranked; a candidate solution which satisfies a higher-ranking constraint, even at the cost of violating many lower-ranking ones, is preferred to a solution which violates a higher-ranking constraint, even if by so doing it satisfies many lower-ranking ones. In its pure form, OT is simply a theory of constraint interaction, independent of what the constraints are; hence, it is applicable, in principle, to any domain that can be formulated in terms of constraints.

Viewed in this light, phonology looks like less fertile soil for such a theory than other aspects of life, like ethics or political theory. Ethical principles, for example, appear to be universal: help your neighbour, help yourself, be kind, tell the truth. What makes ethics tricky is the problem of deciding how to rank these principles in any given situation; here we find considerable variation.

Examples of OT at work in political and economic theory are also easy to find. In my country, Canada, as in many countries, the government has been telling us for some years now that the need to be competitive in the new global economy (which seems to require increasing the profits of the wealthy) must take precedence over other worthy goals, such as reducing poverty and inequality, improving public health and medical care, investing in education, supporting the arts, and so on. Critics ignorant of OT accuse the government of heartlessness and indifference to the welfare of its citizens. The government protests that this criticism is unfair, and indeed, when there is no risk of violating a higher-ranking constraint, it may act to further one or more of these lower-ranking goals.
In such rare circumstances, we observe what McCarthy and Prince (1994) call “the emergence of the unmarked,” the unexpected appearance of a constraint that seems to be otherwise inactive in the system.

In politics, then, it is sometimes transparently evident that one high-ranking constraint can lead to action that requires violations of a large number of other desirable constraints. In phonology, however, it is not as obvious that constraints interact in this way. Could OT, then, have first arisen in some other field, at an earlier time? I think that it did, perhaps a number of times in different parts of the world. Here, I will recount an early instance of the application of OT to a problem of Jewish law in first century Palestine.

The story concerns Hillel the Babylonian (c. 60 B.C.E.–c. 10 C.E.), who was summoned by the Elders of Beterah to help resolve a problem that arises when Passover falls on the Sabbath. The laws of Passover require that a special sacrifice be offered; however, no work is permitted on the Sabbath. Since a sacrifice necessarily involves work (slaughtering, scraping, burning), the question is whether Passover overrides the Sabbath, or whether the Sabbath overrides Passover. The Elders of Beterah had forgotten this law, and hoped that Hillel, who had been a student of the famous teachers Shemaiah and Abtalion, would remember what it was. Hillel wished to show how the law could be deduced with the aid of some new methods and arguments.

The story, which I reproduce more or less as it is told in the Jerusalem Talmud (Yerushalmi Pesahim, Chapter 6—the terminology has been somewhat updated), may (or may not!) help to illuminate some of the general questions raised above, as well as give us some perspective on the rise of OT in our own day.

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“What we have here,” Hillel began, “is a simple case of constraint conflict:"

(1) SAB: You shall do no work on the Sabbath.
(2) PASS: You must offer the Passover sacrifice.

“Conflict of this type is quite general,” he went on. “For example, the Tamid offering (TAM) is performed twice daily, including on the Sabbath, and so outranks the Sabbath; if PASS outranks TAM, then, by transitivity of strict domination, PASS >> TAM >> SAB.”

Hillel then drew the diagram in (3):

<table>
<thead>
<tr>
<th>Output candidates</th>
<th>PASS</th>
<th>TAM</th>
<th>SAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offer no sacrifices</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Tamid sacrifice only</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Passover sacrifice only</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Tamid and Passover sacrifices</td>
<td></td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>

The Elders of Beterah stared at the diagram. “What is this?” one asked after a few minutes.

“It’s called a tableau,” said Hillel. “Everyone in Babylonia is using them. Each row represents a possible course of action, and each column represents a constraint. A constraint violation is signalled by *, and a fatal violation, one which causes a candidate to lose (because it violates the highest-ranking constraint not violated by a competing candidate) is marked by !. Shaded squares are
irrelevant to the choice (the issue already having been decided in previous columns), and the winning candidate is picked out by the pointing hand.”

“This is not in keeping with our tradition,” said one of the Elders of Beterah. “We do not violate the Sabbath under any circumstances.”

“But in fact you do,” replied Hillel, “every week, when you offer the Tamid sacrifice on the Sabbath.”

“But that is not a violation of the Sabbath,” retorted another Elder, “the Tamid is part of our observance of the Sabbath. We have the following two rules.”

He then put (4) and (5) on the board:

(4) Work $\rightarrow \emptyset$ / [_____]Sabbath
(5) $\emptyset$ $\rightarrow$ Tamid/ [_____]twice daily

“Rule (4) must be ordered before (5),” another Elder remarked. “This is a counterfeeding order,” he went on, winking at the other Elders.

“But my approach is intuitive,” said Hillel, “because it directly shows how constraint conflicts are resolved.”

“Our method is also intuitive,” replied an Elder. “First you do this, then you do that. How do you account for the fact that rituals must be carried out in an order, if not by rule ordering?”

“All actions in a series could take the form DO-FIRST,” Hillel answered. “Ranking determines which one actually goes first; the next-ranked one will go second, and so on.”

“It’s like eating steak with chopsticks,” muttered one of the Elders.

“Which reminds me,” said another, “that it’s time for lunch!”

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After the break, the first Elder resumed the discussion: “Let’s get back to the main issue. Your conclusion that Passover overrides the Sabbath is based on ranking PASS over TAM. But in your theory constraints can be freely reranked?”

“Correct,” said Hillel. “This is how we account for variations among traditions and practices.”

“So,” continued the first Elder, “what in your theory tells you that PASS dominates TAM?”

“Well, you have to know that,” said Hillel. “That’s part of the theory of sacrifices. But I have three arguments to support this ranking. The first is an argument from analogy: both the Tamid and Passover offerings are community sacrifices (members of COM), and just as TAM, which is part of COM, overrides the Sabbath, then so does PASS.”

“That analogy does not go through,” retorted an Elder, “since a Tamid offering has a limit (two only), but a Passover sacrifice depends on the number of Israelites. The latter is a completely different type—and, one could argue, a lesser type—of sacrifice.”

It is reported that Hillel expounded to them all day, but the Elders did not accept his teaching until he told them: “Passover overrides the Sabbath. Thus I have heard from Shemaiah and Abtalion.”

As soon as they heard this, they appointed him nasi (= prince) of their academy.

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What do we learn from this account about progress in science in general, and OT in particular? Everyone will draw their own conclusions, but I would like to suggest two: 1) It matters
who you studied with; 2) Whether you construe it in terms of rules or constraints, as a serial derivation or a parallel evaluation, you still have to have a theory of sacrifices.

References