On the Merits of the Particular Case

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"... a stick thrust in the water felt straight and looked bent to a Greek. The sun moved for the Inquisition, the earth for Galileo. Light is a wave for Schroedinger and a particle for Heisenberg. But even the last have had their Dirac. The seeming contradictions vanish in the grace of greater knowledge. We have learned that the answer depends upon how we ask the question. And we have learned to ask the question so as to get an answer of a kind we can use..."

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Through the Den of the Metaphysician

Abstract

The analysis of particular problems for the application and illumination of principles has long been a central activity in the physical sciences. The attempt to take guidance for the human sciences from the physical sciences has often been unconvincing and subject to criticism. After examination of one such attempt by Kurt Lewin and its criticism by Susanne Langer, I follow a view of the process of abstraction advanced by Bourbaki, Piaget, and Weyl as a guide in this study. I make use of a particularly illuminating description by Feynman of a complex physical effect as a concrete example of a specific form of analysis. I argue that this example is useful in understanding epistemological analyses based on computational modelling. The physical examples involve reflection, diffraction, and the uncertainty principle. Instead of borrowing notions from the physical sciences, I reflect on the process of problem solving and abstract from that process objectives, methods, and values which will help us as students of mind to identify and solve our own problems and judge the value of those solutions. This is not an attempt to develop a single, universal method. It is an analysis of how we can proceed to conclusions of interest in which we can have confidence. One hopes that in physics there are other analyses and explanations which can, in turn, further illuminate research in psychology.

Introduction

In the human sciences, one often finds arguments such as these two:

1 the situation here (in the human sciences) is much like such and such a specific situation there (in the physical sciences); this has implications for our methods of exploration and for concept construction. A typical example:

   observation: in the exploration of physics at the quantum level, we have found it necessary to use incompatible descriptions of reality to explain dependably occurring phenomena, *e.g.*, sometimes light behaves as particles and sometimes light behaves as waves;

   analogy: similarly in the human sciences, we must apply different descriptions of phenomena and processes when discussing psychological laboratory experiments as contrasted with the interplay of people in social groups.

2 the methods generally used here (in the human sciences) should be similar to those used for supporting arguments there (in the physical sciences) but possibly adapted for differences in circumstances of application. A typical example:

   observation: statistical methods have proven enormously fruitful in various scientific fields, such as the kinetic molecular theory of gases, thermodynamics, and population genetics. Valid predictions of mass behavior support our theories about the component parts of the ensemble.

   analogy: in the human sciences as in the physical sciences, statistical methods can help us determine what we can really count on in studies of human behavior; thus they constitute the method of choice for the formulation of psychological experiment and its explanation.

Such arguments are merely plausible; that is often the best we can do. Attempts to use the physical sciences as a model for the study of mind have been made often in the past with mixed outcomes. With respect to this discussion's central theme, the merits of analyzing particular cases, the position advanced by Kurt Lewin (1935) in an earlier generation is the most important. Lewin argued that statistically oriented psychological studies were pre-scientific and that they focussed more on coordinations of characteristics than on the specification and illumination of causal

relationships. He suggested that the analysis of the particular case would lead to a scientific understanding of mind. Arguing from the contrast between Aristotelian and Galilean methods in physics, he proposed a program whose primary themes were three: the assumption that psychological phenomena are fully lawful; the advancement of an apt representation; and a commitment to the analysis of the concrete case in full detail. [1]

Lewin warned that until psychology understood and emulated the commitment to the particular found in modern physical science, its progress would be hobbled. The fruitfulness of case study is clear from the role it has long played in the development of major theories of mind. Lewin's claim is stronger: that only through the detailed analysis of particular cases will we be able to probe our ideas with enough precision for science to overcome prejudgment. [2] Lewin's analysis gives us profound lessons for the sciences of mind by contrasting them with the development of physics as a science; but his own theory of a "dynamic psychology" has been severely criticized for permitting itself to be inappropriately influenced by analogies. Langer agrees with Lewin's characterization of the physical sciences as committed to the analysis of particular cases. [3] On the other hand, she attacks "physicalism", an inappropriate commitment to using notions from the physical sciences, as a model for the human sciences with both content-rooted and *ad hominem* arguments. With respect to Lewin's own research, she criticizes directly the superficiality of the analogies on which his program was based. She argues that the terms he takes from physics refer to neither objects, nor forces, nor relationships relevant to psychology in consequence of which he is unable to

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1 For Lewin's explication of the role of quanitification in physical science see The Conflict Between Aristotelian and Galilean Modes of Thought in Contemporary Psychology, pp. 11-12 (in Lewin, 1935). (See Lewin.1 in the Appendix of Extended Citations.)

2 For some of Lewin's reasons for this position, see Lewin (1935), pp13-15. (See Lewin.2)

3 For some of Langer's arguments see The Idols of the Laboratory, pp 33-34 in Langer (1967). (See Langer.1)

do anything important with them. The reason, in her argument, is that the things of physics and their motions are not entities that "...lend themselves to the expression of psychologically important problems." [4] What Langer asks of psychologists taking such guidance is that there be no hand-waving and miracles. The problem must be important. Detailed analysis is required. These are rigorous but sensible demands. [5] A further requirement might be "any borrowed machinery must work." This criticism marks the central failure in Lewin's program, according to Langer; it means he did not even use physical science properly as a model. What should Lewin have done ? Is there a more fecund way to proceed ? I think so, because even if the things and motions of physics are not good models for other sorts of entites, the problem solving of the physicist might provide some guidance in different areas of concern. In *Symmetry*, Weyl sketches the process by which his discussion of symmetry goes forward and relates it to the development of knowledge this way:

> "To a certain degree, this scheme is typical for all theoretic knowledge: We begin with some general but vague principle (symmetry in the first sense), then find an important case where we can give that notion a precise meaning (bi-lateral symmetry), and from that case we gradually rise again to generality, guided more by mathematical construction and abstraction than by the mirages of philosophy; and if we are lucky we end up with an idea no less universal than the one from which we started. Gone may be

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[4] For more detail, see Langer, Ibid., p. 40-43. (See Langer.2)

[5] One focus here, understanding the process of learning, is an important problem for psychology. There are at least two reasons to believe that Artificial Intelligence ideas and techniques will help with this effort. The representation of knowledge is a main issue of that discipline itself. Further and more importantly, if new cognitive structure emerges from the functioning of pre-existing cognitive structures, the building of computational models will provide an experimental ground where new ideas can be simulated with clarity until they are sufficiently well understood that their value in explaining psychological phenomena can be reasonably evaluated. My own psychological studies strive to provide a plausible ground of samples of learning -- a characterization of one significant state in human cognitive development and the processes which early on shape its formation -- from which basis one might explore how the more complex processes of adult thought develop in order to address learning, an essential problem of the human cognitive sciences.

> much of its emotional appeal, but it has the same or even greater unifying power in the realm of thought and is exact instead of vague...."
>
> *Symmetry*, Hermann Weyl, (1952), p.6

The sort of process described by Weyl is different from abstraction by feature-based classification. Piaget also emphasizes a related kind of abstraction, "reflective abstraction", focussed more on what one does rather than on what one attributes to external things as qualities. It is a functional analysis of the genesis of some knowledge.[6] Without using the shield of either Piaget or Weyl, I would characterize this effort as related to their views in spirit. I want to look at an important example of problem solving, characterize it, and then ask how it can help us focus on our own activities in the human sciences and help us understand the significance and value of what we do. I begin with a focus on the importance of analyzing particular cases; I use Feynman's explication of method in quantum analysis as a worked example. I use that worked example to illuminate the meaning of research I have done. Instead of borrowing notions from the physical sciences, I will attempt to reflect on the process of problem solving in a particular case and abstract from that process objectives, methods, and values which will help us identify and solve our own problems and judge the value of those solutions.

Lewin's critique of the psychology of his time fails in fact [7]; even so, I believe his judgment is correct in general: one needs to focus on the particular

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[6] See, for example, ths discussion on pp.320-321 of Biology and Knowledge, Piaget (1971). (See Piaget.1)

[7] Beyond Langer's criticism of his particular formulation, Lewin's entire argument is vulnerable in a specific but limited sense as well. If mathematical knowledge is deductive, it is tautological to the extent its deductions are implicit in its premises. The validity of fit of any formal representation or model to any event or process in the physical world is based on coordinations established by experience. Given the imprecision of measurement, such coordination is quintessentially statistical in character. So Feynman argues in *The Character of Phsyical Law* (1965) if I understand him rightly.

interactions in detail before claiming one's research is of value. In effect, finally I will suggest another plausible argument, that one kind of method in the cognitive sciences is profoundly consonant with the methods of contemporary physics–and furthermore, our epistemological focus and methods could be improved by comparing problem solving in the two fields. My primary source for the physics of this comparison is a series of popular lectures by Richard Feynman, published in *QED: The Strange Theory of Light and Matter* (1985). Feynman was a primary architect of Quantum Electrodynamics (QED) and was its advocate as the most thorough and profound of current physical theories. The work in which this analysis is set forth is an outstanding model for enhancing the accessibility of science. It should occupy a central place in the library of anyone for whom the core issues of this paper are interesting.

Feynman's Focus: the Problem of Reflection

In a public lecture a week after Feynman's death, Marvin Minsky, a colleague and friend of Feynman's for many years, characterized one of his primary contributions to physics this way:

> "Richard Feynman's great originality was in reducing a substantial part of physics to a beautiful theory, called quantum electrodynamics, by deriving almost everything in that field from a single principle ..."
>
> M. Minsky, lecture at Purdue University, Feb. 28th 1988.

The book *QED* is based on a series of lectures given at UCLA.[8] The examples of Feynman's analysis–fascinating in their own right–can also help bring into

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[8] The editor of the transcripts, Ralph Leighton, remarks that:

"... [the] book is a venture that, as far as we know, has never been tried. It is a straightforward, honest explanation of a rather difficult subject–quantum electrodynamics–for a nontechnical audience. It is designed to give the interested