Problems of a Causal Theory of Functional Behavior: What the Hayek-Popper Controversy Illustrates for the 21st Century – Part 2

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Abstract: Part I (Weimer 2021, §1-4, pp. 1-30) overviewed a 20th century clash about whether there could be a causal theory of functionality, specifically for the domain of human behavior. One camp, led by Popper, argued that no causal account was possible due to the creativity and hence unpredictability of behavior; another, led by Hayek, attempted to provide a physicalistic account of "intentional" or seemingly teleological behavior. Both of those views failed, although each emphasized some points that must be carried into a correct account. This second Part, building on and presupposing the material in Part I, emphasizes the role of additional factors and their ensuing complications upon the task of explaining functionality: understanding intentionality and anticipation, problems posed by surface and deep structural ambiguity of action, choice and prescription versus determinism, what could constitute causality in the functional domain, the inevitable ambiguity of physical description, and the derivational history of action in disambiguation. On top of all that, the problems posed by social psychological and sociological domains of action are quite different.

Keywords: Physicality vs. Functionality; Causality; Surface vs. Deep Ambiguity; Complementarity

V: INTENTIONALITY AND THE NATURE OF ANTICIPATORY SYSTEMS

Intentionality is usually discussed in terms of what Brentano called "intentional inexistence," which meant that the object of thought exists "intentionally" within the thought. Intending to do something means that that "something" is inherently present within the process of thought during the exhibition of an intention. If one of Hayek's "hunters" is engaged in the intentional behavior of hunting, then the hunter's nervous system supporting that activity contains within itself a model of the desired goal. How can we understand a "physical system" to possess within its operations a model of some as-yet unrealized state of affairs? How can something that has yet to happen—a future event—control the behavior of the hunter? What are the mechanisms of anticipation that could be present in a functioning nervous system to realize goal directed behavior?

In TSO Hayek proposed one of the first accounts of how this could happen, in terms of the classification of patterns of activity and their subsequent reclassification. To understand how he did this we must note the difference between feedback and feedforward mechanisms. Most of what has been studied in the social sciences involves feedback mechanisms. When we look at anticipatory systems, however, we require in addition to any feedback mechanisms an adequately specified feedforward system. We need to be able to unpack what Hayek said in TSO:

> The representation of the existing situation in fact cannot be separated from, and has no significance apart from, the representation of the consequences to which it is likely to lead. Even on a preconscious level the organism must live as much in a world of expectation as in a world of "fact", and most responses to a given stimulus are probably determined only *via* fairly complex processes of "trying out" on the model the effects to be expected from alternative courses of action (Hayek 1952, p. 121).

As a result of our evolutionary history advanced organisms have come to live as much in the future as they do in the present. They do this because adaptation (which occurs over generations, as a result of biological evolution) and learning (which occurs within the individual's life span) have come about. These phenomena are both directed toward anticipation of future outcomes. Human thought always anticipates the future. How is this so?

Hayek provided an answer by exploring mapping and modeling as a matter of the patterning of the classificatory activity of CNS functioning. Looking at CNS activity in this fashion effectively divorced our knowledge of the external world from that independent world entirely, and re-created knowledge not as somehow having ever been originally attached to objects of the external world, but as existing only as patterns of neural activity resulting from its classificatory activity in conjunction with the fundamental activity of the nervous system, the response to novelty. The qualities which our acquaintance attributes to experienced external objects are not properties of those objects at all, but rather a set of *relations* by which our nervous system effects their classification. All we perceive of external events is their structural relation to each other, and their relation to or in our experience. We are literally theories of our environment: all we can know about the world external to our senses is inherently theoretical, and all our "experience" can do is to modify our extant theories.

Anticipation is a particular type of modeling. This was first realized in the early 1950s by von Neumann and Hayek. Consider von Neumann's account first. He studied what was involved in the origin of life and the problem of self-reproduction. His insight was that anything capable of self-reproduction had to include within itself the complete specification of what it is. What would happen if you could create a machine that would reproduce another identical machine? The constructing machine ("the parent" for the reproduction) would have to have available within itself, within its operating program—if you regard it as a machine with a program running it—a complete description of the machine to be copied. But suppose we were to "push the button" and the copying machine produces a machine which is the exact copy of what it was programmed to reproduce. Now ask the further question, "can that machine that was just produced (the offspring) now produce itself?" The answer must clearly be "no, it cannot reproduce itself," *unless* it already contains a complete specification of itself within it. The machine that constructs or does the copying reproduces whatever it is given. But in the next generation, that of the reproduced offspring, there will be no further self-replication unless it already contains a complete specification of itself as a given. So for anything to be capable of *self*-reproduction it must contain within itself a complete specification of not only what it is but also how to build it. Modeling a living system must contain a forward-looking or "feedforward" component, and that forward-looking system must be an exhaustive specification of what it in fact is. A similar form of modeling, anticipatory modeling, is necessary for any living organism to be able to adapt to environmental change during its lifetime. Any such anticipatory modeling also entails feedforward components in the modeling structure itself. All learning is based upon anticipatory modeling, which is to say, on feedforward mechanisms. That is the import of the quotation from Hayek above.

What we must understand is that cerebral *initiation* of behavior, rather than totally passive responding to external stimulation, is the key to how the nervous system operates. The first systematic discussion of what is involved in feedforward in psychology was by Miller, Galanter and Pribram (1960), who introduced what they called the TOTE unit, for test-operate-test-exit, to show what procedure was necessary for a behaving system to achieve a goal. And now a crucial point: a goal is a forward-looking functional concept that can never be specified without incorporation of anticipated behavior. And that is why no purely physical specification of behavior, even down to the micro-particulate level, will disclose anticipation or expectation or purpose. Such functional concepts simply are not physical. The TOTE unit provides a two-process model: (1) a test, consisting of activity in the patterns of neural activity, and (2) an "operation" upon the test by a bias mechanism. The bias mechanism is inherently oriented toward changing the output responsivity in order to take into account new "information" resulting from the combination of some initial stimulus input and the bias of ongoing central neural activity. A simple model of such a situation is a thermostat, which turns a furnace on or off when the temperature reaches a predetermined set point. The addition of that bias through a feedforward mechanism allows it to anticipate and correct for an intended future state, denoted by the predetermined set point. In this situation it functions by presently available "causes" to produce a "future" event.

This is in effect a servo mechanism, and it indicates what is involved in the cybernetic concept of steering toward a goal. All life is cybernetic in this sense, and that is simply another way of saying that it inevitably and invariably involves anticipatory systems with feedforward control.

Feedforward allows us to anticipate by compressing the time dimension. This was an insight of Robert Rosen (1985) in *Anticipatory Systems*, a mathematical study of the abstract logical-mathematical structuring for all anticipatory systems. As one of his students (Louie 2010, p. 20) put it:

> There must be information about self, about species, and about the evolutionary environment, encoded into the organization of all living systems. He (Rosen) observes that this information, as it behaves through time, is capable of acting causally on the organism's present behavior, based on relations projected to be applicable in the future… Organisms seem capable of constructing an internal surrogate for time as part of a model that can indeed be manipulated to produce anticipation… This "internal surrogate of time" must run *faster than real time*. It is in this sense that degrees of freedom in internal models allow time its multi-scaling and reversibility to produce new information.

Feedforward is what can compress this time dimension. In contrast, feedback control is in essence *detected present tense error* actuated—the stimulus to corrective action is the discrepancy between the system's actual present state and the state the system should be in according to the model. Feedback works only when a system has already departed from what it was supposed to be doing before that feedback control can be exercised. In a feedforward system, in contrast, the system behavior is preset, with an internal model, relating present inputs to predicted outcomes, being in control. Feedforward systems thus have the necessary corrective present change of state determined by a presently existing model of an anticipated future state. It is crucial to note that the vehicle of anticipation is in fact an internal model—the stimulus for change in action is not simply the present input from outside the system, it is the *prediction* under the present conditions that is contained within the internal model. This is exactly like the thermostat, where the presently existing model controls the future behavior. The discrepancy between outcome predicted by the model and the present input is what drives behavioral change. Rosen was clear that the prototypical modeling relation was an interaction between a formal system—analogous to a computer program—and the physical system involved. In such a system the computer program instantiates functionality, which operates by downward causation to control the physical movement of the otherwise purely physical system.

Rosen also emphasized that error and emergence are crucial to models and anticipatory systems. No model is ever exactly the same as the system actually will be in the future. There is inevitably statistical or probabilistic "error" present, as well as finite or incomplete representation, exactly analogous to the problem of measurement. Since this is so, error will arise as a necessary consequence when the behavior predicted by the model diverges from what is exhibited by input to the system. The system can (and often does) fail—if its behavior as directed by the incomplete and inaccurate model (or also perhaps a failure elsewhere in the system, such as a defective receptor or a broken effector) is sufficiently far from what actually transpires in the future. There can be catastrophic failure. Emergence (emergent behavior) will occur when the discrepancies are not sufficiently great to cause catastrophic failure, as when the content of the model contain something new, or not found in the system itself. From the standpoint of the theory of anticipation that novelty is, strictly speaking, an error or discrepancy. But in many cases in human behavior—the growth of science, for example—it is an "error" with very beneficial results: the generation of new knowledge. That can occur in cases in which what Kuhn (1970, 1977) called normal science research leads beyond itself into a revolutionary reconceptualization.

It is interesting to note that in hindsight, Rosen (who published in 1985) had only managed an alternative account to what Hayek had already published in 1952. An organism lives in an environment that is actually an econiche or umwelt of its own construction due to anticipation. That is another way of saying that "the organism must live as much in a world of expectation as in a world of 'fact.'

Inference and expectation are different in society. Individuals are agents: they embody expectations and inferences in their cognition as anticipatory models. Social groupings have no agency—they cannot embody future expectations in some trans-individual super agent. The market order provides a basis for an individual's expectation, but the market order itself cannot "expect" anything at all: it is not an agent, and equally not a subject of conceptual activity. The market cannot anticipate because it is not a functional entity. The market is only a means—a generalized mechanism—not a functional entity. All it does is provide necessary information to an actual agent who uses that information to update his or her internal anticipatory model, and to adjust their behavior accordingly. Functionality exists only in the market participants—never in the market itself. Agents *use* the price of goods or services that are momentarily available to adjust their internal models of a desired future state of affairs in conjunction with their present perception of the ongoing state of affairs. They anticipate how to bring about their goals by adjusting their momentary behavior to make it consonant with what the model specifies the goal (the future state they desire) to be.

Agency incorporates functionality and expectation into its physical system by incorporating input from a model which specifies what that expectation looks like, and simultaneously (that is, in real time) incorporating that semantic information as a guide (again in real time) to adjust ongoing physical behavior. Such combined physical-functional systems depend entirely upon the detection of error—upon the perception of a discrepancy between the internal model's prediction of the situation within the predicted results in the future, and the agent's simultaneous perception of where he or she is in relation to the model's prediction. This simultaneous perception is in itself an expectation based upon a model, because as Hayek noted, the organism lives in a world of expectations in every single moment. The whole point of an agent's behavior is to eliminate an error—discrepancy between what the model specifies must occur and what the agent's input of the situation presently is. Feedback and feedforward are inextricably linked in all adaptive behavior based upon anticipation and expectation. Achieving a goal requires error elimination and/or correction of behavioral trajectory that is specified by feedforward anticipatory specification of that trajectory. Physical systems may have feedback, but they cannot have either success or failure. Success and failure are functional concepts, and only agents can possess, understand, or operate according to such concepts. Feedforward occurs only in living or functional systems. The market order is not a thermostat—it is just the input to an agent which, in conjunction with the agent's internal anticipatory model, tells it to turn on or turn off (purchase or pass depending on price) its behavior. The agent set the bias point for the thermostat; it did not set that itself. We must realize that models and anticipatory structures exist only within agents—subjects of conceptual activity. The market order, like all abstract (or as Hayek called them, cosmic) orders, is totally impersonal and without expectation, inference, purpose, goals, or any actual mechanism of anticipation. And as we must now see, it is entirely without choice contingency.

VI: CHOICE AND THE PROBLEM OF AMBIGUITY

Previous sections overviewed dualisms that cannot be avoided in the human existential predicament. We began to unpack what Hayek had meant by saying "to such a system (the human mind) the world must necessarily appear not as one but as two distinct realms which cannot be fully 'reduced' to each other." This section must follow up that insight by examining what is involved in the realm of human functionality that is designated by the concept of choice (and thus intentionality and purpose). Human beings exhibit choice contingency in the control of their behavior. There are no choices in the physical realm. Indeed, inexorability and (rate-dependent) "determinism" cannot allow choice to exist. Choice is physically inconceivable. Thus, from the standpoint of life, as a functional rather than physical phenomenon, choice is perhaps the most important difference from the inanimate or merely physical realm. We need to explore the implications of the existence of choice, and then indicate how it affects any theory of teleological or intentional or goal directed behavior. Doing so helps to explain why even the most brilliant minds were unable to adequately "explain" purposive behavior.

Choice and contingency. As I have emphasized, subjects are never objects—subjects make choices, and *choices require alternatives that can be realized*. Objects, identical and interchangeable, which are controlled by the inexorable laws of nature, never have alternatives: the concept of inexorable constraint precludes the very possibility of the existence of alternatives. The billiard ball had no choice—it rolled the way it did because of external forces imposed upon it. The context of constraint surrounding the billiard ball is exhaustively and inexorably determinate. But because they have alternatives from which they may choose, because they can harness those inexorable laws of nature, subjects as agents *have the possibility of choice*, the freedom, of making errors. It is crucial to note that there is no conceivable physical concept of error. Error is purely functional and abstract, compatible with an indefinite range of physical phenomena, but impossible to define solely by specifying a list of such physical phenomena. This is also the case for the existence of novelty. Subjects, although they cannot violate the inexorable laws of nature, can, as functional agents, perform new, unexpected, and unpredictable, things. There could be no novelty in a universe totally controlled by inexorability. That was the tremendous appeal—that it was "neat and tidy and complete" in every aspect—of concepts such as Laplace's demon and the philosophical necessitarian doctrine of universal determinism. But the functional world is never neat or tidy or complete. Ambiguity comes into existence when subjects come into existence. And it comes into existence only with subjects, because it requires conflicting or incompatible choices or meanings or interpretations. Because subjects make choices, they can make choices that are not only erroneous but also create indefinite and contradictory outcome possibilities and the interpretations of those possibilities. Those possibilities could never have been exhaustively determined in advance. Choice never leads to any deterministic finality. Choice inevitably leads to more and more choices. Choice "determination" leads to more and more possibilities for future action, not fewer and fewer delimited necessary outcomes. Semantics and choice contingency, even though deterministic in the rate-independent realm once they are made, lead in the dynamical realm to the possibility of indefinite creativity—to *unfathomed knowledge, unmeasured wealth*, as Bartley (1990) chose for a book title.

The existence of choice requires that things could have been otherwise. This denial of necessitarian determinism (a position ably defended by many philosophers, perhaps best by Blanshard, 1973) is the point (with choice contingency) at which psychological or semantic or pragmatic information comes into existence: functional information becomes meaningful (to an agent) when choices must be made—when genuine alternatives instead of deterministic finality reign. Making meaning through choice—delimiting the realm of ambiguity—is the fundamental function of nervous system activity. The orienting response to novelty is the fundamental choice activity of the organism, when it chooses to assess a pattern of neural activity as meaningfully different from ongoing patterns of background activity. Orienting begins the context of choice constraint in which all higher mental processes—all cognition—are embedded. Choices always involve selecting or responding to particular patterns of neural activity that stand out from or are somehow differentiated from ongoing "maintenance" or background patterns. That standing apart can be initiated either by external factors which break into the ongoing patterning because of the salience of their novelty, or by internally initiated changes of patterns—input from outside sources, or reorganized internal patterns that reconfigure in novel ways. All such activity is, as Hayek emphasized in TSO, a matter of classification and reclassification of patterns of activity. Nervous systems are in the business of—exist solely for the purpose of—classifying. Coming to know is reclassification of ongoing patterns of pre-and post-synaptic activity interacting with ongoing patterns of all or none spike potential activity. We are creatures who make things meaningful by creating and interpreting patterns of neural activity. This is the basis of semantic meaning. Shannon or communication theory bits play no role in the process of knowledge generation or semantic meaning construction. Shannon bits are an artificial concept developed for the restricted task of optimizing communication transmission only—for removing as much noise as possible from the channel used for communication. Semantic meaning has its origin within the organism as interpretation of itself and its external environment. That predates the much later problem of transmitting information through physical (only) systems of wires or light or other particle pulses—even neural pulses. Shannon "meaning" mainly concerns eliminating noise from already extant meaning (possessed by a sender) that is being sent (transmitted) to a receiver who already knows how to understand it when it is received, even though it is meaningless physically during the (often noisy) process of transmission.

While the nervous system, viewed as a communication transmission system, also has a problem with noise—and clearly attempts to eliminate it by redundancy and multiple processes of transmission and retransmission—it has something else to worry about: living systems that choose can and do make errors. We can and do (as every writing student has found out when turning in a paper) make "mistrakes." We are fallible creatures who are extremely error prone. That is why the evolutionary approach to epistemology emphasizes that knowledge acquisition depends upon error detection and correction and elimination. Because we can and often do choose wrongly and weave false theories and metaphysical haunted universe doctrines, we can only learn through weeding out error, which we do by constantly proposing alternative metaphysical doctrines and checking our conjectures against empirical reality. We have got to let our theories die in our stead. That is a central philosophical message of evolutionary epistemology, and no one has presented it better than Karl Popper (1963, 1974).

Life began with functional instruction. Life is, by definition, cybernetic—it is functional, and because agency is present *it is steered*, and it always has been. Metabolism in even the simplest single cell is steered and regulated by instructions that prescribe (or are the software program for action). As David Abel put it:

> Every aspect of metabolism with a single cell depends upon programmed instructions, the messaging of those instructions, and feed-back messaging about how well the initial messages were received and carried out… Without programming and the bio-semiosis of those instructions, no progress could be made within any micelle, vesicle or proto-cell toward eventual life in a true cell (Abel 2011, pp. 148-49).

Any such symbolization and coding systems are far prior to our very recent arrival, and subsequent understanding of them. They predate our human existence by literally billions of years. That means that functionality, as instanced in terms of the control, regulation, and integration of metabolism, predates our physical existence on this planet (probably by about three and half billion years). These functional phenomena are not products of our minds. Our minds, like our existence, are their products.

Life used symbol systems and made choices by utilizing linear strings that were, as Pattee has argued, the first language—the genetic language. As Abel said: "semantic/semiotic/bioengineering function requires dynamically inert, resortable, physical symbol vehicles that represent time-independent, non-dynamic "meaning" … No empirical or rational basis exists for granting to physics or chemistry such non-dynamic capabilities of functional sequencing" (Abel 2011, p. 153). How this functionality came about, while undoubtedly the greatest mystery that we can face, is not our focus here. We need only grant that it is the case that it exists, and then explore some of the consequences.

Symbols and meaning are rate-independent. As the quotation from Abel emphasized, symbols and meaning are not dynamic, *even though* their manifestation or expression requires a dynamical system. That fact immediately creates the problem of representation: how do physically specifiable tokens or physically specifiable signs represent rate-independent functional symbols or instructions? This is not a problem of the reference of these terms: we know that certain physical entities are the tokens to which the abstract and conceptual instructions refer. Reference is taken for granted. The issue instead is how do symbols "stand for" or "represent" physical or material structures? The answer is that they do so by employing and following rules. Rules (as opposed to laws of nature) can control voluntary or choice-contingent, behavior. Rules define formal systems. A formalism describes some particular functionality in abstract terms. The formalism provides rules to concretize functionality into the physical realm. Thus, Euclidean geometry qua formalism describes the shape of ordinary or three-dimensional spaces and objects. Formalism in that sense is what Plato was after in his doctrine of Forms—abstract essences that are definitive of general classes of entities that are always instantiated in particulars. Rules are arbitrary, unlike necessary laws. Rules can be broken, and thus are often changed in order to function better. No law of nature can be broken or changed. Being entirely arbitrary, rules require genuine choices in order to be followed. Choices function through decisions that *prescribe* actions. Rate-independent choice functionality prescribes rate-dependent physicality, but unlike that inexorable physicality it is always arbitrary, and because it is arbitrary, it has meaning, and it is quite possibly wrong. Meaning comes into existence with choice and the possibility of error. The more nuanced our choice determination, the more enriched and varied our meanings.

What we are doing is restating and elaborating Michael Polanyi's idea that living functionality harnesses physicality. The formal systems that science and philosophy create and study are based entirely upon choice contingency. Formalisms require arbitrary (but definitely not random) choices in order to be realized: they are quite different from physical systems that are constrained by the laws of nature, where since there are no choices there are no meanings or functions. Some of the major differences between functionality and physicality are outlined in Table 1 (from Abel 2011):

Table 1. ***Comparison of Formalisms to Constrained Physicality***		
Attribute	**Formalisms**	**Constrained Physicality**
Physicodynamic	No. Utterly nonphysical	Yes. Entirely physicodynamic
Options / Possibilities	Many	Few
Uncertainty	High prior to choices	Little
Constrained	No	Yes
Controlled	Yes	No
Limited by forced, fixed laws	No	Yes
Limited by voluntary rule obedience	Yes	No
Chance contingent	No	Some
Choice contingent	Yes	No
Decision nodes	Yes	No
Logic gates	Yes	No
Configurable switch-settings	Yes	No
Abstract or tangible	Abstract	Tangible
Conceptual	Yes	No, except the mathematical nature of the laws themselves
Caused by	Choice determinism	Law-like necessity
Nontrivial function-producing	Yes	Never once observed
Goal oriented	Yes	Never
Which side of The Cybernetic Cut	Far side	Near side
Symbols / Representationalism used	Yes	Never
Meaning generated	Yes	Never
Sophisticated utility generated	Yes	Never
Useful and Pragmatic	Yes	Blind and Indifferent

Table 1
Formality versus Constrained Physicality
From Abel, 2011

Life and conceptual activity—including epistemology and all science—are formal phenomena, and thus are only incidentally physical in their particular physical realization. They depend upon *some* physical realization, but its exact form is always an empirical issue. And even though it is the case that the so-called physical sciences deal with an empirical subject matter, that subject matter is not in and of itself formal. It is the formal aspects that define and provide the meaning of the concepts of life and cognition, not the fact that they are embodied in one or another particular realization that happens to be describable within the laws of nature. And we should note that those laws are not at all "natural" but rather are entirely conceptual and formal and cannot be found as existent entities in the empirical realm. The laws of nature are our creation, and we impose them upon empirical reality in order to make reality intelligible to us. The rate-independent formal realm provides the higher order context of constraints that, in harnessing the physical realm, makes life and cognition possible. Our "human" existential predicament is thus formal rather than just physical.

Small wonder, then, that psychological phenomena must have both a rate-independent (or formal-functional) specification *in addition to* a concomitant rate-dependent physico-chemical (or biochemical) specification. Living systems never perform physical movements—insofar as they are alive, everything they do is the performance of an action. All living action is inherently both formal and physical, and specification of only one domain or the other is inherently ambiguous. This is why, since both Popper and Hayek used only one domain in their accounts, both failed in their attempts to provide an account of functional behavior.

At this point one can see the inevitable limited utility of the computer programming metaphors for life and cognition. Even though they may provide *a formal representation* of such phenomena, there is absolutely no guarantee whatever that such a formal representation *is the one instantiated by life* on this planet. That is why I have emphasized that computer or computation-based models, even if correct, could provide only a partial understanding of life and cognition. We also require the complementary description of the physical systems that realize those rate-independent specifications. All cognition and all minds are embodied. We have to have complementary descriptions of both minds, and their embodiments. Any program based model must be realizable on the physical structures found in living nervous systems and bodies.

Physicality can only be disambiguated—and hence understood—by concomitant functional analysis. Understanding physical objects—those studied by physical theory—requires a duality of descriptions because the laws cannot interact with objects unless specific boundary and initial conditions are applied to tie them down to observable reality. But in the case of agency, in which a subject (and not an object) behaves, the situation is slightly different. Here the problem transcends just the issues of record-keeping and measurement. One must know the functionality, the teleological or intentional "aboutness" of the agent (to use Brentano's 1874, term), in order to determine what any of its given physical "bits of behavior" represent. Two different individuals could make exactly the same "physical" movements (down to the subatomic or any other level of specification) and still exhibit very different functionally defined actions. The referential basis—physical movement—is inherently ambiguous from the point of view of functionality: the same "behavior" can equally well instantiate very many different intentions and thus different kinds or abstract classes of actions on the part of agents. Likewise, a single functional intention can be realized by a literal infinitude of physically specified movements. The fundamental ambiguity of human action is inexplicable unless one understands that a duality of descriptions, with the physical movement specification on one hand and the functional intention of action specified on the other, is absolutely required for disambiguation and hence for understanding.

We saw this problem in somewhat different form within physical theory with respect to record-keeping and measurement. These are functional concepts: functional specification on the part of an agent is required to determine that a measurement has in fact occurred, and that a record has in fact been made. If we try to analyze the physical movements or processes that an agent makes in these functional actions we find, as Pattee emphasized, that the process of measurement or the record itself simply disappears in the complete specification in terms of physical theory. These functions are *nonlinear with respect to physical specifi-*

cation. Measurements, like nervous system activity, are a process of many to one mapping. In the case of the measurement there is an infinitude of actual physical events involved. The functional process of measuring collapses that indefinite number of physical events into a "frozen out" measurement that exists only in the rate-independent realm of human cognition. The nervous system, in processing many inputs as instances of "novel" versus "not different from background expectation" does exactly the same thing in the decision to "collapse out" and focus upon novelty from the flux of activity. And this classification property is precisely what gives the measurement (or the novel stimulation in the nervous system) its determinate meaning. It is exactly like the measurement problem in physics: looking inside Schrödinger's box and seeing that the cat is either alive or that the cat is dead. No physical device can ever make this or any other intentional determination. Meaning requires more than physicality.

A previous section noted that thought and acquaintance are fundamentally different. For epistemology the fundamental opposition is between the knower and the known. Cognition is formal, rate-independent, meaningful, subject to error, incompleteness, and inherently ambiguous. What we undergo in acquaintance is not meaningful, not subject to error or incompleteness, and not known to possess properties of the formalisms denoted in Abel's Table 1. While we know it is a "property" of life it is not actually a property in any definable sense—more correctly, acquaintance is a parallel or *concomitant accompaniment* (presumably physical) to cognition. When we attempt to make acquaintance into a "known," we transcend acquaintance per se and move instantly into what Russell called knowledge by description. Acquaintance per se is not knowledge—it is just something which we undergo. Consider some of the properties in Table 1: acquaintance is not conceptual—in that regard it is like constrained physicality. Acquaintance is not choice contingent—also like physicality. It is not limited by voluntary rule obedience—like physicality. It is not controlled by the individual who has it—like physicality. Clearly it does not use symbols or representationalism (at least in any fashion that we have yet comprehended). It presents no options or possibilities in itself—like physicality. And like physicality it appears to be closer to being tangible than intangible. Nor is acquaintance caused by or subject to deliberate choice—it appears to necessarily follow when our bodies undergo some specifiable things. As such, acquaintance is finite and limited, while the formal realm is unlimited and conceptually infinite. So it would appear that acquaintance, if, as is usually the case, it is regarded as some sort of "halfway" house, is actually much closer to the physical domain than to the functional. It certainly cannot be classified as purely functional.

Acquaintance is in one respect exactly like meaning: it is a predication, and not itself a relation. When we attribute meaning to it, we have moved beyond acquaintance itself into the language of description and into linear thought. Cognition *interprets* acquaintance, when it attempts to know it. Acquaintance per se does not participate in relational structures. Acquaintance itself dissolves into our knowledge of it, and all that is left is relational attribution in cognition. In this regard it is parallel to the way in which a measurement "dissolves" when one attempts to integrate it into a dynamical description in terms of laws of motion for the physical system that instantiated it. Thinking or cognizing about acquaintance does not involve the having of that acquaintance at all.

In contrast, thought comes to us in the specious present as a fundamentally symbolic and abstract form of exemplifications of concepts. Concepts and thought are the equivalent of mathematical functions—generative rules of determination that can provide an indefinitely extended domain of particular instantiations. Concepts map deep structural meaning or content onto potentially indefinitely extended surface instantiations. In that regard all concepts including those that pertain to our unique and privately experienced acquaintance are in themselves fundamentally objective (intersubjective). Application of any concept is a process of objectification. It distantiates from uniquely given particulars in experience. To be meaningful, thought *has to step back from* what is presented to us or "given" in awareness. All thought *must exist in opposition* to momentary awareness. As a result, our concept of the purely subjective—if expressible at all—is completely objective. Whatever role acquaintance initially played is completely absent from our concepts and from our knowledge. Acquaintance is not found in any meanings we entertain. Thought is apart from acquaintance *and has to be* in order to give it meaning. This gulf cannot be bridged—the dualism is an unavoidable complementarity.

The duality of descriptions is an inescapable aspect of epistemology and knowledge acquisition. Since knowledge is not in the physical domain—it is in itself in the functional, teleological and intentional realm of rate-independence—knowing (as a process, with the -ing) must have an embodiment in physicality (symbols must have instantiations in signs as tokens), but the knowledge itself (what the symbols mean) is not and cannot be specified in purely physical terms. No matter what the representation, whether marks on paper or sound waves in the ambient array, or electromagnetic pulses, or whatever, they are merely instantiations of knowledge rather than knowledge. Only subjects of conceptual activity possess knowledge or can acquire it. Knowledge requires knowers, as agents, for its existence. When embodied in a knowing agent it harnesses the (what are then lower level) laws of physical nature. Thus, in agency knowledge is always a higher order constraint operating upon physicality. For subjects of conceptual activity, it is the paradigm exemplar of functionality. And that is one reason why, since it seems to exist only in living subjects, that we find its appearance to be unique and improbable and therefore regard it as amazing. This is perhaps what misled Popper into thinking that one could have knowledge—and thus epistemology—in the absence of knowing subjects. He was attempting to understand the distinctions between physical and functional, formal and factual (as well as others we have overviewed). We need to realize that just because it is awe-inspiring, that alone does not mean that we cannot study it and try to understand how and why it came into existence, and what its role is in the universe.

VII: CONSTRUCTING A SYNTAX OF ACTION IS HARDER THAN YOU THINK

At this point we have the bare essentials of the background against which to try to construct a structural analysis of functional cognition of our behavior—generically, the syntax of action. While Popper ignored (more likely did not understand) this problem, Hayek may have assumed that he had in fact provided an unambiguous physical representation of a simple but intuitively "clear case" of intentional (as a paradigm exemplar of functional) behavior. It is all too obvious that he did not in fact succeed. Without supplying a concomitant and complementary structural analysis of the functional specification of "hunting" (or any other intentional) behavior, any physical or "bare movement" specification is inherently ambiguous and incomplete. Here, as anywhere in science, we must have a duality of descriptions. There must be complementary functional analysis (or analyses) for any attempt at a physical specification of action.

Considered from the perspective of semiotics, with its threefold categorization of the manifestations of functionality and meaning as involving syntax, semantics, and pragmatics, it becomes clear that the activity of hunting, since it involves coordination of activity on the part of groups in the example Hayek used, is essentially pragmatic in nature. Before one can understand such maximally complicated group activity it is strategically simpler to consider the activity of a single individual in a situation in which the pragmatic context is assumed to be a constant, and therefore can be "canceled out" of the analysis. This would leave us with the (one would hope, easier) task of understanding the interactions of syntax and semantics in individual behavior. This is an enormous task that is certainly hard enough even as a first step. Unfortunately, it is not clear that one can even find such a "simple" case. Soliloquy is a potential example, but even in speaking to one's self, pragmatic context may not be constant or even clear. Shakespeare's plays provide sufficient examples of that lack of clarity. And even in seemingly clear examples there are often ambiguities in word meaning, phrasing, and implied context. Understanding the meaning of the soliloquy can require not only a linguistic analysis of the sentences involved, but also a discourse analysis (Endnote 4) of the way in which the sentences and phrases relate to one another, and perhaps further contextual analysis in terms of the gestures and movements which accompany the "speech acts" (to use a relatively neutral term). Human action is always context-sensitive, and that context ranges over both semantic and pragmatic components. Without clear-cut accounts of what is involved in not only the pragmatics and semantics of the situation, but also the syntactic structures realizing those forms of meaning, any interpretation of the behavior is ambiguous and thus indeterminate (since underdetermined by any physical laws), and not yet explainable by any theory. We would then be back where we started with all of semiotics to be accounted for.

A simple example. For half a century I have used a brief example (first in Weimer 1969) to illustrate this situation. It is very simple, involving the activity of only a single individual. Suppose someone (even the usual variables such as sex and age, general state of health, and similar attributions, need not be specified) engages in the following sequence of "behaviors." The individual drives up in a car to a building, looks at it briefly, parks the car and gets out, and then enters the building after walking up steps toward a door. After opening the door and entering the building (which has the name of a bank written above the door entered), the person walks over to a counter, takes a piece of paper and a writing instrument out of the pocket of his or her clothing, makes a series of marks on the piece of paper, and then hands the piece of paper to an individual on the other side of the counter in front of him or her. Now we ask the seemingly "simple" question, given that sequence of (in principle) exhaustively physically specifiable (even down to the subatomic level of description) cluster of physical movements: What behavior was instantiated? Without further functional information being specified, one cannot ever unambiguously interpret this "mere" physical sequence. Was it an act such as cashing a check? Was it a signal to someone standing outside the building looking in? Was it (for all you depth psychologists) an exhibition of latent hostility toward one's mother? Was it a love note for a significant other? Was it perhaps only an excuse used to get to speak to someone the actor would like to get to know? Was it a desperate attempt to get a relative of the actor released from being held hostage? Could you even begin to tell if it was "just" a joke of some kind? Was it perhaps an act of coercion by an evil neuroscientist sitting in the car for demonstrating some brain stimulation process to control behavior?

The list of plausible accounts of that string of physical "bits of behavior" is indefinitely large, and none can be determined to be more or less correct than any of the others without a full and complete specification of the functional—i.e., the intentional and pragmatic and goal directed or teleological—context, as well as the semantic context in which it has occurred (recall Endnote 4). At any level of semiotic analysis, any specification of physical movements on the part of a living subject is inadequate to determine what functional behavior it exhibits. A semiotic framework—from pragmatics on down—simply must be available for understanding (for disambiguating) what the behavior means.

There is context for action, and then there is context for that context. For the purpose of analysis, we must always select something within a single context at the next higher level. This exemplification of downward causation (as Campbell 1974a, 1974b, used the term) will enable us to concentrate on, say, a semantic analysis *if* the pragmatic context is taken for granted. In that context we note that Chomsky (1957, 1965) was able, in the study of language, to ignore many semantic issues in order to concentrate on syntactic structure. In so doing he was able to show how structural devices, at least at the surface level of syntax, can eliminate *some* semantic ambiguity. At the same time he showed that some other cases of semantic ambiguity could be explained only by looking over the surface syntactic *derivational history* of the utterance. He showed that at a higher level, it would be possible to disambiguate the pragmatic context as well as the semantic context in which syntactic structures occur *by looking back over the context provided* by the history of their derivation. This is what is required to disambiguate a given surface structure or linear string.

This applies to overt behavior as well. The moral is that any functional specification of what an actors' intention actually consists of cannot be unambiguously realized without a structural derivation (specification of the derivation of the syntax) of the movement necessary to manifest it. My "check-cashing" (at least that is one possible interpretation) example shows this problem. Analogously, no Hayekian account of the *functionally specified behavior alone can be accepted as* a *grammar of behavior* to show how the particular physically specified movement exhibited by the individual(s) instantiates the abstract functional specification "hunting." Any adequate syntax of action is years in the future of psychology.

Parenthetically, we may note that in economics, considerable progress has been made by *ignoring the full range* of pragmatic and semantic contexts in order to focus on what has come to be called "economic action." For the economist action has a very limited and moderately well specified meaning in terms of standard examples that are discussed in the literature. This familiarity with a delimited range of "actions" misled overly rationalistic theorists, such as Ludwig Mises, into thinking that economics could be formalized into an axiomatic system. Since human behavior is productive, as Chomsky and many other linguists have pointed out, and as I have argued with respect to the entire range of human intentional behavior, such an approach is simplistic in the extreme. There is no hope of constructing an exhaustive catalog of intentional action, and the praxeological approach to economics is as much a waste of time as the behavioristic approaches have been in psychology. We need to look at the lessons learned in linguistics to see the extent to which they are applicable to the other domains of human action.

We have a potential study guide (a sketch of an outline of a blueprint, as Feigl [1967] used to say when referring to the mind-body issues) available in developments in linguistics, which deals with one particular type of "behavior"—language—that has employed the technique of structural analysis to disambiguate function and hence meaning. Here there is an important lesson for how to understand the relation of surface structures (linear strings) of overt behavior (or action) to their underlying causal structures and processes which, when exhibited, remove the ambiguity in the surface strings by pointing to the implicit pragmatic or semantic context from which those strings were generated. Let us see what can we learn from the analysis of a single "isolated" sentence?

Deep structure ambiguity is fundamentally different from surface structure ambiguity. The mid-20th century revolution in linguistics showed two things that are necessary: first, any adequate grammar (of language or behavior) must employ formation and transformation rules that are powerful enough to rewrite strings of symbols into strings of symbols. Chomsky showed that that power requires more than the then available phrase structure grammars were able to provide: it requires the power to "look back over" the derivational history of the utterance in question in order to see how its constituent phraseology is parsed to provide an interpretation (a meaning). Second, Chomsky's revolutionary addition to the surface structure analysis of phrase structure grammars was the realization that ambiguity could occur at both the surface and also at the deep conceptual structural level of grammar. In addition to simple phrasing and embedding problems of meaning, requiring only the correct grouping of strings into phrases in a sentence in order to disambiguate it, there was another kind of ambiguity that was fundamentally different. This newly noticed (but always present) phenomenon of deep structural ambiguity requires one to look back in history into the non-surface or "deep" or underlying derivational history in order to see which of the alternative possible interpretations a speaker had intended to "mean" with the surface linear string.

Consider some examples. If a speaker were to utter this old joke:

What's that in the road ahead?

It can be taken to mean two things. First, "What is there ahead of me in the road?" Or, second, it can be interpreted to mean "Is that a head on the road in front of me?" Whether the "something" on the road refers to "a head" or to an unknown is disambiguated by paying attention to how the linear string is in fact phrased (parsed) into groups of words—what the form of its surface structure is. Against this background Chomsky introduced a fundamentally new kind of ambiguity. Consider:

Praising professors can be boring

The shooting of the hunters was terrible

These examples require one to be able to *look back over the derivational history of the utterance* in order to disambiguate the interpretation. In the case of the latter example, you do not know whether the hunters were terrible shots, or whether the hunters were themselves the ones being shot. All our perceptual behavior (whether speech perception, or visual or auditory perception or whatever) provides ambiguous input in this sense. The history of science is replete with examples, many pointed out by Hanson (1958) and Kuhn (1970, 1977), just as Chomsky's examples were becoming known in language. For instance, Hanson argued that what Tycho and Kepler "saw" when they looked at the sunrise from exactly the same point of view would have been entirely different. Tycho would have seen the sun revolving around the fixed earth, while Kepler would have seen the moving earth revolving around the fixed sun. Or to take a different sort of example, one in which two circles and two elliptical extensions extend from the outermost circle, it would be interpreted very differently if someone said, "incoming missile," than if they had said "Mexican on a bicycle."

This process of looking back over the history in examples such as these requires one to look at what the linguist calls non-terminal vocabulary elements instead of just the terminal items. Here one needs to be familiar with the theory of Post languages, stemming from Emil Post (1943, 1965). Terminal items are words or surface entities in the language, non-terminal items are (for natural languages) such things as NPs and VPs, Det. or Aux., and even the concept S for the "sentence" as a whole (S is the axiom for natural language). We do not speak noun phrases or determiners or auxiliaries or verb phrases in the linear surface structure of speech, but it has been necessary to *postulate* their existence as classes of syntactic structure devices in order to understand (i.e., to disambiguate) the longer linear strings we call sentences. The terminal versus non-terminal distinction shows a fundamental difference between the abstract underlying conceptual structures and the terminal or surface vocabulary items of language behavior. The study of (natural) language utilizes only one axiom, S, intuitively understood as sentence. Other Post languages could have different axiom sets (such as A for "act" in a grammar of behavior) and indeed more than one axiom. The derivational history of a sentence proceeds by differentiating the highest level of relevant non-terminal items (in many languages, something like the S-V-O structure, read as subject, verb, and object) and then the constituents of those lower levels of analysis. For example, the S may be differentiated into a noun or a noun phrase, the V into a verb or a verb phrase, and the O into a direct object. Thus "The boy hit the ball" is a paradigm exemplar of an S-V-O sentence construction. Here is a structural diagram (Figure 1) for a simple declarative sentence:

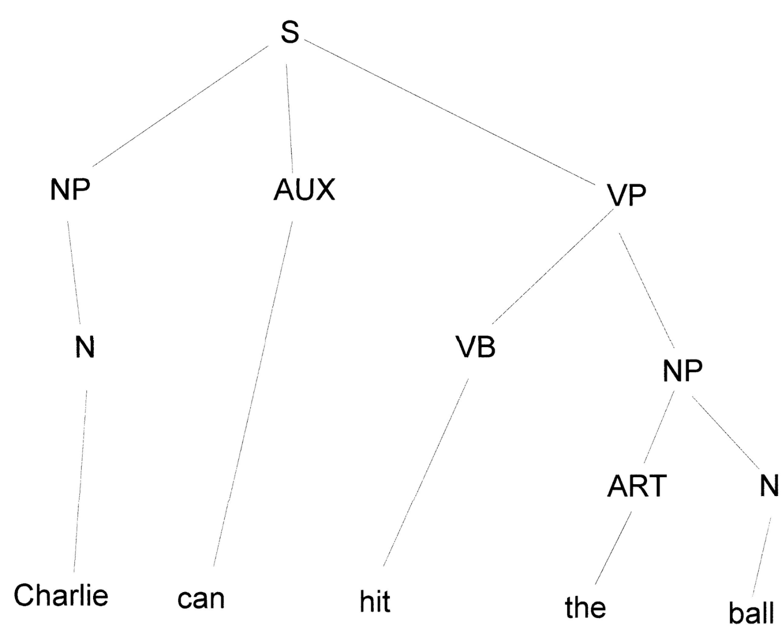

Figure 1:
***Derivational diagram for* Charlie can hit the ball**

The problem posed by deep structural ambiguity is that such utterances instantiate (at least) two instances of capital S, i.e., two distinct sentences, instead of one sentence *in the same linear string* of terminal elements. For instance, one "sentence" in the deep structurally ambiguous sentence illustration above is paraphrased as "It is terrible that the hunters were shot" while a second sentence is "The hunters were terrible shots." In the behavioral case that is represented in the "check-cashing" example, there are potentially very many types of act, or perhaps other axioms in addition to acts (so the grammar would require A, B, and C, if you will, or perhaps more likely, E (for emotion) or some other primitive) that must in some fashion be incorporated into the account and subsequently disambiguated. In surface ambiguity such a disambiguation can be effected by correctly parsing the terminal string of physical movements. Much more likely is the "deep" case, which will require looking back over the history of the *semantic context* in which the act occurred. That will also require knowledge of the pragmatics involved. If we happen to determine that, immediately before the behaviors described in the above example, the actor received a threatening phone call from his or her parents' residence, we can narrow down our possibilities to two or three: a basic act of check-cashing, and something that must be like the hostage rescue interpretation, or perhaps a very bad joke. This dual or perhaps triple "act" possibility in a single sequence interpretation is one reason why any attempt at constructing a grammar of action is so incredibly difficult—without a full contextual determination there simply is no possibility of determining what act, if any, a given bit of physical behavior instantiates. And in the example above, one could easily add a fourth act—exhibiting hostility to one's mother, as a result of a "threatening" phone call to the actor.

VIII: HUNTING AGAIN

One would certainly assume there are simpler examples to consider. Can we find anything with "natural" units that intuitively correlate directly with physical events? Here we face problems on both sides. Since functions are physically ambiguous, we might consider looking for seemingly natural physical units. The problem here is that the entire history of physical science has been a quest to "carve nature at her joints," with little if any success. What we have found after several millennia of trying to do this is that no matter what we have proposed as a "natural" joint of nature, it in turn is found to have joints.

What are the right levels, and units of analysis? We can now examine the seemingly simple example of purposive behavior that Hayek employed. Despite its simplicity, it actually exhibits a large number of functional concepts, which are either embedded in other abstract functional classes or required by the necessity to coordinate movement by feedforward or anticipatory systems between other living, and hence equally functional, entities. At a bare minimum we need to look at the web of interconnections between the various levels shown in Figure 2. Hunting is a relatively specific abstract entity, and it must be subsumed under a broader abstract intention or goal, such as fending off starvation or providing for one's family, etc. If we wish to understand an instance of hunting, we must state or presuppose such an abstract level. Once we settle upon the functional concept of hunting, we must further delimit it to hunting something more specific: hunting a deer, or a small edible mammal, a mushroom, or something like that. We must then determine whether this is coordinated with other individuals or not. In Hayek's example there was at least one other like kind functional entity, another hunter. Once that constraint is specified, we can then concentrate upon feedforward or anticipatory mechanisms that would begin to delimit actual movement on the part of the hunter(s): this would involve anticipation of the behavior of the prey, of the other hunter, and of "your" (the first hunter's) movements with respect to both the prey and the other hunter. At that level of specification there would necessarily be an immense functional selection of particular kinds of movements to be determined. For instance, the first hunter's actions would involve further functional concepts such as walking, running, hiding, crouching, aiming some sort of weapon at the prey, and then shooting or throwing the weapon at the prey. This would in turn require further specification of movement directed by feedback and subsequent feedforward for not only the hunter, but the hunter in conjunction with feedback from the position and activity of the other hunter, and the same of the prey. We can see an over simplified diagram of this sort of information in Figure 2.

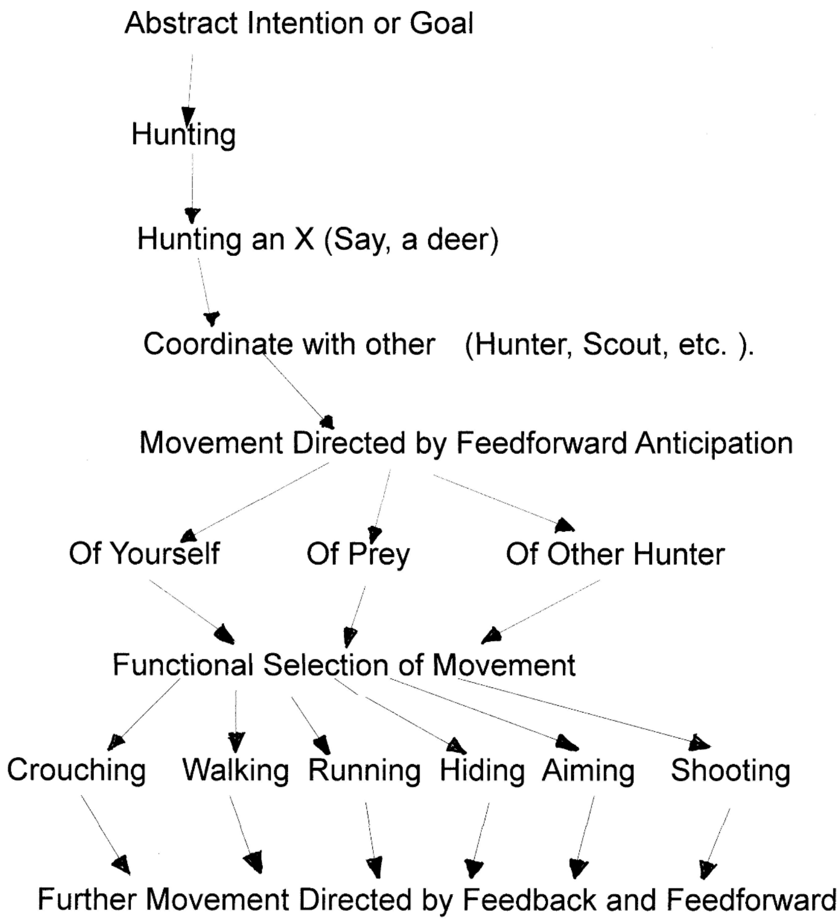

Figure 2:
Overview of Hunting as Functional

Only once we have accounted for all the information specified by the functional concepts in Figure 2, could we then begin to specify actual physical movements that could realize the functionally specified abstract concepts.

What is the proper level to correlate with functions? Here the problem is far from simple. If we take even the lower-level of functional selection of movement on the part of the single hunter, there are an indefinite number of ways in which any of those concepts—such as walking, crouching, aiming, etc. can be realized in a pattern of physical movements. If we were to take something as seemingly simple as crouching, we would need to specify whether this involved going down on one knee and bending forward, going down on both knees, leaving one's head in an upright position to further observe the prey and other hunter, or talking it down to be less visible to the prey, moving behind a rock or tree, the positioning of the hands and arms, and an indefinite number of other particulars. Here we could at least begin to try to delimit the possibilities by specifying action patterns or concepts, such as bending one's knee, that could at least in principle be put into standardized action classes determined by neurophysiological action patterns and muscle movements.

Assuming that we can succeed in delimiting the possibilities for such complex behaviors by specifying physiologically relatively determinate patterns it is quite likely that in any given unit of time (say, for example, a two-minute interval) there could easily be between 100 and 500 identifiable "fixed action pattern" physical movements. Perhaps at that level of specificity one could disambiguate the possibilities for how a simple concept such as crouching could be realized. If not, it would be necessary to move to an even finer grained analysis to begin to get such clarity.

Hayek's example was "simple" only because it was intuitively obvious, and perhaps less ambiguous than my "check-cashing" example on first examination. In any case, it should be clear that we are not presently able to construct a grammar of action for even the simplest functional specification. We do not yet know what nonterminal vocabulary elements—the abstract functional categories—are relevant. Here we will need evolutionary biology and psychology to identify relevant (recurrent) "classes" of such (theoretically specified) abstract entities.

IX: PROBLEMS OF INTERPERSONAL SPONTANEOUS ORDERS ARE DIFFERENT

If the problem of intentionality (as a representative instance of individual behavior) is so difficult, what are we to make of apparently even more complex situations and interactions such as the market order of society or economics? Why are we farther ahead in understanding such functional concepts as economic action, or the nature and effects of competition, or the nature of the business cycle? Perhaps because the task there is actually made easier because of an accepted restriction. Economic analysis *presupposes as a given* the issues of intentionality and functionality of human behavior. It is "axiomatic" (more correctly, simply postulated) for the discipline that no one in the economic order acts "unintentionally." Everybody is out for some "economic" purpose in the cases that have been studied—usually one's own enlightened (supposedly!) self-interest in one form or another. Even so-called altruistic behaviors, not only in biology but in economic acts such as charity and the misguided desire to do benefit "for the greater good" usually have a straightforward connection to an individual self-interest, and in any case *always* have a purpose. The total number of actual economic intentions or purposes do not figure in economic analysis. They are presupposed to exist, but not as part of economic analysis. What appears to be the central problem in such analysis is how individuals utilize their own *local knowledge* in order to take advantage of an ongoing order of which they individually know virtually none of the details. As Hayek was clear in the 1930s, the fundamental problem of economics is epistemological.[1] He stressed this in, for example, "Economics and Knowledge" in 1937, and most of the essays included in *Individualism and Economic Order* (1948). That problem is for the individual to utilize a single given bit of information, the price of a good or service, in order to determine how best to allocate his or her resources (Endnote 3). This does not require the individual to have any knowledge whatsoever of the

1 Ebenstein and some others regarded Bill Bartley's "heavy-handed" editing of *The Fatal Conceit* as too "Popperian" and constituting a "fatal deceit" because it shifts from purely economic considerations to focus attention on the problem of the *distribution* of knowledge in the extended order of society, in order to address the epistemological problem of how that order *evolved*. While I agree that Bartley edited too heavily, one should realize that, because of my prodding, Bartley had come to a more "Hayekian" position prior to his too early death, and was quite sympathetic to Hayek, attempting to focus the original manuscript. He (Bartley) wanted to show that the position is part of the evolutionary epistemology developed in the 20th century by Popper in philosophy, Campbell in psychology and biology, and Hayek in economics. Hopefully we can come to view this last work as jointly written by both Bartley and Hayek, and as reflecting the evolutionary viewpoint Hayek had endorsed since the 1920s. In the meantime, *mea culpa* for suggesting Bartley to Hayek for this task. It is also an unfortunate reminder that far too many economists, with a limited focus, fail to understand the framework from which Hayek operated. In this regard I cannot conceive of how economics can succeed without being able to incorporate a thorough grounding in epistemology and in psychology.

derivational history of prices that the market supplies. Nor does it require detailed history of the participant's motives or intentions. Such knowledge is atemporal in that regard. There is no possible ambiguity in a price: it just "is." Indecision or ambiguity can reside only in a given individual's acting in accordance with that given price as a guide to action. One can hesitate and debate many factors in a cost-benefit analysis of how to proceed, but one cannot debate the price of a given item: it just is what the market says it is. This explains why the economic market order is so incredibly powerful—it is just a means, and not an end in itself. It is an information transmission system that enables any individuals who participate to best serve not only their own interests but indirectly the interests of all other participants. Human functionality—intentionality, teleology, goals, etc.—remains outside the analysis of the market. If it were to intrude, the impersonal market order would collapse back into a teleological taxis structure. If that is allowed to happen, we will lose the process responsible for all our present-day knowledge and wealth, and our power over nature.

Linearity in the market and in the brain. This has importance for the issue of linearity. While both the market order and our behavior "run off" in time in linear fashion, only historians of economics pay serious attention to details of market history. The market order presented to us is a given surface structure. An individual market player may keep track of relevant prices in terms of highs and lows, and may wonder where things "really" are in terms of the business cycle, but there is never much need to determine why, say, a certain price was the low in some specified period, or why one business cycle lasted for a different time period than another. The problem of market participation is a matter of maximum utilization of limited information: the information supplied by a particular market price at the present time. Any attempt to "analyze" the market before making a move will generally result in it being necessary for a participant to redetermine a more current price, and thus, simply will delay a decision.

There is an informative partial parallel to this in how we analyze surface forms of complexity in linear strings in language. We can, within any sentence, embed another phrase or sentence, and the typical hearer will have little problem in interpreting it. We easily move from "the boy hit the ball" to something like "the boy (wearing the red jacket, who lives in the third house down on Elm Street) hit the ball." Consider the hardest example—mirror image embedding. Start with:

Oysters bite

An unusual sentence perhaps, but still relatively easy to understand. Now embed this same sentence within it:

Oysters oysters bite bite

Isn't that fun? The normal speaker-hearer of English can instantly paraphrase this sentence as "The oyster the oyster bit bit (back)." But the absolute limit for most hearers is triple embedding. We just don't have the span of processing capacity to do more than that with linear strings. Given the uncertainty of our world we are oriented toward incorporating more information as time goes by (future oriented) rather than going "back" to processing something already there in the past. Consider an example that isn't as novel as the oysters. Give me a quick paraphrase of this:

The rat which the cat which the dog chased ate was black.

You can easily handle some sentence forms even if they are "a mile" long, but this simple triple embedding is beyond you. This has perplexed some linguists and mathematics types who do not understand why, given the power of recursion in other aspects of sentence generation, this should be such an insoluble "performance" problem. In that regard it is like what would be involved in the market order if a participant had to "remember" where everything had come from and how the momentary price had been determined.

But this "problem" goes away when we realize that just because the derivation of a sentence, from the axiom S down through any intermediate levels of non-terminal and hence abstract vocabulary items, eventuating finally in a surface string of words, is a one-way process—it goes conceptually as well as dynamically from top to bottom—and it must go that way, since it is a matter of *downward causation* from the pragmatic-semantic intention to the surface structure realization of a sentence in strings of words. There is no causal arrow going from the bottom linear string back "up" in this situation. The neural process "cloud of activity" eventuates into linear strings in the genesis of language behavior. The processing of those strings puts information back "up" into that cloud of neural processes, but it does not require or utilize a total specification of the derivational history in order to get that information "uploaded" (pardon the computer metaphor). Disambiguation, when needed, comes *later*, well after the initial pickup of the string. Despite the fact that they are both motoric processes (in the construction and in the perception of a string) there is no need to presume that they are literally symmetrical.

To consider the market for a moment, the absolutely remarkable fact upon which it is based is that we do not ever have to go against human psychological organization and "look back over a derivational history" in order to participate in its ongoing pattern of activity. It is a purely linear string, in the specious temporal moment for participants, and all we need is the limited local "instant" information of what a price is. All we have to process is the last item in the string. We then determine, on this information, whether to buy or not. That is the economy of knowledge in the economic domain. It is not as hard a problem for humans to solve as the psychological issues of gaining knowledge of ourselves or our econiche.

As a conceptual aside, we can consider the difference between the market order and the individual in terms of the difference between rate-independent and rate-dependent. Individual cognition—all our knowledge, all our theories, all our explicit processing results—actually is occurring in the specious present moment, i.e., it is timeless. Our conscious understanding of the meaning of a sentence or an equation such as F = ma is instantaneous. It may have taken us considerable time to come to understand what such an equation or sentence means, but once we understand it that meaning is just "there," the lightbulb turned on instead of the dark. In contrast to this is the dynamical world of physicality, in which the flow of time is both inevitable, indispensable, and inexorable. All our knowledge of nature—all of our physical theory—is in our rate-independent realm of conception, while all its objects are in the rate-dependent realm of temporality. Human knowledge and understanding occurs in a timeless domain. Overt human behavior occurs in a rate-dependent, dynamical domain. That is, once again, the complementarity of the duality of descriptions.

The information made available to a subject by the spontaneous ordering of the market is at any given instance rate independent. What a subject does with that information—how the subject behaves in the real world—in harnessing physicality to fulfill intentionality, requires *behavior through time*. This dynamical process is geared entirely toward anticipation—as Hayek said, we live as much in a world of the future as we do of the present. As anticipatory systems we are geared toward expectations of outcomes in the future. That is why there is such a tremendous "performance problem" with things such as multiple embedding in sentences. Our evolutionary history never required us to be able to handle such things. The entire spontaneous order of society depends for its existence upon the fact that spontaneous complex orders make available to us information "in a flash" or in the specious present, and that is what we have evolved to be able to handle.

Considerable problems return, however, when one moves from market order information pickup by an individual to overall social functioning. Here superimposed problems of social and political organization make it more difficult to determine what is really at issue, and thus problems of intentionality and purpose within individuals become crucial once again. The problems of social organization that are found in the theory of law provide many instances of the conflict between law with a capital L, as principles of general order that apply, analogously to the laws of nature, every-where and every-when in the society, with the conception of law with a lower-case l as particular commands to perform certain actions (legislation). In social history law with a capital L has eventuated, at least in representational democracies, in the conception that no one, especially the leaders or the magistrates, is above the rule of law. Because of the limits of our information processing capacity, it is not possible to formulate general laws without utilizing negative rules of order, i.e., prohibitions upon general classes of action (Weimer 2020). The economy of knowledge requires the Law to be formulated negatively, as general prohibitions of certain abstractly, i.e., functionally, specified classes of action. In contrast is the concept of legislation, which is a requirement that one must perform certain definite acts (to achieve certain specified purposes) in certain circumstances. Legislation, unlike the Law, still requires specification of many intentions or purposes and many behaviors, many of which are often in conflict with one another. Like all attempts to limit analysis to surface structures of behavior this approach is inherently ambiguous (to say nothing of impossible for one to remember) as a result. The legislation written on the books of the United States government (for one example) is so voluminous that a single individual cannot carry it about single-handedly. Hayek correctly argued that we cannot make social rules of conduct, which have a group selected derivational history far different from a single individual's knowledge or history—into merely surface structure positive prescriptions to respond. That would require ignoring all that inherited context, and he argued for that position in a fashion that is analogous to what I have argued above—the ambiguity of functional specification prohibits such an approach. Hayek's argument in this regard is quite tenable, based upon the necessity of incorporating the history of the species and the given organism in living systems in order to understand the behavior of those living systems and, *ipso facto*, the particular individuals within it.

Both between and within systems analyses require complementary accounts. Hayek began his psychological work a hundred years ago with the *Beitrage* in 1920. Thirty years later, after studying economics extensively, his initial writings eventuated into TSO. That book detailed an account of central nervous systems (restricted largely to humans). As an account of the classificatory activity of neural processes it was pioneering then and still correct today. But in this "within" domain it was possible to initially ignore the problems posed by the duality of descriptions (and theories) necessary to address the mental and physical realms. The issue of communication within the CNS, while acknowledged, was never dealt with in any detail, and accounts were always noted as based upon "simplifying" and "ideal" situations. In such simplified frameworks it is possible to momentarily ignore the problems posed by communication "between" individuals, in a manner similar to the way in which one can ignore certain complications of a mathematical equation when the same term appears on both sides of the equals sign. But today we cannot, all things considered, succeed in understanding the problems of communication simply by canceling out terms on each side. They have to be accounted for in some principled manner, and must be accounted for on both sides of the equation. Coordination of behavior between two sovereign or independent subjects of activity forces us to acknowledge the duality of descriptions von Neumann was forced to postulate when confronted with a parallel problem in what is involved in self-reproduction. And as von Neumann knew (and later the discipline of biosemiotics was forced to acknowledge), that conceptual approach is an explanatory necessity *within* the individual living system as well.

As we have been forced to acknowledge fundamental differences between the semantic control structures of computers (their software programs) and the syntactic realization of that control in the hardware, we are forced to employ a semantic (as well as pragmatic) account, based upon *choice constraint* on the part of the subject, in order to explain the *physical constraint* realized in the movement of the "matter" of living bodies. The semantics of life and cognition control the physical realization of movement. We have been forced to accept this from study of the origin of life, from the first folding transformation on upward to the highest form of conceptual activity. Individual subjects, always different in virtue of the uniqueness of their history, can never be treated as objects like physical theory, for which any basic entity (such as a photon or an electron) is totally identical to any other one. Living subjects are unique in that our derivational histories are always unique and "one-off" compared to any other given subjects. But all of us are unique, and this requires that explanatory adequacy can be achieved for individual behavior only by a theory that acknowledges the duality of descriptions, and hence provides two theories for two domains at once. Intentionality is built into living systems when functionality arises. Explaining functionality always transcends physicality, but requires it as a substrate.

Why economics is easier than psychology. The fundamental problem of economics is the economy of knowledge—how such limited knowledge on the part of any given individual results in such tremendous economic benefit to others. The fundamental problem of psychology is the acquisition of knowledge—how the nervous system utilizes the response to novelty in feedback and feedforward mechanisms to create adequate models of ourselves and external reality. Understanding the utilization of a small amount of knowledge is an easier task for economics to explain than the psychological task of explaining how all our knowledge is acquired and can be made available for utilization. Both fields address spontaneously organized complex orders, and the principles of organization for such orders share commonalities, like the presence of creativity or productivity, opponent process regulation, and differentiation by the application of recursive processes. The economic realm presupposes as given the intentionality or purposiveness of human activity. Psychology must utilize complementary theories in the physical and functional domains to explain how intentionality arises in subjects. Economics can get by with just studying the utilization and distribution of economic goods while keeping the problem of intentionality constant across individuals and contexts, so that they can in fact be ignored in the economic analysis. Psychology and the social studies must address a welter of additional problems, such as the organization of the nervous system in the genesis of behavior and cognition, and the social dimensions as higher order harnessing constraints creating what Ferguson aptly called the results of human action but not design. In the latter class of problems is the issue of the ingredients of the context of constraints that are necessary for the social order to function as an ongoing evolving process. Here we need to know what are the necessary constraints in order to remove unnecessary constriction of the output of the order (as by government intervention that is beyond what is necessary for personal defense and legal protection in the performance of contracts, for private property, etc.). Imposed upon such knowledge are all the problems dealt with by social and political theory. For example, is a government run and taxpayer funded postal service necessary, or would private enterprise pick up the task and be more efficient in the absence of that government "entitlement" being provided? What about "private" police protection and "national" defense? Those are actually live empirical issues that need to be studied rather than pontificated upon in advance.

Economics is split into two fundamentally different approaches. The first, which is what we have been implicitly discussing, is the domain of microeconomics, which ranges over individual action in the market order. The second, macroeconomics, attempts to discern and relate within causal relationships global or transcendent concepts pertaining to descriptions of the overall economic activities of a large entity such as a nation. Macroeconomics attempts to discern simple relationships between easily quantified but theoretically largely irrelevant concepts such as the overall "gross domestic product" of a nation, or the overall employment or unemployment, or an overall money supply controlled by a central banking system. While such large-scale interests occupy many, there are coherent reasons for why actual economic theory must range over the micro domain instead. The problem is straightforward: just as David Hume argued three centuries ago that when one observes empirical phenomena one never sees causes but only the constant conjunction of events, when one observes social or economic action one never sees putative entities such as crowds or minorities or the disadvantaged, but rather only individuals. When one looks for a "crowd" one finds only individuals who are momentarily within reasonable proximity of one another. There is no evidence of any such thing as "crowd behavior," as an existent over and above the behavior of the individuals. The fact that individuals behave differently when in close proximity compared to how they behave when they are alone is a fact about individuals, not about alleged social wholes.

The contention that economics is easier than psychology pertains only to microeconomics. That field exists and has made progress only because it has been able to select a small aspect of the domain of functionality, intuitively specified as economic action, and study it in relation to individuals. Attempting to discern functionality in macroeconomic relationships would require one to undertake a task as or more difficult than that faced by psychology in attempting to address the entire realm of functionality for human behavior.

SUMMARY (PART I AND PART II)

Hayek's TSO provided a worked-out sketch to account for the central nervous system as an instrument of classification, and thus a feedforward mechanism to be used in the specification of intentional behavior. Arguing against Mach's doctrine of phenomenalism, he showed that the only problem that physical science could address was how the mental order arose in the systems of classification provided by neural activity, showing that in principle someone who was blind could know all of physical science.[2] His later "within systems" paper attempted to go beyond the discussion of an individual nervous system's activity to explain dyadic intentional behavior. This causal account of functionality was attacked by Karl Popper, who argued that it was not possible to provide a "causal theory of mind" in purely physicalistic terms.

Both positions were wrong: Hayek failed to provide a purely physical account of intentionality, and Popper, correctly emphasizing the productive nature of language, vitiated his own argument by vacillating between arguing for the noncausal account of mind (on the basis of productivity in language and his interpretation of indeterminism in physics), on one hand, and on the other hand, a causal theory of mind as "plastic control" that, like Hayek's patterns of classification, was to reconcile freedom of action with causal determination. Understanding the failure of both accounts requires exploration of several points. Hayek did not comprehend the import of the duality of descriptions in science, and in addition, wanted to make the concept of dispositions (behavioral dispositions to respond) central to his descriptive "physical" account. But dispositional concepts and analysis occur only in pre-theoretical and noncausal fields, and they disappear with the presence of actual causal and explanatory accounts. And like Popper, he failed to understand the necessity of distinguishing between surface structure and deep structure components of behavior, and thus missed the fact that any "physical" account of functional concepts is infinitely ambiguous and hence useless unless it is accompanied by a complementary theory (due to the duality of descriptions) of how the indefinitely extended domain of surface structure physical "bits of behavior" can be shown to derive in principled fashion from the deep structural rules of determination originating in that "functional" domain of intentionality and meaning.

Constructing such an account of choice contingency, as a syntax of action or a "grammar" of behavior, involves detailed construction and analysis of a realm of abstract functional concepts, analogous to the non-terminal vocabulary items in a Post Language description, that we did not then and simply do not yet have available. We do not yet know what the abstract entities underlying intentional action (or emotional action) are. As a comparison, the analysis of potential abstract deep structures found in recent linguistics, while limited for language only, can at least provide an outline of what we require for behavior and action, although not any specific content. Only if such an analysis can be provided can we realize the goal of explaining teleological action. The central feature of any such accounts is the fact that they must be historical—they must look back over the derivational history of the behavior in question in order to disambiguate it, and thus to determine what functional meaning it exhibits.

An interesting consequence of the limited range of teleological behaviors found in individuals in economics—where the concept of human action is delimited to economic-action—is that economics is much easier to do, and thus considerably more advanced than psychology or the social studies. By limiting itself to one particular form of teleological behavior microeconomics has succeeded fairly well in understanding market behavior. This also shows why macroeconomics, ranging over an enormous number of conflicting goals and inchoate intentional actions, has little to offer as an explanatory science.

2 That one does not require the qualia of acquaintance, but rather only the knowledge and language of description in order to do all of science is a key point of the epistemological position called structural realism (see footnote 10 above), and it is clearly stated and elaborated in the last chapters of TSO.

ENDNOTES

2. The problem of "backward" causation can be addressed by two approaches. First, by employing a surface-deep analysis (requiring hierarchical, or even more complex, structuring) in which higher order "causal nodes" eventuate into lower-level, and finally surface structure linear strings. Such an analysis occurs in the timeless or rate-independent realm of conception, and is therefore in itself independent of dynamical constraints. A second, rate-dependent way it can be addressed is by the concept of *downward causation* as introduced into biology by Campbell (1974a, 1974b) especially in "'Downward Causation ' in Hierarchically Organized Biological Systems." Campbell's position adds to three positions that are accepted as "facts of life" in present-day biology. First, any and all higher levels are constrained to act in terms of the laws of the lower levels down to those of sub-atomic physics. Second, the teleological achievements at higher levels require for their explanation a full account of their implementation by specific lower-level mechanisms and processes. Third, "laws" of biological evolution are emergent with respect to the laws that are sufficient for physics and inorganic chemistry. To this Campbell added a fourth position: downward causation. And he specifically noted that this type of "causation" can be considered downward only if substantial extents of time, covering several reproductive generations, are included as one unit or "instant" for the purpose of conceptual analysis. This is an aspect of the fact that organisms are the product of *group selection over generations* rather than individual "mutation" or individual behavior. As an example, he discussed the jaws of a worker termite or ant:

> We need the laws of levers, and *organism-level selection* (the reductionist's translation for "organismic purpose"), to explain the particular distribution of protein found in the jaw and hence the DNA templates guiding their production … Even the *hence* of the previous sentence implies a reverse-directional "cause" in that, by natural selection, it is protein efficacy that determines which DNA templates are present, even though the immediate micro-determination is from DNA to protein …
>
> If we now consider the jaw of a soldier termite or ant, a still more striking case of emergence and downward causation is encountered. In many of the highly dimorphic or polymorphic species, the soldier jaws are so specialized for piercing enemy ants and termites, huge multipronged antler-pincers, that the soldier cannot feed itself and has to be fed by workers. The soldier's jaws and the distribution of protein therein (and the particular ribonucleic acid chains that provide the templates for the proteins) require for their explanation certain laws of sociology centering around division-of-labour social organization (Campbell 1974a, p. 181).

To reemphasize, this has consequences for both biological selection and the problem of explanation:

> For biological systems produced by natural selection, where there is a node of selection at a higher level, the higher-level laws are necessary for complete specification of phenomena both at that higher-level and also for lower levels. Scientific description is still incomplete when all the details of points 1 and 2 are solved (Campbell 1974a, p. 182).

[Point 1 refers to lawful constraints of the lower levels, point 2 refers to higher-level implementation by specific lower mechanisms.]

The import of this is straightforward:

> Questions about the function of a process at one level are questions about a selective system at some higher-level. For complete scientific description of the distribution of restrictions in biological systems we need additional laws, restraints imposed by the selective system of the highest level of selection and affecting distributions at all lower-level levels) (Ibid.).

This conception of higher-level constraint is discussed later, in the problem of disambiguating surface structure linear strings by looking back over their history of derivation from the deep conceptual structures at "higher" levels of analysis. Hayek's account fails because it makes no explicit provision for the higher order constraints to act upon the "lower" or physical domain underlying action.

3. As Hayek emphasized, this is maximum control by minimum constraint. It is the vast superiority of the market order in comparison to other control structures. The control structures of the market order transcend "mere" hierarchical structuring, requiring far more abstract and decentralized control than a hierarchy can ever encompass. Elsewhere (Weimer 1977) I contrasted hierarchical structuring with Polanyi's conception of *polycentric order* and von Foerster's conception of *coalitional* systems. The tremendous explanatory superiority of either of those over hierarchies is that they provide mechanisms (processes) for the complete or nearly complete *decentralization of control*. In a hierarchy there is always one dominant node at the top (equivalent to the dictator or a chief executive officer, as in Meehl's 1989, "command neuron" hypothesis), and that node is the ultimate locus of control: all the lower (intermediate level, or non-terminal vocabulary below the level of axioms) layers down to the terminal vocabulary or surface strings depend on the top node for the form of the realization of the surface string. The obvious superiority of hierarchical structuring over linearity is that one can eliminate (or render nonfunctional) a single intermediate level node and the surface structure string will still manage to (at least nearly completely) run off. If an item in a linear string is removed, the string stops dead at that point. But what about situations in which multiple functional hierarchies are involved? In the polycentric order, almost any node can function (at any given time) as the top node in a hierarchy, and if one control point is blocked any of the others can take over and direct the terminal string output. In a coalitional structure in which an indefinite number of polycentric orders can be embedded together, there is virtually no problem of disruption at all. The market order, as an analogy, is not affected if any potential participant chooses not to participate or ceases to participate.

   And in such relatively decentralized orders a seemingly paradoxical result is that a single lower-level output ramifies, albeit with a tiny impact, throughout the entire structure. This appears to be what is involved in the market order, in which a single participant needs to employ only his or her very limited local knowledge in order to affect the overall structure of the entire order by their participation. Polanyi emphasize this by noting that even choosing to listen to a single radio program modifies, however slightly, the overall balance of all that is available on the radio. Hayek's focus for discussion in the social structuring of knowledge and its utilization was almost always on this factor of maximum control by minimum constraint. This is how the market order can not only fulfill the selfish individual goals of a given participant, but also, in selfless fashion, provide a situation in which all the market participants are better able to satisfy their own individual goals.

4. One would have hoped that discourse analysis and so-called conversation analysis would be able to provide help in these extended contextual analysis situations. Both focus on "bigger than the sentence" analyses of what is involved in the determination of meaning and the manner in which sentences are formed and used. Unfortunately, they seem to get no farther than looking at how sentences are linked or embedded together, and the answers proposed usually do no more than separate out strings as chunks that are "strung together" into some bigger structures. There is no attempt at other than a surface structure analysis—a dispositional bunching together—in most cases. Far more interesting food for thought was found in the work of Zelig Harris (especially 1982), from whom Chomsky got and reinterpreted the concept of "transformation" as a rule in linguistics, and Erv Goffman (1956, 1974) on the "dramaturgical approach" to interpersonal interaction (which is not all that far from Hayek's hunting example). Less interesting (at least from the standpoint of theoretical insight) are attempts such as Pulvermüller (2014), which get no farther than labeling short strings of action (short, easily identified groups of behaviors) as components of a larger action sequence. That approach simply attempts to pick out co-occurrence relationships, with little if any theoretical interpretation. We need far more than breaking up a long surface string into embedded subsections. Where are the equivalents of paragraphs, sentences, or phrase breaks? What would be the non-terminal vocabulary items in a Post Language description of human action?

Harris was interesting for two things: First, an entirely surface structure approach to sentence formation that is analogous to an earlier approach in philosophy by Frank P. Ramsey to specify the referential basis of theoretical terms. Ramsey took theoretical terms and simply "reduced" or identified them with the—infinitely extended—domain of empirical particulars they relate to, creating a so-called Ramsey Sentence of empirical-observational consequences to replace the theoretical terms so their reference would be determined. Harris did the same thing: apply a Ramsey-sentence approach to the totality of sentences in which, if one defines more and more word classes recursively into subclasses, one can approximate, like string analysis, more and more of a "grammar" defined as permissible individual word combinations. If this empirical daisy picking approach to concatenations of words worked, it would be a lexicon grammar of permissible word combinations. This would require the creative power of semantics to reside *outside of language*, because the grammar was "nothing but" concatenations of surface words, perhaps in a grammar of action that would employ recursivity to generate novel meanings in both language and all other behavior. The appeal of such an approach is that it makes the problem of meaning independent of its realization in language. Meaning would have to be prior to our utilization of language, arising in (perhaps) our primitive emotionality and our initially global and diffuse responsivity to environmental stimulation. An analogy to this is found in the work of Porges (2011), who argues that our most primitive meanings arise from the responses in which we, with our inherited primitive reptilian brain structures, interpret any incoming stimulation as either frightening or threatening, or as not harmful. Generalizing that approach, meaning arises simply as the acquaintance side of our emotions or passions as responses to stimulation. Our higher (mammalian, and then hominid) cognitive structures have built upon and refined this (reptilian and earlier) basis to create the indefinite number of meanings that human beings possess.

The second thing Harris came close to understanding was the necessity of dual descriptions in theory, by his emphasis upon the language-metalanguage distinctions that can be made within a natural language, as when studying the "language of science" as a sub-language of ordinary language (which is close to what Sellars, 1963, did with the distinction between the manifest and scientific "images"). And one should note that the later Chomsky, in abandoning his earlier transformational approach to semantic structuring, moved back much closer to Harris. But in my opinion Harris is an informative instance of failure to come to grips with the real problems rather than a path to their solution. No approach to a lexicon grammar, or a study of co-occurrence relationships, or a bunching together of words, can succeed unless it presupposes that somehow the issues of functionality, intentionality and teleology, can be handled in some other fashion or made not to exist at all. And the issue of deep structure ambiguity, in which one surface manifestation—sentence string—is actually two or more meaningful separate sentences at once is not something that can be addressed at all in a surface analysis. In that regard Harris was in exactly the same position as Hayek attempting to "reduce" the problems of intentionality to physical specification simply by showing that one can construct a particular idealized instance in which the teleological aspects can momentarily be held in abeyance and identified with given particular physical instantiations of behavior.

Another issue of tremendous importance, usually neglected entirely in discussions of "cognitive" matters such as knowledge acquisition, is the importance (already hinted at in the discussion of Porges) of affect and emotionality. The CNS also includes the autonomic nervous system and especially the vagus nerve. Writers such as Porges have explored the immense complexity and differentiation of functional architecture of what used to be separated only into the distinction between sympathetic and parasympathetic aspects. But emotionality and affect underlie the vast majority of our functionality. Whether this can be addressed as an integral part of a syntax of action, or whether it requires a separate and parallel account on its own is presently an open issue. How our emotions and passions such as love, hate, fear, desire and the myriad others function in the genesis of behavior is presently unknown beyond the relatively crude conceptions available under the headings of motivation and drive. The issues that the behavioristic (and neo-behavioristic) learning theorists studied under the heading of drive theory in the mid-20th century need to be updated with an understanding of the neural structures and processes that underlie them.