Psycholinguistics and Plato's Paradoxes of the Meno

WALTER B. WEIMER *Pennsylvania State University* [1]

Two fundamental problems in both psychology and philosophy concern the nature of knowledge and the nature of our acquisition of knowledge. No matter how "pure" it may be in research interest and theoretical intent, psychology ought to be very applied in the sense that it should seriously attempt to answer our fundamental questions concerning the nature of human knowledge and the process by which it is acquired. Yet, despite the spectacular successes experimental psychology has had in its attempt to understand the phenomena of *its* domain, it remains to be seen whether the answers advanced to fundamental problems such as the two above are adequate, or whether they are indeed answers at all.

This article explores two problems of knowledge, which take the form of paradoxes, from their origins in Plato's *Meno* to their reemergence in contemporary philosophy and psychology. I trace the pendulum swing of intellectual fashion from Plato's attempt to solve the paradoxes with some ingenious postulations concerning the nature and workings of the human mind, through to Aristotle's (and the majority of contemporary thinkers') attempts to deny the Platonic machinery and the solution it envisages, and conclude with the resurrection of Platonic doctrine in psycholinguistics. Running throughout is the rather disheartening theme that we have not learned much about these problems in somewhat over 2,000 years of reflective thought. That is, my task is to convince one that the Platonic solutions, *inadequate* though they may be, are *still*

the best available. Thus, I shall defend Plato indirectly (*a*) by showing that his doctrines *are* both intelligible and "scientific" today and (*b*) by indicating that opposing theories are quite incapable of providing adequate solutions.

Plato's Problems in the Meno

It has long been a favorite philosophical pastime to propose *the* true problem or paradox that Plato intended the *Meno* to portray, and then to supply *the* true resolution of that problem. It is not my purpose to engage in this fruitless game of *true* Plato exegesis and scholarship: there is a case to be made for many legitimate problems in the *Meno*, and undoubtedly some are more important, and more difficult, than others. My concern is rather with two epistemological problems that are fundamental in the sense that their proposed solutions have never been less paradoxical than the problems themselves.

Although they may or may not be the "true" paradoxes of the *Meno*, I wish to argue that the ones examined are genuine problems for both contemporary philosophy *and* psychology, and that their resolution, in one or another manner, must be a prime task of both disciplines. These problems are, first, the nature and role of abstract entities in knowledge and the learning process, and second, the "productivity" or "creativity" of behavior. Let us develop them by considering a stylized version of their presentation in the *Meno*.

The dialogue begins with the questions, "Can virtue be taught? Or is it acquired by practice? If neither, then how?" This is traditionally a jumping-off point for inquiries into ethics and value theory, or into the problems of education. But it should be noticed that virtue, or justice, etc., are "abstract entities." And Plato, speaking through

Socrates, protests that he does not know the meaning of such abstract terms. Yet, both Socrates and Meno feel that they can recognize *instances* of, say, virtuous behavior. For any given behavior, they can tell whether it is or is not virtuous. Although they do not know what the abstract concept means, and cannot define it, they *can* identify particular instances of it.

But now the perplexity arises: How can one know a *part* of virtue (an instance of virtuous behavior) without previously knowing virtue in the whole (abstract)? How can people know a part of something they do not know? Socrates and Meno admit that such a result cannot obtain. And yet their analysis demands that such a result obtain, for otherwise we could not know anything. The dilemma takes this form: A man cannot inquire either about what he knows, or about that which he does *not* know; for if he already knows, there is no need for inquiry, and if he does not know, he does not know the very subject about which he is to inquire. This is the paradox of knowing in the *Meno:* We cannot learn (come to *know*) anything unless we already know (have learned) it.

The second problem arises from the famous passage in which Socrates demonstrates seemingly innate and unknown capacity or knowledge in Meno's "uneducated" slave boy. This is the passage in which Socrates, the original master of the Socratic method, succeeds in getting the slave to prove a theorem in geometry (that the square twice as large as a given square has a side equal to the diagonal of the given square), despite the boy's protestations that he does not know the answer. By reiterating simple facts that the slave admits he does already know, Socrates has him prove the theorem by himself, a feat the boy had thought was beyond his powers. But now the problem arises: how can one be aware, or have knowledge, of things of which one is *not* aware? How can one exhibit a knowledge of things for which one's prior learning experience has given no preparation? This is the paradox of learning (or productivity or creativity): the *novel but appropriate* behavior that constitutes "creativity" is not based on past experiences. Whenever we learn something *new*, that knowledge cannot be based on learning (prior experience).

The two paradoxes dovetail in a distressing manner, because of the obvious relation between learning and knowing. We cannot learn anything *new* unless we already know it (by some other means), and we cannot know *anything* unless we have already learned (come to know) it. How, then, are human knowledge and learning possible?

Plato's Solution: The Doctrine of Forms and the Doctrine of Anamnesis

Plato considered these "paradoxes" spurious. He had a formulation of the nature of knowledge and a theory of learning that rendered these paradoxical results explainable. His theory of knowledge accorded a fundamental role to abstract entities, the "essences" of things (Platonic forms), and it held that the mind is acquainted primarily with abstract concepts, and acquainted only derivatively with concrete particulars. His theory of learning proposed that all so-called learning is actually remembering, that there is no real "learning" at all. This is the doctrine of *anamnesis* (recollections).

The doctrine of *forms* is presupposed in the *Meno* rather than formulated or explicated. The Platonic epistemology is *essentialism* (Popper, 1963): true knowledge is a description of the ultimate nature or "essence" of things—the reality which lies behind appearances. Behind every appearance (thing in the material world) lies an ultimate reality (essence) which is "known" by the intellect in possession of its truth. Plato distinguished three worlds or realms of being: the first world, the world of material objects; the second world, the world of psychological awareness; and the third world, the world of forms, essences, or ultimate realities. *True* knowledge and primary being reside in the third world; the material things of the first world have derivative or secondary existential status. If we, as creatures of the second world, happen to exercise our faculties correctly and happen to be lucky, we will glimpse the essences in the third world. For a Platonist, the function of scientific theory (as *true* explanation) is to *deny* the status of reality to appearances, and to derive them (lawfully) from the underlying level of forms, which alone constitutes reality.

Anamnesis dovetails nicely with the doctrine of forms. The doctrine of recollections states that there is no learning (of essences), only remembrance. It hinges on the immortality of the soul. For *if* the soul, as a denizen of the third world, is immortal, *then* it already knows everything there is to know. This is the text of the *Meno:*

The soul, then, as being immortal, and having been born again many times, and having seen all things that exist, whether in this world or in the world below, has knowledge of them all; and it is no wonder that she should be able to call to rememberance all that she ever knew about virtue, and about everything; for as all nature is akin, and the soul has learned all things, there is no difficulty in her eliciting or as men say learning, out of a single recollection all the rest, if a man is strenuous and does not faint; for all inquiry and all learning is but recollection [Sesonske & Fleming, 1965, p. 17].

Thus the illusion of learning results from the frailty of memory.

For the theorist in possession of the doctrines of anamnesis and forms, the "paradoxes" of the *Meno* are indeed spurious. The paradox of knowing simply disappears. The forms and essentialism combine to guarantee that "knowledge" is of essences *if* we are aware of (remember) anything. The problem of productivity disappears because creative behavior could not be dependent on prior learning, for there is no learning: we are "creative" or "productive" because we remember well. This paradox exists only if it is assumed that knowledge is based on learning, a thesis that the doctrine of recollections explicitly undermines. Thus for Plato, there is a solution for these prima facie paradoxes that renders their conclusions perfectly plausible and desirable. If these doctrines are correct, then the "paradoxical" situations are only to be expected. It remained for Aristotle and the nominalists to dissolve the paradoxes, because they rejected both of these Platonic doctrines.

Aristotle's Rebellion and the Beginning of Modern Dogma in Philosophy and Psychology

To most modern readers the doctrines of forms and anamnesis are absurd. Such talk of the immortality of the soul, of a realm of essences, and of innate ideas is a quaint relic of an earlier, less sophisticated era that was easily satisfied with glaringly inadequate and unscientific explanations. Such a reader traces his heritage to Aristotle, who also rejected his master's preachment on these issues. Aristotle commonly is regarded as the founder of the doctrines of *nominalism* (which holds that there are no nonconcrete, nonparticular entities), and *associationism,* and he first used them to dissolve Plato's paradoxes.

To combat nativism, Aristotle needed a mechanism of the mind that rendered memory, or recollection, explainable without resorting to a transcendent soul. This he found in associationism, which he "borrowed" from Plato. Aristotle claimed that the sequence of cognitive events is not random, but rather sequentially organized: habit and necessity of connection are the organizational principles. In both habitual or spontaneous connection *and* purposive or directed thought, the same three fundamental laws are operative: the laws of similarity, contrast, and contiguity. These principles of association provided him with a mechanism of the mind which could explain recollection without recourse to the Platonic doctrines. Consider H. C. Warren's (1921) rendition of Aristotle's view:

Recollection occurs inasmuch as one experience naturally succeeds another. If [the succession be] necessary, it is plain that when the one is stimulated it will stimulate the other; if not necessary but habitual, then it will stimulate it only in most instances. It is a fact that some persons are more habituated after being stimulated once than others after many times; just so we remember some things better after seeing them once than other things after many times. Hence, when we are recollecting we keep stimulating certain earlier experiences until we have stimulated one which the one in question is wont to succeed. And just so we hunt through the sequences, thinking along from the present or some other [thing], and from similar or contrasted or contiguous. By this means the recollection comes; for the experiences are in some cases identical with [the one in question], in others simultaneous with it, in others they involve a portion, so that the remainder is small and is thereupon stimulated. . . . It is not necessary to inquire how we remember the remote, but only the contiguous; for it is plain that the procedure is the same— I mean, that of sequence—when we [recollect] without preliminary effort and even when we fail to recollect. For experiences habitually follow one another, this succeeding that. And so, when a person wishes to recollect, he will do this: he will endeavor to get some initial experience, which the one in question succeeded [pp. 25–26].

Associationism, then, provides a mechanism of the mind that explains recollection without recourse to the doctrine of anamnesis.

Nominalism enters Aristotle's system to combat the forms as soon as associationism is admitted. One has only to note that the senses (which are assumed to be the foundation of our knowledge) present us with particulars which are associated by the mind, rather than with universals or other abstract entities. We never perceive redness, or mankind, or the law of gravitation; rather we see individual red objects, this or that man, and falling

objects. Why then say that the mind is fundamentally aware of forms or any such abstract entities? Aristotle, with his "scientific" temperament, could see no reason for the primacy of forms at all.

But Aristotle did recognize the conceptual utility of generic concepts. How then is one to derive them from particulars? His answer was a theory of abstraction based on the principles of association, which we may call the *subtractive theory of abstraction*. This theory says that our generic concepts result from the association of common elements (or features) of particular objects. Mankind, for instance, means nothing more than the sum of properties found in common in particular men. There is nothing more to redness than the common features of all of the individual red things we experience. For Aristotle and the nominalists, the abstract or universal is merely that which is shared in common by concrete particulars.

Examining the question of the nature and role of abstract entities in the learning process shows that from the Aristotelian point of view the "solution" to Plato's paradox consists in its dissolution. Abstract entities play no essential role in our knowledge, for all learning is the learning of particulars and their recombination, and abstract concept formation is a *derivative* result of this process of recombination. Learning and knowledge have their basis in concrete particulars only: abstract specification occurs only as a result of the learning of particulars. The problem of productivity likewise vanishes: it is an illusion resulting from overlooking the recombination of old particulars. Productive thinking is nothing but the association of new combinations of elements. Aristotle solved Plato's paradoxes by dissolving them entirely.

The Centrality of Aristotelian Thought Today

A moment's recollection (if you will pardon that term) shows that Aristotle's doctrines are at the heart of contemporary thought in epistemology and the psychology of learning. The centrality of associationism as the mechanism of the mind is so well known as to require only the observation that *not one single learning theory* propounded in this century *has failed to base its account on associative principles*. Associationism enjoys incredible currency, even among otherwise mortal enemies

such as neobehaviorism and the Gestalt approach (see Neisser, 1967, chap. 11).

And contemporary associationists mirror Aristotle's thinking with respect to creativity and serial ordering almost exactly. Learning theories are *copying* theories: if the present situation held nothing in common with past situations, learning would be impossible, for there would be nothing to learn *from*. Learning cannot occur unless some concrete, particular elements remain invariant within the overall variable situation. If the *same* stimulus situation is not somehow instantiated in apparent novelty, learning cannot be exhibited, for there would be nothing from which to transfer prior training. Consider the following "explanation" of novelty:

If the correct response must always occur before it can be rewarded, what novelty is added by learning? The new feature is that the particular response rewarded now occurs regularly to a specific cue, whereas previously its occurrence at just that time and place may have been exceedingly infrequent. The connection between cue and response is the new product of learning. Often a number of different response units are connected to cues so that they all occur together, either simultaneously or successively. Thus a new pattern of responses is produced; the responses are old, but the combination is new [Dollard & Miller, 1950, p. 37].

Serial order is also a matter of the association of elements of behavior. Hull (1930) provided the classic stimulus–response approach with mediation theory (generic r_g), and his basic thought pervades those formulations addressed to complex phenomena, where the problem is most acute (see Berlyne, 1965; Jenkins & Palermo, 1964; Osgood, 1953, 1957, 1963).

These same theorists follow Aristotle in dissolving the problem of productivity. Consider these comments for their *denial* of genuinely creative behavior:

Productive thinking takes place when "past learning is subject to modification and reorganization," for example, when an individual who has never "reacted to the weight aspect" of a pair of pliers conceives of its possible use as a pendulum bob "during the stress of the problem situation." . . . Productive thinking is typically a product of stimulus-response generalization, and it invariably permits of wide extension to future problem situations through further stimulus-response generalization [Berlyne, 1965, pp. 315, 317].

This same theorist echoes the subtractive theory of abstraction in a particularly clear fashion:

Abstraction, on the other hand, consists of making overt behavior depend on certain properties of a stimulus pattern while disregarding other properties. . . . Abstraction, then, means making behavior take account of some of the signals in the message and disregarding the remainder [p. 45].

In philosophy, the dream of constructing the entire complexity of the world on a basis of concrete particulars constantly recurs. A recent milestone in this tradition is Nelson Goodman's (1951) attempt in *The Structure of Appearance* to construct *abstracta* out of *concreta*. W. V. O. Quine is also of professed nominalist leanings. In general, one must admit that nominalism, seemingly implied by the empiricist world view, dominates the philosophical scene. Generic concepts, classes, etc., are admitted, albeit grudgingly, but the majority of lip service is still to nominalism.[2]

But despite the plausibility and pervasiveness of the "received view" doctrines stemming from Aristotle, it is easy to see that they are indefensible dogmas. The destructive burden of this article is to show that nominalism and associationism are utterly incapable of providing adequate accounts for our two problems. They are, indeed, considerably more implausible than the seemingly unscientific doctrines of Plato. Let us now examine some recent "heresies" in philosophy and psychology that expose the "received view" doctrines as the egregious blunders that they in fact are. Consider first the untenability of nominalism.

The Conceptual Primacy of the Abstract

A number of developments in recent philosophy force the abandonment of nominalism in its traditional forms. They may be grouped conveniently under the heading of the epistemological, or more

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[2] There are prominent cracks in the nominalistic bulwark, however. For example, Quine (1960) now defends nominalism *as an admitted bias,* on pragmatic grounds only. Consider these comments in *Word and Object:*

The case that emerged for classes rested on systematic efficacy. Note it is certainly a case against nominalism's negative claims, but still it is no case against a preferential status for physical objects. In a contest for sheer systematic utility to science, the notion of physical object still leads the field. On this score alone, therefore, one might still put a premium on explanations that appeal to physical objects and not to abstract ones, even if abstract objects be grudgingly admitted too for their efficacy elsewhere in the theory [p. 238].

But the point remains—one cannot notice cracks in the wall of nominalism unless the solidity outweighs the proportion of crumbling doctrine.

generically, the conceptual, primacy of the abstract. We can dismiss nominalism by considering (at least) these areas: the conceptual nature of facts or "factual relativity"; the abstract nature of scientific explanation or the "deductive unification of experience"; and finally, the primacy of the abstract in the nature of both common sense and scientific knowledge, and in scientific theory construction.

Consider first factual relativity. Philosophers of the "empiricist" persuasion that Aristotle championed hold that our knowledge is founded or based on "facts." The given in experience for the nominalistic empiricist is the particular, the concrete, and the *atheoretical*. The deliverances of sense are the touchstone on which scientific knowledge rests and is validated, and those deliverances have nominalistic properties "built in," according to the received view. But there is a problem with "facts": they cannot have either the nominalistic or the foundational properties that this position demands. Facts cannot be the "raw data" of observation.

A little reflection shows that observation is something over and above the raw data of perception—it requires an active process to *construct* facts out of the raw data. Observation requires skill: it is an achievement term in the sense of Austin or Ryle. As Turner (1967) rightly noted: "An observer who could claim no other credentials than those of naivete would see very little that would be of interest to the scientist [p. 190]." But this has simply not been noticed by empiricist philosophers.

The reason such philosophers have ignored the conceptual nature of facts is obvious: it destroys the foundation (all knowledge is a deliverance of sense) on which their world view was erected. For the empiricist, reality consists of the given, the concrete, and the particular. Factual relativity says, in effect, that the given cannot be "taken" at all, that what there is is not concrete as the empiricist construes the term, and that the particular cannot be known at all without prior or simultaneous knowledge of the general.

But theorists do not, in viewing the same "objective" situation, perceive the "same" facts. As T. S. Kuhn (1970) has indicated in discussing paradigm clashes, theorists on opposite sides in a clash literally live in different worlds. This gulf between observers of different theoretical persuasions is well captured in a historical example:

If in the brilliant disc of which he is visually aware Tycho sees only the sun, then he cannot but see that it is a body

which will behave in characteristically "Tychonic" ways. These serve as the foundation for Tycho's general geocentric-geostatic theories about the sun. . . . Tycho sees the sun beginning its journey from horizon to horizon. He sees that from some celestial vantage point the sun (carrying with it the moon and planets) could be watched circling our fixed earth. Watching the sun at dawn through Tychonic spectacles would be to see it in something like this way. Kepler's visual field, however, has a different conceptual organization. Yet a drawing of what he sees at dawn could be a drawing of exactly what Tycho saw, and could be recognized as such by Tycho. But Kepler will see the horizon dipping, or turning away, from our fixed local star [Hanson, 1958, p. 23].

Factual relativity guarantees that one cannot simply go out into the world and neutrally collect facts. Without a prior conceptual framework, that is, a point of view from which to impose order upon reality, there is only the changing phenomenal flux of experience, the "blooming, buzzing confusion" of William James. The data of sensation do not come with little tags attached proclaiming their factual status. Observation is not merely focusing one's attention on the data, but rather assimilation of data into the conceptual scheme of the observer.

Factual relativity, emphasizing the theoretical contamination of the allegedly solid and neutral data base of science, is the first step in the overthrow of nominalism. The nominalist holds that what is given to the mind, the basis of all its further constructions, is atheoretical and neutral, or in a nutshell, concrete. Factual relativity removes this alleged concreteness from the deliverances of sense in a most convincing fashion: the "data base" for either science or everyday human endeavor is theoretical, shifting, dependent on nonobjective factors, and thoroughly nonconcrete.

Thus, what is given to the mind is not concrete: is it also not *particular?* If it is not particular, then nominalism, as the thesis that there are no nonconcrete nonparticulars, is untenable. Let us now look at the perceptual experiences that are said to constitute the ultimate data base of scientific explanations, and see that not only are there no "perceptual experiences" whatsoever at the "basis" of science, but also that the propositions of explanatory discourse deal with abstract and ideal entities.

Concordant with the view that science does not "collect" its facts but must instead "manufacture" them, this claim can be advanced: science can never deal directly with particulars or individual things at all, but only with "abstract" entities or

thing-*kinds*. Most contemporary "philosophy of science," insofar as it deals with substantive theories at all, is concerned with the purely formal structure of the subject-matter theories examined (in particular, those that are or can be axiomatized). But one factor that has been quite neglected is the restriction which the structure of scientific axiomatic systems imposes on the subject matter of such theoretical systems.

In endorsing factual relativity, we have denied that any form of the given in experience provides a bedrock on which to found science; now we must question the other facet of the empiricist "foundations" view of knowledge which holds that that which is given is to be taken as particular. Posing the issue in this form leads back to the problems of knowledge with which we began: how does the nominalist-empiricist *know* (or come to recognize, be acquainted with, or recollect, etc.) his concrete particulars as *instances* of particulars? That is, if a "thing" is proffered to me as "an X," where X is any description (i.e., classification) of it *whatsoever*, how can I know that to be the case (that it *is* an X) without first knowing what it is to be an instance of a thing-kind, namely, of kind X? In order to recognize a thing (fact), mustn't one presuppose knowledge of, or operation within, a framework (theory) of thing-kinds? Reflection indicates that classification is fundamentally a process of abstraction. But this goes against the nominalistic attempt to accord abstracta *derivative* status from concreta, by making the process of abstraction a *sine qua non* for determination of concreta. Let us develop this point by considering what is involved in "scientific" explanation.

The ideal form of theoretical explanation is usually taken to be the hypothetico-deductive schema. The question we must ask is: Does employment of the hypothetico-deductive method *idealize* the domain to which it is applied? That is, what does the process of deduction require of the empirical predicates of the science before it may be applied legitimately?

Körner (1966) considers two classes of such constraints. The first concerns elimination of inexactness and indefiniteness of predicates. The logic of the hypothetico-deductive framework is an unmodified classical two-valued logic. Thus, strictly speaking, the hypothetico-deductive framework admits no inexact predicates whatsoever. So it must, strictly speaking, be the logic of the finished sci-

ence report, that is, admit no open concepts in the sense of Pap (1958). The point is this: the hypo-thetico-deductive system is *not* connected to experience directly: the empirical predicates with which it deals must be idealizations or abstractions. Raw experience is rendered into "concrete" categories by the process of abstraction.

When applied to perceptual characteristics, the abstraction consists in distinguishing between relevant and irrelevant determinables and, so to speak, removing the deducibility-relation which holds between any relevant and any irrelevant determinable. It results in the formation of new, "abstract" determinables—every abstract determinable and its perceptual counterpart being mutually exclusive. . . .

This type of abstraction which, in order to distinguish it from other kinds, I shall call "deductive abstraction," and which replaces perceptual by abstract determinables, reinforces the general effect of the restrictions which the logico-mathematical framework of every theory imposes upon perceptual characteristics [Körner, 1966, pp. 166–167].

Even this is not sufficient to render an empirical predicate fit for a position in a deductive unified system. Further idealization removes the predicate from perceptual experience entirely:

The disconnection of the theory from its perceptual subject-matter can now be also expressed by saying that no perceptual proposition and no perceptual predicate occurs in any deductive sequence. That this must be so is clear. All inexact perceptual predicates are precluded from occurring in any sequence, and the exact—though internally inexact—determinables have been replaced by non-perceptual predicates through abstraction—to say nothing of the further replacements due to the conditions of measurement, general and special.

No perceptual proposition will be a last term in a deductive sequence. The theory will be linked to perception not by deduction but by identification [Körner, 1966, pp. 168–169].

This means that the reference of "empirical" concepts cannot be given, but is rather idealized, or constructed, by the active abstraction of our conceptual frameworks. An ideal straight line within an axiomatic system is a far cry from *any* empirical line, such as a light ray, the surface of a straight edge, etc. But our theories of reality deal with the abstract, idealized elements such as "straight lines" and not with the lines drawn with rulers or physical objects. With that admission, our theories become nonempirical: their reference is to ideal entities rather than to concrete physical ones.

We need note only this in conclusion: the nominalistic dream of constructing "abstracta" out of "concreta," thus relegating the former to second-class status, must admit that particular concreta can be identified only with the help of abstracta. But acknowledging this fact abandons the dream entirely. Particular "facts" can only be known as instances of abstract, theory-determined, thing-kinds. What we are "presented" with by the construction of experience is neither concrete nor particular. Particulars depend for their very existence on the primacy of abstract categories. Those categories exemplify the force of Plato's paradox of knowledge: We cannot "know" anything (as an instance of a thing-kind classification) without already "knowing" the abstract concept. Nominalism simply does not account for the nature of our knowledge.

The third point to be made under the heading of the conceptual primacy of the abstract is that our knowledge is inherently based on abstract specification, because *not only science but also common sense can deal only with the abstract*. If either science or common sense reasoning is in the business of achieving (by whatever means) our knowledge, then, because of "the way the minds works," all our knowledge is abstract.

Let us consider the ramifications of this contention by exploring two theses which contain basic insights into the nature of human knowledge and the organism which has that knowledge: the thesis of structural realism (as a theory about the nature of our knowledge), and the more psychological thesis of the abstract specification of experience due to F. A. Hayek (1952, 1969). These positions provide slightly different arguments against nominalism, and serve both to "overkill" nominalism and to drive home the conceptual primacy of the abstract in yet another manner. Consider Hayek's position first.

In a fascinating and neglected book entitled *The Sensory Order*, Hayek (1952) is concerned with *perception*, and the physiological correlates of our psychological abilities. Hayek's thesis is that no sensory input is "perceived" (i.e., inputed through the active central nervous system) *at all* unless it is perceived as one of the kinds of input accepted by the (innate or learned) classes of sensory order. Sensory perception is always an act of classification; the input signal is "processed" by any member (to which it "keys") of the sensory "orders" which impart to the phenomenal event the properties it has. No sensory input is perceived unless it can be "isomorphically" accepted as a match by

the classes of sensory order. No constructions of phenomenal existents are possible except in terms of the (prior) apparatus of classification inherent in the operation of the functional nervous system. Unless an "event" gives rise to the pattern of sensory input that fits an organism's preexisting natural kind classifications, it is not perceived at all. Perception is thus never of the attributes of "objects" in the world at all: instead, objects are *abstractions* of the organization and memory of the central nervous system.

The sensory (or other mental) qualities are not in some manner originally attached to, or an original attribute of, the individual physiological impulses, but . . . the whole of these qualities is determined by the system of connexions by which the impulses can be transmitted from neuron to neuron; . . . it is thus the position of the individual impulse or group of impulses in the whole system of such connexions which gives it its distinctive quality; . . . this system of connexions is acquired in the course of the development of the species and the individual by a kind of "experience" or "learning"; and . . . it reproduces therefore at every stage of its development certain relationships existing in the physical environment between the stimuli evoking the impulses. . . .

This central contention may also be expressed more briefly by saying that "we do not first have sensations which are then preserved by memory, but it is as a result of physiological memory that the physiological impulses are converted into sensations. The connexions between the physiological elements are thus the primary phenomenon which creates the mental phenomena" [Hayek, 1952, p. 53].

Again, Hayek's thesis is that an "event" is not seen at all unless it is assimilated to a classification that already exists in the functioning of the central nervous system. Everything that we know about stimuli, our entire knowledge of the "external" world, consists in the classifications effected by the action patterns of the functioning nervous system. Human knowledge is a system of rules of determination that indicate equivalences and differences of various combinations of input patterns.

The conceptual primacy of the abstract is that:

We ought to regard what we call mind as a system of abstract rules of action (each "rule" defining a class of actions) which determines each action by a combination of several such rules; while every appearance of a new rule (or abstraction) constitutes a change in that system, something which its own operations cannot produce but which is brought about by extraneous factors.

This implies that the richness of the sensory world in which we live, and which defies exhaustive analysis by our mind, is not the starting point from which the mind derives abstractions, but the product of a great range of abstractions which the minds must possess in order to be capable of experiencing that richness of the particular [Hayek, 1969, p. 318].

Hayek's psychological thesis literally *is* the doctrine of anamnesis in modern, evolutionary dress. Now, are there philosophical considerations that have equal affinity to the Platonic doctrines? The thesis of *structural realism* fills this bill of "particulars" quite well.

To set the stage for structural realism, consider the distinction, made famous by Bertrand Russell, between knowledge by *acquaintance* and knowledge by *description*. You are directly acquainted with, for example, the color of your shirt, the warmth of your coffee, the pain of your headache, etc. Anything that is in the "phenomenal experience" of an individual is known to him by direct acquaintance: roughly, anything that is within subjective experience, that is, "directly observed," is known by acquaintance rather than by description. But suppose you are to meet someone with whom you are *not* acquainted, whom you have not met personally. You can still know someone (or something) by description without being acquainted directly with him (or it). Suppose you are to meet a new brother-in-law at the airport, and have only your sister's description to go by: he is "about six feet tall, has sandy hair, weighs 175 pounds, has blue eyes, wears blue suits, etc." Once you have personally met someone previously known only by description, then (given sufficient time) you may become directly acquainted with the reference of most of your previous knowledge by description.

Knowledge by description is the basis of our learning new things, as yet unexperienced. We learn to assimilate descriptions to known acquaintances (e.g., Small boy: "Mommy, what is gray hair?" Mother: "It's like your grandfather's, dear." The boy, knowing his grandfather by acquaintance, now knows what "gray hair" refers to). Knowledge by description is inferential and propositional: it is knowledge *that,* whereas knowledge by acquaintance is knowledge *of.* The crucial point is that all scientific knowledge is knowledge by description. Structural realism is a thesis about what constitutes that knowledge by description (not our knowledge of sensory impressions and acquaintances).

The thesis of structural realism can be stated quite succinctly. First distinguish between the mental and the nonmental world (including our bodies in the latter), and note that "everything

that we usually consider to be perceived properties of external objects must be recognized as existing *wholly* and *only* in the mind [Maxwell, 1968a, p. 151]." The properties that we ordinarily ascribe to external objects "are just as much in the mind as those we experience in dreams or hallucinations. . . . In a real and important sense, then, all of the external world, including even our bodies is unobserved and unobservable [p. 152]." This distinction between the mental and the nonmental, locating the *properties and contents* of the latter in the mind, is like Berkeley's commentary on Locke's distinction of primary and secondary qualities. Berkeley pointed out that the distinction was invalid: everything is secondary in the sense that all properties and qualities are in the mind rather than "in" the objects themselves.

But if this is so, of exactly what can our knowledge of the nonmental realm consist? The enormity of the issue can be thrown into bold relief by reflecting on the fact that all of our "natural" and "physical" sciences disclose knowledge only of the nonmental sort. Can science conceive meaningfully of any properties of the entities of the nonmental world? Structural realism answers thusly:

The only aspects of the nonmental world of which we can have any knowledge or any conception are purely structural (or, in other words, purely formal). . . . The notion of *form* or *structure* needed here may accurately be said to be logical (and/or mathematical) and, in a sense, abstract; *characterizations* of instances of it will be in terms of logic alone, i.e., *the logical connectives, quantifiers, and variables* —they will contain no descriptive terms. . . . *Structure,* in the sense we require, *must be factual and contingent* and, at least in its exemplifications, *concrete.* Furthermore, it cannot be emphasized too strongly—what should already be obvious—that structure is *not* linguistic nor, even, conceptual in character; it is an objective feature of the real world [Maxwell, 1968a, p. 153].

Structural realism is structural in the sense that our knowledge of the entire nonmental world, from our bodies to theoretical entities, is of the structural characteristics of that world rather than of the intrinsic properties of those objects comprising it.

Structural realism may be stated in terms related to Kant's distinction of *phenomena* from *noumena.* Kantian phenomena, which exist wholly in the mind, are the only occurrences of which we have direct knowledge: we know phenomena by acquaintance. But the noumena, the things in themselves, are completely removed from our acquaintance: we have no direct knowledge of them at all.

Yet the bulk of our knowledge is about the noumena: but that knowledge is of their structural characteristics. Thus, against Kant, both common sense and science disclose knowledge about things in themselves, but that knowledge is purely structural. The only things of which we know the intrinsic properties are the phenomenal qualia of the mental world. This requires some rather drastic changes in our usual way of thinking about the world and our knowledge of it.

One of the concepts most in need of revision (actually reinterpretation) is that of *observation.* We speak commonly of "observing physical objects." But, strictly speaking, there can be no observation of public objects at all:

Observation, as usually conceived, is a naive realist concept through and through. Therefore, if structural realism is true, then, in any usual sense of "observation," we observe neither public objects nor entities in our minds: we never observe anything at all. For example, if I have a dream, no matter how vivid, of seeing a white dog, I cannot be said to have observed a dog or, indeed, anything, since there existed nothing corresponding in any straightforward way to the ostensibly observed object. On the other hand, if I do what ordinarily could be called "actually seeing a white dog," then . . . I do not actually observe anything (or even *see* in the usual sense), for there *is* nothing external to me which is white in the usual, qualitative sense, or etc., etc. [Maxwell, 1968b, p. 167].

Talk of the observation of objects, as is common in science and common sense, must be taken as a shorthand formulation (in terms of naive representational realism) for discourse about sense impressions and their structural relation to the external objects which are their causes.

To conclude our account of scientific knowledge, consider the role of the abstract in structural realism. We must note the sense in which abstract entities are *the* essential components of scientific knowledge.

Recall that the opposition to abstract entities in science is that they are alleged to be too far removed from the deliverances of sense (or whatever is taken to be the foundation or data base of knowledge) to be "real." What is real to the nominalist is what is particular, concrete, visually and tactually present to the investigator, etc. Against nominalism we argued that the particular cannot be known as an instance of a particular of kind X without presupposing knowledge of universal, or otherwise abstract, entities (such as thing-kinds). But, if scientific knowledge is formal or structural, then it is

always abstract because the formal relationships which characterize the nonmental world are not particular, concrete, always present to the senses, etc. *Structural knowledge is fundamentally abstract knowledge in the sense that it is not what is presented in our experience.* Theoretical entities are specified by reference to their (almost invariably mathematical) structure. "Scientific" knowledge of nonmental entities is limited entirely to this structure, and we cannot attribute to theoretical objects the properties that the nominalist bases his claim upon: that is, the particular and concrete deliverances of our senses. William Kneale (1949) caught the nominalist's fallacy:

That transcendent (theoretical) hypotheses are concerned *only* with structure has often been overlooked in the past, because scientists and philosophers have mistakenly allowed themselves to slip some imaginative elements, such as perceptible hardness, into their concepts of the objects mentioned in the hypotheses [p. 94].

But the nominalist can be left in a quandary: his dilemmas only lead us away from the main point. Scientific knowledge of the nonmental world is a matter of having defensible opinions about the abstract structure of that world. Abstract entities are essential to scientific knowledge for this reason.

Here it is well to pause, reflect upon the major points of this section, and ask where we are with regard to the problems for which Plato postulated forms and anamnesis. I hope to have succeeded in showing that Aristotle and his nominalistic descendants have continued to ignore the paradoxes that Plato raised. To be a nominalist today is to admit that one cannot address any of the interesting questions that we have discussed.[3] But demolishing nominalism, no matter what its significance, is unimportant when one reflects on the question that naturally follows it: Can *anyone* say anything significant about "the way in which the mind works?" Unfortunately, the answer, we shall see, is more no than yes.

Psycholinguistics and the Reemergence of the Problem of Creativity

Psycholinguistics is inherently Platonic in outlook. Chomsky (1966a), in tracing his heritage in linguistics to Descartes, overlooked his psychological and epistemological descent from Plato almost entirely. For the transformational grammarian, creativity in language is the prime datum for linguistic theory. No theory that fails to provide explanatory machinery sufficiently complex and powerful enough to explain the novel but appropriate use of language can be considered adequate. Consider Chomsky's (1966b) succinct presentation of the centrality of productivity:

The most striking aspect of linguistic competence is what we may call the "creativity of language," that is, the speaker's ability to produce new sentences, sentences that are immediately understood by other speakers although they bear no physical resemblance to sentences which are

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3 Associationism is said to unite *particular* elements. But is associationism in fact nominalistic? A straightforward argument attributed to Harold Höffding (1891) shows that it *cannot* be; that, in Bradley's (1883) cryptic formulation, "Associationism marries only universals." The Höffding step and the Höffding function destroy the nominalistic interpretation of associationism.

Consider what associationism is said to do. Two elements, A and B (their stimulus or response characteristics, neural locus, etc., are irrelevant), because of one or more of the "laws" of association, have been linked together, such that when one occurs, the other tends to occur also. The laws of association tell you the sufficient conditions for this "linkage": contiguity, similarity, frequency (and the whole host of others that have been proposed). But the elements *cannot* be directly associated: they *never* recur in nature in the same manner. Due to the Heraclitean flux the same elements never reappear. Thus the elements A and B may not become associated directly unless you believe in one-trial learning, *and* unless you recognize that

only the "atoms" or parts of those elements (call them *a* and *b*) can thus be associated "directly." The contemporary formulation of this elementism, represented in Estes' (1950) assumption of stimulus elements, pervades the mathematical psychology literature. Associationism, in order to survive an obvious refutation of its claim to be the mechanism of the mind, was forced to *postulate* (remember, no one has ever shown us a stimulus element) an atomistic picture. But with this tacit admission the association of A and B is not of this form:

$$A \text{——} B$$

But rather of this form:

$$
\begin{array}{cc}
A & B \\
\prime & \prime \\
\prime & \prime \\
\prime & \prime \\
a \text{——} b
\end{array}
$$

There is no linkage *at all* between A and B, except as a *shorthand notation* for the linkage through a and b. The link between A and a has been called the Höffding step, and the entire sequence from A through a–b to B is the Höffding function. The "proper part" or thing-*kind* nature of the elements a and b is what is devastating to nominalism. Since thing-kind identification involves one inescapably in abstract and "universal" specification, Bradley's thesis stands: associationism marries only universals. Yet, if the doctrine must presuppose universals in order to explain them, then its claim to explain universals in terms of particulars is false.

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"familiar." . . . Modern linguistics, however, is seriously at fault in its failure to come to grips with this central problem [p. 11].

With this admission, Plato's paradox returns: for how can one exhibit knowledge for which one's prior learning history has given no preparation? Chomsky takes exactly the same approach to productivity as Plato did in explicating Meno's slave's recollection of things "already known." Chomsky (1965) argues that

In bringing to consciousness the triple ambiguity of (5) [I had a book stolen] in this way, we present no new information to the hearer and teach him nothing new about his language but simply arrange matters in such a way that his linguistic intuition, previously obscured, becomes evident to him [p. 22].

Plato's problem, although ignored by many of his successors, has not disappeared after all. And the point is that associationism cannot provide a sufficiently powerful generative mechanism to account for creativity.

There is no sense of "habit" known to psychology in which this characterization of language use is true (just as there is no notion of "generalization" known to psychology or philosophy that entitles us to characterize the new sentences of ordinary linguistic usage as generalizations of previous performance). The familiarity of the reference to normal language use as a matter of "habit" or as based on "generalization" in some fundamental way must not blind one to the realization that these characterizations are simply untrue if terms are used in any technical or well-defined sense, and that they can be accepted only as metaphors—highly misleading metaphors, since they tend to lull the linguist into the entirely erroneous belief that the problem of accounting for the creative aspect of normal language use is not after all a very serious one [Chomsky, 1965, p. 12].

"Habit" theories cannot handle creativity because they would need an infinitude of associations in the organism's central nervous system to be "activated" and displayed (probabilistically, dispositionally) in novel behavior. Even if there were a way to get all of those habits into the organism (a physical impossibility), they would not be "habits" at all: *they could not have been learned.* Associationistic learning theories are identical element-copying theories, and the distinguishing feature of novelty is precisely that it is novel: it is not a copy of anything at all. At no point in the organism's prior history has there been anything to learn *from* when novelty is exhibited. Generalization in stimulus-response theory presupposes identical elements (from which generalization occurs): there simply is

no stimulus–response theory of generalization for abstract entities.[4] Thus Chomsky claims that a speaker-hearer's *knowledge* of his language is infinitely greater than his prior learning history.

To account for productivity, the transformationalist has been forced to acknowledge the explanatory primacy of abstract entities. The only way to explain "creative" utterances is to employ rules in the grammar that range over inherently abstract entities that never appear in actual speech or written language. The explanatory primacy of the ab-

[4] Let us make this point in one further manner. Psychological theory tells us that concepts of particular and generic nature arise by the gradual predominance of the similarities of entities over their differences. The theory is to provide a mechanism whereby similarity alone imprints itself on the mind: abstraction, after all, merely subtracts from the total presentation the *relevant* attributes—which are defined in terms of their similarity. The similarity in diversity is made manifest to the mind *as such.* Elements cannot be similar (let alone identical) unless they are recognized as similar.

But there are two problems immediately facing the subtractive theory of abstraction or "generalization." First, it must postulate that perceptions can be ordered into series of similars. Second, it must account for the fact that similarity or dissimilarity does not appear as an element of perception along with the perceptible qualities of the particular entities. Each problem leads to the same conclusion: the theory presupposes what it is to explain.

The construction of series requires the same conceptual apparatus as the structuring of sentences, that is, generation of potentially infinite sequences according to rules. In one sense, the weakness of the subtractive theory of abstraction is that it selects, from all possible logical orders and relations, only the principle of similarity. It ignores the indefinite number of other syntactic structuring relations. According to what principles was similarity chosen? Clearly it was not chosen; it was presupposed. Consider a series of presentations of a α, a β, a γ, etc. The connection of the members of such a series by the possession of a common property ("a") is only a special example of the possibility of logical connection. In all series, the connection of the members is due to a law of arrangement establishing a rule of succession: that which binds the elements together conceptually is not itself a new element, but is itself the rule of progression. This led Cassirer (1923) to conclude:

The unity of the conceptual content can thus be "abstracted" out of the particular elements of its extension only in the sense that it is in connection with them that we become conscious of the specific rule, according to which they are related; but not in the sense that we construct this rule *out* of them through either bare summation or neglect of parts. What lends the theory of abstraction support is merely the circumstance that it does not presuppose the contents, out of which the concept is to develop, as *disconnected particularities,* but that it tacitly thinks them in the form of an ordered manifold from the first. The concept, however, is not deduced thereby, but presupposed; for when we ascribe to a manifold an order and connection of elements, we have already presupposed the concept, if not in its complete form, yet in its fundamental function [p. 17].

stract is at the heart of two crucial distinctions in the transformational account: deep and surface structure, and competence and performance. Exploring these distinctions for a moment will show the centrality of abstract specification and productivity in psycholinguistics, and thus the affinity of the approach to the Platonic epistemology.

The competence–performance distinction leads directly to "creativity." Our *knowledge* of our language is vastly greater than our *learning* history. Linguistic experience is limited since we have been exposed to only a relatively small sample of our potential linguistic utterances. Yet we can understand any sentence that is grammatically well formed in our language. Competence has to do with our knowledge of the structure of language. Linguistic performance, on the other hand, has to do with the actual speaking of language (see Chomsky, 1967, p. 398).

Performance is what the speaker actually *does* in speaking a language, but language per se is not performance. The language, the goal of the linguist's investigation, is an abstract system, that is, a competence system (of rules or principles) that a speaker has that enables him to speak and understand. Thus language, as the subject matter investigated by linguists, is an abstract system quite removed from the deliverances of sense (speech sounds per se) or whatever else is taken to be the "basis" of knowledge. Need I now remind you that the knowledge of language disclosed by contemporary linguistics is wholly of its *structural properties*, as Maxwell used the term in describing structural realism?

Linguistic creativity automatically rules out all extant associationistic theories of language learning, for they cannot, because of the limitations of the principles they employ, account for the infinite number of sentences that every speaker-hearer is potentially capable of understanding (with *no* previous "learning" history). All learning-theory formulations of language are by definition performance theories: they cannot talk to the problems of competence at all.

Ambiguity, as a specific example of the problems of meaning, provides a convenient entrance into the surface-deep structure distinction. A grammar, according to Chomsky, relates sounds to meanings. Sounds exist as part of the "objective" or nonmental world. But what about meanings? They are not part of the "physical" world in the same

way as are sounds: meanings must somehow be abstractions from the "primary" data of the senses. Chomsky developed the surface-deep structure distinction to explicate the abstract nature of meaning and its mode of representation in particular utterances. Let us first develop the notions "abstractly," and then relate them to ambiguity.

In order to explain certain phenomena in language, Chomsky found it necessary to draw a distinction paralleling the distinction between appearance and reality. Consider the case of scientific theory construction. The commonsense man lives in a world of perceptible objects, persistent things, sensible qualia, etc., that is, in what Sellars (1963) called the manifest image of enlightened common sense. In attempting to construct a theory of reality, science has come up with quite a different picture of the world, populating it with microphysical entities, events in space-time, etc. Thus, scientific theory functions to deny the status of reality to appearances. It *reconstructs* appearances as manifestations of the underlying reality disclosed by its postulations. The surface structure is the world of appearances. Deep structure is the underlying reality postulated by science to explain the world of appearance. Surface-structure appearance is a manifestation of underlying deep structure reality.

The surface structure of a *language* is what is heard or spoken in the actual occurrence of speech (or written, in the case of writing). It is all the information contained in an utterance as it is heard or as it is written. A labeled bracketing or parsing of constituents exhausts the information contained in surface structure. Performance exhibits, but is not synonymous with, surface structure. Deep structure is the abstract, underlying *causal* order from which the surface is generated (within the system as it stood in Chomsky, 1965, the base component). Deep structure is *essentially* abstract structure since it is *nowhere* manifested in surface structure. And yet, the abstract deep structure determines the meaning of the surface-structure strings.

This problem of the relation between the meaning of an utterance and the deep structure is made abundantly clear in those cases where one and only one surface structure can be understood in different ways, that is, in cases of deep-structure ambiguity. In these cases, no amount of interpreting the surface-structure string will help in ex-

plaining the multiple meanings of the utterance. Consider the following sentence which has only one surface-structure representation (parsing or bracketing):

Flying planes can be dangerous. [1]

Sentence 1 has two possible interpretations, neither of which can be extracted unambiguously from just its surface structure:

(a) Being a passenger or pilot can be dangerous (the plane might crash).

(b) A plane might crash into you (while you are on the ground, etc.).

The point is obvious: surface-structure analysis cannot account for the understanding of an indefinitely large class of sentences. Deep structure is a necessary postulation in order to do so. The general strategy for requiring the notion of deep structure in any explanatory linguistic theory is found in Chomsky (1966b, pp. 37ff). Should doubts persist, this source should convince one of the necessity of the postulation of deep structure in explanatory models in linguistics.

To summarize the import of this digression, the function of the surface–deep-structure distinction in transformational linguistics is to separate the world of appearance (surface structure) from the reality (deep structure) underlying it. Deep structure, insofar as it is not manifested (even indirectly) in surface structure, is *abstract* structure. The explantory entities of linguistic theory are as abstract as any forms that Plato could have countenanced or desired.

And the surface–deep-structure distinction has application far beyond the linguistic realm for which it was introduced originally. The entire psychological domain, *all* behavior rather than just language, is susceptible to analysis in terms of the distinction. Chomsky's revolution in linguistics has, among other things, shown very clearly that no explanatory theory that does not make the distinction can provide an adequate psychology (since linguistics is only one branch of cognitive psychology). The problem of productivity in *all* behavior forces psychology to acknowledge the explanatory primacy of the abstract, and effectively reinstates Plato's approach to the domain's problems.[5] But the recognition of a problem is only a

first step. And what must be emphasized is that in recognizing the gravity of the problems of productivity and meaning we have reinstated Plato's epistemological problems in the *Meno*. We must now reevaluate the doctrines he proposed as their solutions. We have already reinstated (at least implicitly) the doctrine of forms in accounting for the nature of our scientific knowledge, and now we must reconsider the case for anamnesis.

Recollections Revisited: The Biological Basis of Cognition

To the empiricist and the behaviorist, the doctrine of recollections is an anathema. But what is its status with the contemporary nativist, and the theorist who rejects associationism as the necessary and sufficient mechanism of the mind? Is there any hope of resuscitating the doctrine in anything like its original form? That the answer is "Yes, it can be reinstated" becomes obvious when we reflect on what the doctrine requires, and what it was designed to accomplish. It requires something akin to a soul, that can be present in an individual, and yet contain a priori knowledge that transcends any given individual's lifetime and experience. There must be a mechanism that presents reincarnation and earlier lives influencing present competence (as one essential characteristic of "souls") as other than an absurdity, granted our present scientific perspective. To reinstate the doctrine, we need a mechanism of a priori (in the sense of innate) competence (knowledge in the sense of capacity, rather than specific contents) as the

[5] In an obvious sense, the transformational grammarian has made a significant improvement over Plato's handling of creativity. As Sesonske and Fleming's quotation from Plato above indicates (see p. 17), he really had *no* account of creativity or productivity other than the postulation of an immortal soul that had *already experienced* everything that could be manifested as "creative." Plato's soul is an eternally enduring entity which can know (in the sense of be acquainted with) all possible instances of a concept. This is in a sense a *denial* of the ability or "competence" to be creative: it claims that creativity is an illusion of remembrance. Chomsky does not deny creativity, and his significant advance over both Plato and the associationists is the theory that a syntax which allows recursion to occur *is* a mechanism of creativity: that is, Chomsky's *generative* grammar is a mechanism that uses finite resources infinitely. He has provided an explanatory mechanism that makes infinite use of finite means: Chomsky *explains* creativity rather than explaining it away, as Plato does. The negative task of this article is to argue that we cannot improve upon the Platonic approach to the problems of the higher mental processes, but it is not to deny that we have made some real improvements over Plato's specific proposals.
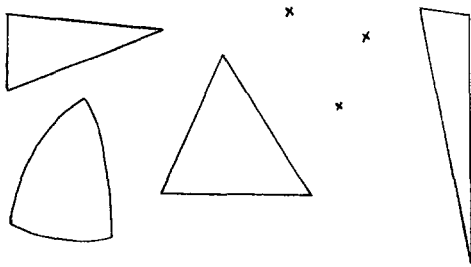
FIG. 1. Triangles as instances of triangularity.

product of "earlier lives." All the modern Platonist needs to retain anamnesis is a mechanism accounting for the "ideas," as capacities, of prior lives being built into a given individual—a mechanism provided by the theory of evolution. The slave whose creative competence Socrates helped to demonstrate had not lived before, but his nervous system and its capacities were determined by a mechanism utilizing (albeit very indirectly) the experiences of racial ancestors who did live prior to the boy. The competence underlying productivity can be innate—and evolution can tell us how. As an afterthought, note that the biology of Darwin that revolutionized the discipline was a rebellion against the biology of Aristotle.

But surely this is not right—surely the reconceptualization in biology to which we must pledge allegiance is Lamarck's rather than Darwin's. And is it not well known that the Lamarckian doctrine of the inheritance of acquired characteristics is repudiated thoroughly today? To this question the answer is clearly yes and no. Lamarckian *biology* is indeed in disrepute: there is no evidence for the inheritance of acquired physical characteristics. But the *inheritance of behavioral characteristics* is well documented, as the discipline of behavior genetics discloses. And the inheritance of capacity to respond, that is, competence as a structural concept underlying the functional notion of disposition to respond, is all the contemporary Platonist needs to maintain his thesis. He does not have to talk about the inheritance of *learned* behaviors at all—only of structural capacity, which determines or constrains behavioral capacity.

But, if specific learned behaviors are not innate (or, in traditional terminology, there are no specific "innate ideas"), what *is* built into the productive or creative organism? Here we have only the wildest speculations supported by the least possible evidence.

The Role of Abstract Entities in Perception and Conceptual Learning

In examining the nominalistic tenor of psychology, we saw that it can account for neither the abstract nature of concepts nor the similarity with respect to which they are ordered. Now we must see how abstract entities are *essential* to perception and conceptual learning. We can do this by noting that concept formation is fundamentally a "productive" or "creative" behavior, and thus requires the rules which would generate it to range over abstract entities.

Suppose an organism is to be taught the concept of "triangularity." It is impossible for any list of physical attributes to exhaust the meaning (reference) of "triangularity": there is an infinitude of distinct triangles. Thus, no identical-elements copying theory can teach an organism the concept. The number of associations required to learn that the figures in Figure 1 (and indefinitely many others) are all triangles would be infinitely large. An organism which has learned that these figures are instances of "triangularity" has learned the rules characterizing the concept. This is just a description, not an explanation. An explanation must specify the rules, their order of application (if any), whether they are learned or innate, and many similar points. All that we know at present is that the rules range over abstract entities (i.e., structures not found in the surface structure of particular triangles).

In learning that such instances are triangles, the organism is constructing a theory of *triangularity*. As such, its *task* is identical to that of the scientist constructing (we want to say "more sophisticated," but that prejudges the issue) theories of reality. Could it be that the same procedure is used in both behaviors? Probably the answer is yes. The organism's task is to determine which proper subset of, say, visual presentations to which it is exposed constitutes instances of triangularity, *and* to extrapolate from that given "corpus" of triangles the defining characteristics of the concept. Put differently, the organism attempts to construct a theory of the regularities of its corpus of visual presentations. In these and all other cases of concept formation, the organism may fruitfully be considered as a *theory of his environment*.

But the visual presentations constituting exemplars of triangularity are an infinitely large class.

Indeed, *all* generic concepts extend over potentially infinite ranges of instantiations. How can an organism recognize all such instances, with *no* prior exposure to them, as instances of the *same* concept? How can the organism answer the "similar with respect to what concept" question when presented with a novel instance?

The only way known for organisms to "make infinite use of finite means"—such as they do in recognizing an indefinitely large class of objects as members of the same concept—is to employ "grammars" (in the linguist's sense) of perception or behavior whose rules make use of abstract entities. Only grammars that allow indefinite recursion and employ nonterminal symbols in their derivations of surface structures from deep structures can do this. What such grammars show is how an abstract "deep structure" meaning can be mapped into indefinitely many distinct surface structures. *A generic concept is the same as an underlying deep structure that can be characterized only by the rules of the grammar*, rather than by listing the infinite number of "attributes" that are present in its (surface structure) instantiations. Concept formation is thus a generative process that may be understood through the model of language. To realize this is to realize that abstract entities are necessary for the scientific explanation of all "productive" or "creative" behavior. Concepts *do* express the "essence" of things in very much the way that Plato's doctrine of forms indicated, rather than the common features of "attributes" that Aristotle's nominalism proposed.[6]

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[6] The problems of meaning, in particular those of reference, must be conceived as involving abstract entities. The reference of classes that are not denumerated specifically is *not in principle determinable by a list of particulars.* This is because the list would have to be infinitely long: reference is determined by rules generating the denotata, not indefinite lists of associations. In this respect, concept formation is exactly analogous to creativity or productivity in language: no finite state grammar can explain either process. The reference of a concept cannot be equated with any notion of association, be it particularistic or generalized and abstract. This is clear when stated in another way. If the number of properties a concept has is its content (or intension), then it is clear that content increases as we descend from higher, abstract concepts to lower, particularistic ones. Also, increasing extension (range) of concepts corresponds to the progressive diminution of content (intension). The most general concepts are provably not associationistic or elementaristic simply by noting that they have no intension at all.

> The conceptual pyramid, which we form in this way, reaches its summit in the abstract representation of

How Does an Organism Become Familiar with Abstract Entities?

Evolution is corroborated as well as any theory can be: perhaps our present picture of the details by which it occurs (especially at the genetic level) is incorrect, but quite likely Darwin successfully painted "the big picture" (see Waddington, 1969). In order to survive, an organism must come to know its environment. This knowledge, at the lower phylogenetic levels, cannot be conscious. Yet, speaking either philosophically or commonsensically, the problem of knowledge is bound up inextricably with the notion of consciousness. So, in these senses, to speak of Nature (capital N) as constructing Her organisms to contain a theory of their environment (knowledge) is at best a colorful metaphor. But we must talk this way, and therefore it is time to break with both philosophy and common sense. If we drop Nature in favor of a theory of evolutionary selection, then the problem of unpacking the "metaphor" that the organism is a theory of its environment becomes much simpler: all we must do is explain how an organism could be a theory of anything at all.

If an organism is to survive in this world, it must be able to operate as a biological mechanism within the world. The mere fact of survival implies that an organism has been effective in maintaining the appropriate commerce with its environment. The nervous system of the organism is responsible for this commerce. How does the nervous system function? How did it come to behave as it does? The answer, literally rather than metaphorically, is that the nervous system functions as a theory of the environment of the organism; it makes inferences about environmental contingencies. To the extent that the theory is adequate and the inferences valid, the individual, and thus the species, survives. If the theory is inadequate, both may be expected to die out. Evolution is a mechanism that allows nervous systems to construct more and more adequate theories of the environment. Man, the thinking, rational animal, is an emergent phenomenon in this respect: only his central nervous system has developed to the extent that it can create consciously, as well as

"something" under the all-inclusive being of which every possible intellectual content falls, but which at the same time is totally devoid of specific meaning [Cassirer, 1923, p. 6].

operate according to, theories of the environment. Insightful or "reasoning" behavior in lower animals falls far short of this ability. It is in this sense that comments, such as Sellars' (1963) cryptic aphorism that with language, man's actions came to have reasons as well as causes, are to be understood. But returning to the central nervous system as a theory, how could it come to recognize abstract entities as underlying the surface structure of appearances?

We must explore several possible ways (and their implications for psychological theory construction) to see what insights they have for the construction of a genuine grammar of behavior. One possibility is that organisms do *not* become familiar with abstract entities. This view says that the surface-structure world of appearances is the only world: that appearance is reality. Theories of organisms based on such a view can be rejected out of hand; they must postulate an infinite complexity within the central nervous system to account for behavior in infinitely varied circumstances. This is why "habit" or similar dispositional analyses fail. Associationistic theories, insofar as they are grammars defined in terms of nonabstract or terminal vocabulary elements, fail for this reason.

A second possible way for organisms to become familiar with abstract entities is *indirectly*. Distinctive feature analysis or analysis by synthesis procedures exemplifies the indirect method. The problem of handwriting recognition by machine is a case in which an ill-defined concept (a written alphabetic character) must be recognized by this method. The physical invariance between different people's handwriting is much less than the invariance between the characters of the alphabet. That is, there is more variability in the way people make the same characters than there is between characters in the same alphabet. There are an indefinite number of ways to make an "A," each of which is recognizable as an "A." Hierarchically organized feature detectors such as Selfridge's (1959) Pandemonium, if made complex enough, can recognize such ill-defined concepts. Thus, abstract entities could be recognized by the organism if something comparable to "feature detectors" are found in the nervous system. The work of Lettvin, Maturana, McCulloch, and Pitts (1959) and Hubel and Wiesel (1959, 1962) provides prima facie support for the existence of such detectors.

The third way in which an organism could become aware of abstract entities is *directly*. This must be qualified immediately, for direct (in the sense of noninferential or certain) knowledge is a myth. But, whereas it has been assumed by empiricism and associationism that what was given in experience (presented to the organism's central nervous system) were particulars, it is at least conceivable that what is presented are *universals*. Might it not be that we are structured such that in looking at an object we perceive it not as a particular object but as an instance of a thing-*kind*? *If* that is the case, then perception is fundamentally of abstract entities, even though our experience is with so-called particular or "concrete" instances. Thus, this alternative claims that insofar as we are "directly" aware of *anything*, it is universals rather than particulars. This is, of course, the view of Hayek mentioned above.

On Hayek's view, the theory which has been built into the organism's central nervous system operates upon truly abstract entities. This is what Kant had in mind in elaborating the a priori categories of human understanding. The innate Kantian categories operated with such abstract entities as space, time, causality, etc. But against Kant, these categories (at least some of them) are part and parcel of all sentient creatures, not just man alone. An organism that perceives abstract entities directly would be able to tell from incomplete physical representation (surface structures) the nature of the underlying deep-structure reality.

So we must evaluate two possible ways by which organisms could operate with abstract entities: directly and indirectly. At first, the indirect method seems the most likely candidate, especially for lower organisms. There is strong prima facie evidence for feature detectors in the peripheral processing mechanisms of as lowly a creature as the frog. But does the frog's eye tell the frog's brain about abstract entities (bugs) only indirectly?

Even if the frog's eye tells its brain about "bugs" by a complex feature detector network, it does not follow that these abstract entities (bugs are defined by rules, not by listing their potentially infinite physical characteristics) are known by the frog only indirectly. For to say that the frog's retina is equipped with feature detectors that indirectly alert the higher centers of its brain to the presence of abstract entities merely relocates the problem—it does not solve it. How do the feature detectors at

the retinal level in turn sense abstract entities? There is only one conceivable answer: they do so *directly*. Perception is essentially transformational as Lenneberg (1967) indicated, and it deals (if one understands that, he can say *therefore* it deals) with abstract entities.

What does this say for the future of psychology? Perhaps a brief example will indicate some of the ramifications, at least for learning. The basic paradigm for learning will be concept formation rather than conditioning (either classical or instrumental). Concept formation is the "fundamental" or basic mode of learning, not to be explained by conditioning, but rather *instanced by* conditioning. Concept formation proceeds according to rules that will often (with higher organisms) range over abstract entities, as when, say, a rat learns "to go to a corner and turn," or "to find the goal." The fundamental rules will be concerned with abstract entities: associations, be they between stimuli and responses, or ideas, or whatever, are at best epiphenomenal manifestations of underlying processes. Cornering, turning, finding a goal, and countless other functional "responses" cannot be defined in terms of observed behavior because the list of physical distinctive features involved would be infinitely long. These responses are abstract, defined only by rules. Thus, a grammar of even the rat's behavior must employ abstract entities in its derivations. Psychology as a whole now must follow psycholinguistics back to Plato. And that leads us to the moral, if such there be, in this article.

Have We Learned Anything about Learning in the Last 2,500 Years?

Not long ago psychologists would have scoffed at anyone asking such an "absurd" question. Who could look, for example, at the vast Skinnerian literature on contingencies of reinforcement (Honig, 1966; Skinner, 1969) or behavior modification (e.g., Krasner & Ullman, 1965), or the work on mathematical learning theory and probability learning (Crothers & Suppes, 1967), etc., etc., and seriously question that we have learned a lot about learning?

But there are other frameworks than behaviorism, and from their point of view, it is not obvious that we have learned so much or, indeed, anything of importance at all. One thing that cognitive psy-

chology has learned (again) from the revolution in linguistics is that stimulus-response associationistic behaviorism cannot be correct. And regardless of the tenability of behaviorism, it never told us about learning at all, only about behavior. We may know quite a bit about learned behavior (defined via the transfer of training paradigms) but very little about the nature and mechanisms of learning per se. The fact that Plato's paradoxes still have their paradoxical consequences is sufficient to make the point. And the point is driven home by the startling (and somewhat disturbing) fact that Plato's "solutions" are still the best we have. Behaviorism, with the doctrines of associationism and nominalism, dissolved our paradoxes. I have sketched some of the developments in contemporary (and not so contemporary) philosophy and psychology that have forced their reintroduction as legitimate paradoxes. But I have most definitely *not* solved or resolved either paradox, nor has Polanyi [7] or anyone else. The value of Platonic psycholinguistics and the transformational approach to cognitive psychology lies in the fact

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[7] A relatively novel account of the problems posed by the *Meno* has been advanced by Michael Polanyi in connection with his conception of "tacit knowing" (see especially Polanyi, 1966). Polanyi takes as Plato's problem, for which the doctrine of recollections is advanced as the solution, that of resolving the paradox that stems from pointing out the absurdity of believing that one begins either scientific or philosophical inquiry *by seeing a problem*. Polanyi feels this is paradoxical, and advances his conception of tacit knowledge to resolve the paradox.

I believe that Polanyi has lost sight of the primary problem that Plato proposed the doctrine of recollections to solve. With the advantage of historical hindsight provided by the Chomskyian revolution, I think that Plato had the seeming anomaly or "paradox" of the productivity of behavior very clearly in mind in the *Meno*. His message is thus primarily that we know and do more than our prior experiences have given us practice with, and only incidentally that we can do things which we cannot express verbally. That is, his message is that our knowledge and ability (competence) goes far beyond our experience and practice (performance). To say that we know tacitly, as Polanyi defines the concept, cannot explain how this can be so. For Polanyi "tacitly" accepts the doctrine that learning is transfer of training and requires experience: hence, tacit knowledge cannot account for transcendence of prior learning and experience. Even admitting that his account explains how we can know more than we are able to tell, it cannot account for knowing in the absence of a learning history. It is this latter problem which is again coming to be seen as crucial, and it is the transformational grammarian's "solution" to it that I feel is perhaps the most significant result of psychological inquiry since Plato's time. Yet, the point remains: Polanyi's account, though informative and tantalizing, has *not solved any of the* paradoxes we have discussed.

that it can and does recognize the gravity of Plato's paradoxes, not in any solution they have proposed. Indeed, Plato himself had no real solution: his insight appears to have been in the correct location of the problems, not in their solution. He had two vast promissory notes that served to *relocate* the problems into different areas. This article has argued that his insight was better than that of his successors, from Aristotle down to the neobehaviorists. In 20-odd centuries we have managed to learn nothing at all "new" about the nature of knowledge and learning. And that does not augur well for the future of psychology. Perhaps we are doomed to have a (tolerably efficient) *technology* of behavior modification, but no *science* of knowledge and learning at all. One might contemplate these caustic remarks by C. D. Broad (1933) in this regard:

Poor dear Psychology, of course, has never got far beyond the stage of mediaeval physics, except in its statistical developments, where the labours of the mathematicians have enabled it to spin out the correlation of trivialities into endless refinements. For the rest it is only too obvious that, up to the present, a great deal of Psychology consists mainly of muddle, twaddle, and quacksalving, trying to impose itself as science by the elaborateness of its technical terminology and the confidence of its assertions [p. 476].

Or, to develop the same point from a different perspective, one might consider the parallels in the careers of behaviorism in psychology and the logical "-isms" in philosophy. Logical positivism and its successors, despite *great* technical virtuosity and success, stifled philosophical progress because they ignored the history of philosophy. Indeed, the practitioners convinced themselves that the conceptual history of science was irrelevant to the philosophy of science. Behaviorism and its successors, despite equally great technical virtuosity and a fair amount of success in the modification of behavior, have stifled psychology's progress because they have ignored the history of psychology's problems. But, in psychology no less than in philosophy, to ignore history is to be doomed to repeat it. And this is exactly what the field has done with regard to the human higher mental processes.

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