Language and Learning
The Debate between Jean Piaget and Noam Chomsky

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Remarks on Lorenz and Piaget: How Can "Working Hypotheses" Be "Necessary"?

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In his paper, Piaget argues against the viewpoint of Konrad Lorenz, who holds that the categories of thinking have developed in the process of phylogenetic adaptation of the human species to its environment. Logically enough, Lorenz calls these categories "innate working hypotheses" of the human cognitive system. Piaget, on his side, feels that the contingent and provisionary status of a "working hypothesis," born out of the haphazard guesswork of mutation, contradicts the "necessary" character of our cognitive structures.

I would like to argue in favor of the Lorenzian view. In particular, I intend to point out that the notions of "working hypothesis" and "necessity," as used by Lorenz and Piaget, respectively, are not at all contradictory.

An Epistemological Argument

Lorenz proceeds from an epistemological viewpoint which is shared by most other ethologists (and also, for instance, by Gestalt psychologists and logical empiricists such as Feigl) and which has been labeled "critical realism."* The basic assumptions of critical realism are the following:

1. There is a structured reality, the so-called "objective world," the structure of which remains the same whether or not there are organisms who perceive it correctly, or perceive it at all.

2. Organisms form a special subset of this "objective world." They are characterized by the fact that their behavior can be interpreted as "adaptive" in the sense of optimizing their chances of survival.

3. This adaptiveness defines a mapping relation: for every possible behavior of an organism, a set of environmental situations in which this behavior would be optimally adaptive can be

* Editor's note: The debate between Putnam, Chomsky, and Fodor in Part II brings further clarification of the issue of "critical realism." Putnam is considered to be one of the most authoritative exponents of this school of thought.

assumed to exist. Thus it can be stated that the behavior of an organism contains "information" about the features of the environment. This information refers to the intersection of all possible situations in which the given behavior would be optimally adaptive.

4. The concept of information is, in this context, not confined to the mere syntactic meaning that it has in information theory. Rather, it can be interpreted *semantically:* we can speak of "true" or "false" information depending on whether a behavior is in fact adapted to the *existing* situation or not. This should be elucidated by a brief example. There is a set of involuntary eye movements that are controlled by the vestibular organ, so-called "vestibular eye reflexes." Among other possibilities, the human eye may, in a given situation, perform a steady rotation in the horizontal plane; in other situations, the eyeballs may be tilted to a given angle around their sagittal axes. If a human organism is subject to a lateral linear acceleration, the eyes will perform a reactive movement. However, this movement does not consist of a lateral drift, which would allow the person to keep track of the environment passing by, but rather consists of a steady tilt around the optical axis. This response would only be adaptive in the context of a lateral body tilt; in this case it would help to maintain the stability of the retinal image. Thus we can describe the situation in terms of the organism having "misinterpreted" the lateral linear movement as a steady body tilt (actually, the lateral acceleration has interfered with the pull of gravity to yield a deflection of the otoliths that is equivalent to and indistinguishable from a lateral body tilt). In this case, the "information" contained in the eye movement about the spatial situation of the body is *false:* to be adaptive, the behavior would require a situation that does not exist in reality.

5. The subject of the experiment just described is not aware of his (involuntary) eye movements. But if he is asked about his subjective experience, he will indeed report the sensation of being laterally tilted. In other words, subjective experience corresponds to the "information" that the external observer assigns to the responses of the organism. Critical realism, now, generally postulates that our subjective experience (or our "phenomenal world") can be understood as the "information" contained in the totality of our behavioral states of readiness; that is, every subject's phenomenal world stands in a mapping relation to objective reality, corresponding to it more or less exactly, but by no means identical with it.

In everyday life, we do not make this distinction. To my naive understanding, there is no other mysterious world beyond the world of my immediate experience: the object that emits light waves to my eyes, and the object that accordingly appears in front of my eyes, are taken to be one and the same, located in one and the same space. This everyday viewpoint is called "naive realism"; we get along with it very well outside our laboratories (due to the fact that the mapping apparatus is so ingenious that it makes only a very few, minute errors). But even as scientists, we have to be very careful not to relapse into the naive view when the theoretical situation actually demands a more critical position.

The critical-realistic dichotomy between objective world and subjective world is indispensable as soon as we want to deal theoretically with the concept of "false information," as for example, in the case of an optical illusion, or any kind of cognitive error. In addition, the naive subject engaged in the struggles of everyday life has a vital interest in the veridicality of his cognitive structures. Far from being a mere issue of academic epistemology, success in the attempt to subjectively map objective reality in an adequate way does in fact determine the chances of survival. So what the subject vitally needs are cues in his phenomenal world that tell him when there is good reason to assume that the cognitive representation is correct.

At this juncture I will make a brief excursion into the psychology of thinking.

An Argument Borrowed from Cognitive Psychology

I would like to present the thesis that man's quest for knowledge has a structure that is similar, in principle, to that of a natural drive.

Ethologists usually distinguish two main phases in a drive process, called "appetency" and "consummation." These can be distinguished in the following ways:

1. Appetency (for example, searching for food) is accompanied by a state of tension. In consummation (for example, eating), this tension is more or less suddenly reduced. This reduction is felt to be pleasurable.

2. During evolution, appetency behavior becomes more and more complex, variable, and sophisticated, whereas consummation behavior remains comparably primitive, inflexible, and unmodifiable by experience.

3. Every natural drive can be expected to have a biological meaning, that is, to produce with sufficient certainty an *effect*

which directly establishes a selective advantage. However, in spite of its importance, this effect only seldom plays a role in our subjective experience; the fact of whether or not the effect occurs touches our passions less than might be expected. The reason for this failure is that it would be too difficult for our perceptual apparatus to ascertain the effect directly. Therefore, at first we hold fast to an earlier, more accessible link of the causal chain, which is the consummation. Thus the consummation is the *experienced* goal of appetency behavior, even though it does not constitute the *biological* goal. The latter—namely, the "effect" mentioned above—is only a sequel of consummation.

Thus, for example, in pairing behavior it is not the process of fertilization itself which is experienced as consummation, but rather certain events which are accessory to the transport of semen from the male to the female organism, that is, events preparatory to fertilization and, indeed, not necessarily entailing fertilization.

We note, therefore, as a matter of principle, that a successful consummatory experience, however tension-reducing it may be, *never necessarily* entails the naturally intended effect. Our emotions, however, do not know this, and it is only toward consummation that we feel driven, and in which we come to rest. Everything beyond consummation is, at best, a matter for ethics.

Perhaps the parallelism with cognitive behavior will already have become clear from the foregoing. Indeed, the analogy is striking if we allow for the "act" of cognition occurring internally rather than in the realm of observable behavior.

With cognitive activity, too, we find a more or less complex appetency—a state of tension in which the solution for the problem is sought by trying out various strategies, by applying past experience, and by engaging in productive thinking. Eventually, if we are lucky, this tension is released all of a sudden in a consummatory experience. This consummatory situation has been investigated mainly in Gestalt psychology. It was called the "aha-experience" by Karl Bühler—the sudden emergence of a meaning that justifies itself by an unquestionable, cogent *evidentness*.

This experience is accompanied, and in fact caused, by a characteristic change in the cognitive structures at issue. In terms of Gestalt psychology, unsolved problems have the character of "defective structures": they are structures with apparently missing parts, or with parts that contradict each other. Generally speaking, problems are structures in disequilibrium.

During the process of productive thinking, we observe sudden spurts of equilibration. It is these sudden gains of equilibrium and harmony that are emotionally reflected by the "aha-experience."

So much for the consummatory situation. The effect, however, which normally is coupled with this consummation, and to which this consummation owes its biological existence—this effect is the *truth* of the cognition: "truth" in the critical-realist sense of optimal adaptation of the cognitive structures to objective reality.

In this sense, we can say that whereas truth is the objective effect of thinking, the experience of evidentness is its subjective goal. Evidentness, as we have seen, grows out of structural equilibrium, harmony, and order, which ultimately are aesthetic rather than epistemological categories. But according to how our cognitive system is constructed, beauty seems to be taken as a guide to truth. Nature appears to share the confidence expressed in the medieval formula *verum et pulchrum convertuntur*—the confidence that "true" and "beautiful" are interchangeable, synonymous concepts, both reaching, in cases of verbal insufficiency, toward the same Inexpressible.

The only problem is that this formula hides a naive realism, that is, a realism that confuses correlation with identity. Consummation is only correlated with the effect, but cannot assure it: the experience of evidentness *guarantees* truth just as little as the experience of orgasm guarantees fertilization. Otherwise, the whole business of "verification" would not be necessary in science.

Consequences for the Lorenzian Concept of "Working Hypothesis"

I will now outline the consequences of the previous argumentation for an evaluation of Piaget's criticism of Lorenz's views. To begin with, when we use concepts like "working hypothesis" and "necessity," we ought to make clear whether we are arguing on the level of subjective or objective reality. Generally, when we speak of a "working hypothesis," we have *both* levels in mind. Objectively, a working hypothesis is characterized by a somewhat loose correspondence with reality. Subjectively, it presents itself as a tentative, not cogent, form of noncommittal guesswork.

This subjective connotation is strictly excluded in the Lorenzian line of reasoning. As far as the subjective level is concerned, Lorenz would fully agree with Piaget as to the cogent,

necessary character of the inherited categories of reason. All he wants to state is that these categories are more than simply a means of *organizing* experience (what Kant had implied)—that in fact they also have a *representative* function, in that they tell something about the structure of the thing-in-itself. On the other hand, Lorenz also wants to say that these categories, however evident, necessary, and unfailing they may appear, are nevertheless only a phylogenetic *attempt* to reach the asymptote of truth.

If we now turn to the concept of "necessity" as used by Piaget, it seems equally clear that it can only be meant to denote the *subjective* appearance of the products of thinking. The term "necessity" is obviously referring to what I have called the "cogent evidentness" of a solution that has come to be a "good Gestalt." In fact, Piaget explicitly derives "necessity" out of processes of equilibration—and we have seen earlier that, in deed, the establishment of cognitive equilibrium entails the *experience* of evidentness. If, however, equilibration processes were interpreted as producing "necessity" in the *objective* sense of being "necessarily *true*," it would be hard to see on the basis of which epistemological principles (other than naive realism) this correspondence should be established.

Since Lorenz uses the term "working hypothesis" in a strictly objective sense, whereas Piaget's notion of "necessity" must be understood to refer strictly to a subjective state of affairs, it follows that the two concepts are unable to contradict each other in a logical sense. They could only be seen as contradictory if one failed to distinguish between the subjective and objective levels; this, however, would amount to a naive realist position.

The Problem of Logical and Mathematical Necessity

It could be argued by Piaget that the above considerations miss the point he wanted to make. He could state that, when speaking about "necessity," he was not referring to mere subjective *cogentness*, nor did he mean objective truth in a realist sense; rather, what he actually had in mind was logical *validity*. A proposition like "2 + 2 = 4" is, indeed, not a "working hypothesis" in any sense of the term. It is worth mentioning that Lorenz, in the paper referred to by Piaget, has already dealt at length with exactly this problem. He says:

> Nothing that our brain can think has absolute a priori validity . . not even mathematics with all its laws. The laws of mathematics are but an organ for the quantification of external things, and what

> is more, an organ exceedingly important for man's life . . . which thus has amply proved itself biologically, as have all the other "necessary" structures of thought. Of course, "pure" mathematics . . . is, as a theory of the internal laws of this miraculous organ of quantification, of an importance that can be hardly overestimated. But this does not justify us in making it absolute. Counting the mathematical number affects reality in approximately the same manner as do a dredging-machine and its shovels. Regarded statistically . . . each shovel dredges up roughly the same amount but actually not even two can ever have exactly the same content. The pure mathematical equation is a tautology . . . Two shovels of my machine are absolutely equal to each other because strictly speaking it is the same shovel each time, namely the number one. But only the empty sentence always has this validity. Two shovels filled with something or other are never equal to each other, the number one applied to a real object will never find its equal in the whole universe.[1]

I doubt, though, whether Piaget would be content with this explanation. However tautological mathematics may be, it is certainly not trivial in a psychological sense. Solving a mathematical problem is a genuine act of productive thinking—a kind of highly complex interaction of the "dredging machine" with itself, an interaction not covered by Lorenz's model.

Mathematical reasoning is an activity of the brain, just like any form of empirical problem solving. Thus the initial Piagetian question persists: how could a contingent and basically defective creature of random mutation and selection ever reach a state to produce things like a mathematical equation, which is necessarily true because it is *ideal*? In fact, this is just the old Cartesian riddle of how we can possibly perceive, through a mathematician's sloppy drawing on a blackboard, the ideal triangle with an angular sum of exactly (and necessarily) 180 degrees.

If, then, our categories of thinking would just reflect the state of perfection of our genetically acquired brain hardware, our mathematical thinking would, according to this line of argument, never reach the ideal state of conceiving "$2 + 2 = 4$," but rather would be confined to something like "$2 + 2 \cong 3.98$."

However, this argument implies a very concrete notion of isomorphism between mental structures and brain structures. Indeed, if a perceived or imagined triangle were nothing else but a kind of photographic mapping of a triangle constructed out of visual cortex potentials, it would admittedly be hard to understand how it could come to have ideal properties—even after an infinite duration of phylogenesis! Gestalt theorists were caught

in precisely this kind of argumentation when they postulated the existence of "field forces" in the brain to account for the regularities of mental gestalt.

Blind alleys of this kind can be avoided only if one gives up, once and for all, expecting subjective phenomena to be "facsimiles" of brain processes. It is not the *configuration*, but the *meaning* of a neural message that can be understood to be directly represented in one's consciousness; the term "meaning" (or as Lorenz prefers to say, "information") refers to the environmental features that would have to be presupposed to render the behavioral effects of this neural message optimally adaptive.

Interestingly, this notion implies a complementary relation between the *limitations* of behavior and the degree of *regularity* of the assigned meaning.

If there were a method to ask Jerome Lettvin's frogs about the shape of flies,[2] they would probably agree that all flies are ideally round—simply because their sensory system does not allow any behavioral differentiation with respect to the orientation of the fly. Higher organisms whose sensorimotor equipment enables them to, say, predict the direction in which the fly is most likely to make its next move, have to pay for this increased competence with some loss of perfect symmetry in their representations of the world.

Viewed from this angle, the Platonic world of pure ideas, which to our intuition reveals itself behind the distorted shadow-world of empirical things, is far from being an asymptote that could never be reached by a cognitive apparatus tinkered up by blind mutation and lame selection. On the contrary, our ability to conceive of ideal forms and relations is a heritage of ancient, primitive stages of our cognitive phylogenesis.

It is in this realm of ideal forms that we experience logical necessity. A syllogism like "All X are U; Y is X; so Y is U" is necessarily valid only for a mind that is capable of understanding the *idea* of areas nested in such a way as to successively enclose each other. Only the ideal character of this conceptual image supplies the intuition of the nonexceptionable validity, that is, the necessity, of the above syllogism.

To summarize: whoever intends to question the phylogenetic origin, and hence the "hypothetical" character, of the basic categories of thinking, can certainly not do so on grounds of their being "necessary" in the sense of evident, cogent, ideal, and perfect. Of course, this leaves entirely aside the question of

whether, in general, the conception of a phylogenesis by way of random mutation plus survival of the fittest is a good model. As things stand, it is certainly the only legitimate model available; but we ought to be aware that it does not explain the reality of consciousness. Selection, it is true, enables us to introduce the concept of adaptiveness into the description of organisms, hence to assign "meanings" to brain processes, meanings that can then be taken as descriptions of conscious contents. But this is a purely *formal* procedure, a "manner of speaking" *(façon de parler),* a way of organizing our knowledge. Consciousness, however, is more than a mere formal construct—at least to the owner of the brain in question. This *reality* of consciousness, which was only neglected but never validly refuted by behaviorism, ought to remind us of the preliminary character of our present understanding of nature.