ON COGNITIVE LUCK:
EXTERNALISM IN AN EVOLUTIONARY FRAME

Ruth Garrett Millikan
University of Connecticut
University of Michigan

Steven Pinker (1995) chides the educated layman for imagining Darwin's theory to go this way (the vertical lines are "begats"):

[Figure #1]

Pinker says, "evolution did not make a ladder; it made a bush" (p. 343), and he gives us the following diagrams instead, showing how it went, in increasing detail, down to us:

[Figure #2]

"Paleontologists like to say that to a first approximation, all species are extinct (ninety-nine percent is the usual estimate). The organisms we see around us are distant cousins, not great grandparents; they are a few scattered twig-tips of an enormous tree whose branches and trunk are no longer with us." (p. 343-44). The historical life bush consists mainly in dead ends.

Moreover, when we look still more closely at the life bush, examining in detail the various lineages that form the littlest twigs (the species), we see the same pattern over again. The vast majority of individual animals and plants forming these various lineages didn't make it. The twigs are largely made of fuzz--of myriad little lives that broke off before reproduction. To a first approximation, all individual animals die before reproducing. A good indication of a species' mortality rate is how many more offspring than one per parent are conceived on average. Consider spiders, fish, and rabbits. And recall that Octavius was a common Roman name.

Species went extinct, typically, because of changing environments, including the comings and goings of other living species. The study of these environmental changes and resulting extinctions is, of course, a purely historical study, a study of the disposition of historical bits of matter positioned at particular points in space and time, running afoul of other historical bits of matter positioned in accidental juxtaposition. The places where the streamlets of life managed, instead, to flow on, through little chinks in the barriers thrown up by geological history and other competing life forms, were also accidental in the very strongest sense. That there are no empirical laws of evolution is a matter of general agreement among evolutionary biologists. There are applicable and interesting mathematical models of certain aspects of evolution, ways of calculating the necessary outcomes of certain assumptions, as when demonstrating that WERE

Johnny to continue to earn 5% a year on his $10,000 investment for 15 years, and WERE he not to spend any of it, he WOULD accumulate $20,000. But models of this kind are not empirical laws. The results of the evolutionary process we still have with us today are the outcome of sheer cosmic luck, no more and no less.

There are, however, two great and simple principles that, conjoined, account for the fact that, despite vastly changing historical circumstances, there still exists life, indeed, vastly abundant life. Call these principles "multiplication" and "division." "Multiplication" says that the more progeny each member of a group bears, the more chance there is that some of these progeny will be lucky enough to happen upon accidental chinks in the environmental barriers through which they may slip to the next generation. If enough baby sea turtles are born, a few will accidentally avoid being eaten on the journey from their birth nests to the sea. "Division" says that if enough variety of life is produced, then there is a good chance that some of the environments that chance by will be suited to someone or other. "Division" is effected both by the vast number of species and by polymorphism within species, especially sexual species. The history of life is like a lottery that was bound to be won by some, because so many bought tickets and there were so many different drawings.

Turning to life within a single species it is easy wrongly to suppose that there is another principle that keeps lineages going. Natural selection has acted to preserve only the fittest characteristics for any given species, so that these are had pretty much by all members of the species. The result, we tend to suppose, is that each normal little animal is nearly ideally designed for its own particular niche. But why, then, do so many species need to have so many babies? Why the thick long fuzz on all the lineage lines if all the animals are so "fit"? The reason is that, like everything else having to do with the propagation of life, fitness is a matter of statistics. Higher fitness lends only a higher <u>probability</u> of survival and reproduction. A die loaded with sixes on two sides doesn't help if you throw one of the other four sides, as you are most likely to do. The tossing, here, is done by the enormous variety among individual environments. The kitten with an immune system resistant to feline distemper is run over by a car, the kitten who exhibits sensible behavior on the roadway gets exposed to distemper, while the kitten who has both strengths is poisoned by a neighbor. There is no way to be "fit" for all contingencies. Where environmental barriers are diverse and shifting, introducing numerous and diverse kittens raises the chances that a few will manage to pass through, but it doesn't raise the chance for <u>each</u> kitten. Assuming that the probabilities pertinent to relevant environmental factors remain constant over time, one might confidently predict that a species will continue to survive. But to predict how the individual lineages within the species will go so as to make this happen would require a detailed knowledge of every cranny in the environment at every time. Predicting that someone will win is easy enough, predicting <u>who</u> will win is impossible. For the system that propagates a lineage is not contained in the individual bodies of the organisms making up the lineage. It rests also upon statistically reliable yet accidental episodes of environmental cooperation. Individual lineages do not advance lawfully.

Instead of laws for lineage advance, there are mechanisms. Given a propitious environment by the luck of the draw, there are various mechanisms by which selected individual organisms composing a particular species have historically projected themselves forward in time. The working of these mechanisms is explained, not by laws of the particular species, but by laws formulated in more basic sciences. Physical structures with which the organism is equipped, coupled with propitious supporting physical structures in the environment, project the lineage in accordance with physical laws. There is, for example, a mechanism by which newly hatched green turtles reach the sea when they occasionally do. But of course there is no law that they reach the sea--not even a _ceteris paribus_ law, any more than there is a _ceteris paribus_ law that little boys grow up to be President. Similarly, there is a mechanism whereby sand is sometimes prevented from entering our eyes (the eye-blink reflex) but there is no law that sand is kept out of our eyes.

Now let us magnify the little lines that are individual organisms moving moment by moment through their individual life cycles. Over here under the lens is a barnacle. It waves its little fan foot through the water once, twice, ten times, a hundred and ten times, and the hundred and eleventh time it picks up a microscopic lunch. Over here is Tabby, after a squirrel. Whoops, missed! Now she is after a bird. Missed again! An hour of stalking with no profit. Never mind, here she comes now to _cry_ for her dinner, where environmental circumstances are more likely, for her, to bear fruit. Over there, now, is Grackling the goose, doing a mating dance for his chosen. She spurns him today, but perhaps she will not tomorrow. Or he will find another mate instead, either this season or next. Over here is Rover, kicking up sand as he runs. Despite his healthy eye-blink reflex, one grain still goes into his eye. The eye waters profusely, but does not wash out the sand. Later Rover rubs the eye with his paw. Eventually manages to clear it. Similarly, looking to less visible behaviors, there are membranes to keep harmful bacteria from entering Rover's body. And there is also a whole series of mechanisms designed to destroy those bacteria that still manage to get through.

In this manner, at every point where an organism initiates interaction with its environment as needed to spin out its life line, we find innumerable failures. Counteracting these, we again find Multiplication and Division. We find numerous tries; we find redundant mechanisms. The result is that the life line occasionally proceeds, small step by small step, right through to the next generation. But there are no laws that govern this process. There are only numerous and diverse mechanisms operating in a stocastic environment hoping for a passible drawing. There are lots of fuzzies everywhere along each individual life line, lots and lots of deadend tries.

Up to now without comment I have been treating biological species not as classes but as big, scattered, historical entities, enduring for longer or shorter periods through time. What species an individual organism belongs to depends not on its timeless properties but on its historical relations to other individuals. Dogs must be born of other dogs, not just be like other dogs; sibling species count as two or more for the same reason that identical twins count as two, not one. M.T. Ghiselin (1974) and

David Hull (e.g. 1978) have argued that species not only are not "spatiotemporally unrestricted classes;" they are actually individuals--a position that appears to be reasonable for the case of the most familiar macroscopic animals if not for species generally (cf., Mishler and Donoghue 1982). According to Hull, because species are historical entities, "their names function in no scientific laws." Individuals are not examples but rather parts of species and "parts do not have to be similar...to be part of the same whole." Hence no "statement of the form 'species X has the property Y'" is ever a "law of nature," i.e., a fully universal law, true by natural necessity rather than by historical accident (Hull 1978, in Sober 1994 p. 207). This will be true even if we include among "laws of nature" also ceteris paribus laws--laws that are not strict but that could be made strict by specifying certain additional details of circumstance. Hull concludes among other things, "There is no such thing as human nature" (Sober p. 211).

On the other hand, there is reason to be less strict with the notion of law. Given any species there are a great many traits that nearly all of its members have in common not by accident but for very good reason. Hull himself has emphasized that species as well as individuals (quoting Eldrich and Gould 1972) "are homeostatic systems-- ...amazingly well buffered to resist change and maintain stability in the face of disturbing influences" (Hull, p.114). Stability results, for example, from continuity of selection pressures in a niche, and from the necessity for the various genes in a gene pool to be compatible with one another. At root, the reason it is possible to run richly numerous inductions over the members of any species is very like the reason one can run inductions over the temporal parts of an ordinary individual. There is no universal law of nature saying that if Robert could speak Turkish yesterday then he can speak Turkish today, but it is certainly a good bet that he can. It is causally because he spoke it yesterday that he can speak it today. Similarly, the reasons one can run inductions over the members of a species are causal reasons. Given common ancestors and a common niche. it is because of the traits of the ancestors and the niche that each member of the species has certain traits, hence that the members of the species have traits in common. If the names of species do not figure precisely in laws, they certainly do figure in legitimate scientific generalizations. One way to conceptualize species, then, is as what I shall call "natural kinds," meaning by that term not kinds over which universal laws hold, over which relatively reliable inductions can successfully be run and not accidentally but for good reason. For example, the structures and dispositions that make certain human abilities possible can be studied as traits of the natural kind Homo Sapiens. Despite Hull's warnings, there is surely such a thing as human nature--a limited range of properties and dispositions found quite reliably in humans.

It follows that a species can be studied in two ways. It can be studied as an historical individual. This sort of study is intrinsically ecological, deeply interested in the environment. It focuses on the contrast between the individual life lines and portions of these that have pushed on in contrast to those that have failed. It studies the mechanisms by which the life bush has thrust forth new shoots through accidental chinks in the environmental barriers. It studies the vast lottery of life. Alternatively, a species can be studied as a natural kind. Generalizations can be made about the members of the class of objects composing it. However, when considered merely as a class of objects, any dispositions that characterize the kind, or that would characterize the kind in any physically possible environment, are as legitimate to study as any other. These dispositions may show up, for example, when the organisms are in the wild, or in cages, or in spaceships, or in laboratory apparatuses, or under the microscope--or under 5 atmospheres pressure, or subjected to 5000 volts current. For what these objects are disposed to be like and to do in one environment is as much a part of their objective nature as in any other. Their nature as mere objects makes no reference to an environment.

The received view is that human cognitive psychology is the second sort of study. It studies laws that "quantify over" individual humans.[1] Yet it is clear immediately that this cannot be strictly so of psychology. Indeed, it is not obvious that there is anything about an organism, considered entirely apart from its historical circumstances, to define it even as a living thing, let alone as a chunk of res cogitans--under 40 atmospheres pressure? surrounded by cyanide gas? at 100g acceleration? in the continued absence of all ambient energy? What makes the individual organism a life form is not just its constitution or dispositions, but these taken within the historic setting from which it has emerged. Obviously then we must soften the claim that cognitive psychology, or any other life science, studies organisms merely as natural kinds. Organisms must be studied with one eye on their "normal environments." that is, only after taking a peek at the actual life lines, as opposed to the life ends, of the species and examining the environmental contexts of these differences. We study fish in the water, pigs on land, and birds in the air. We study human cognizers surrounded by air containing oxygen, at about one atmosphere pressure, supported by a surface underneath, within a certain range of temperatures, whose heads are not in strong electric fields, or being banged on too hard, or chewed on too eagerly by tigers. It is against this sort of stable background that the cognizer is studied as a natural kind.

[1] The received view is also that these are ceteris paribus laws. But this is clearly an error. Ceteris paribus laws apply to all things of a given kind given only that circumstances or surrounding conditions remain the same. It is not a ceteris paribus law, for example, that children can learn to read. It is not, typically, due to surrounding conditions that they cannot, but due to native disabilities. Ceteris paribus laws do not say, just, "Most X's are Y's."

Yet, given our earlier observations, isn't there a puzzle about how to define this stable environment? In the environment that is statistically normal for a species, the environment in which animals of that species typically find themselves, the individual animal dies. It dies before maturing or reproducing. Doesn't it follow that we must study the individual not in the normal environment but in an especially lucky one? This overlooks that it is over their whole lives that the statistics on individuals are so terrible. Hour by hour, supporting rather than threatening environments may be statistically normal. So there may after all be some relatively fixed and stable set of conditions, for many species, relative to which the lifeline mechanisms of its members can be studied, premature deaths being viewed as caused by temporary disruptions of these conditions. Similarly, although nobody doubts that human cognition requires a supporting environment, perhaps it requires, on the whole, merely the same mundane set of stable supporting conditions that sustains the human body from hour to hour. Against this steady background environment, the human, including the cognitive systems, might be studied purely as a natural kind. That, I believe, is the image most have of the study of human cognition.

But something important is left out of this image. What is left out is the fuzz on the individual life lines. Remember Tabby in search of her dinner, Grackling in search of a mate, and Rover with sand in his eye. In general, the behaviors of animals effect loops through the environment that feed back into their life lines only under quite special conditions, conditions that are not statistically average at all. Indeed, the various mechanisms controlling an animal's behavior each require different supporting conditions. Each behavior has its own special needs: Tabby's hunting behavior requires a proximate dinner that is not too vary and fleet; Grackling's dancing behavior requires a proximate female who is willing, and so forth. It is the job of the cognitive systems to collect information about the specifics of the environment on which behaviors will be based. The question naturally arises, then, whether the cognitive systems also have fuzz on them--whether they too require special supporting conditions that vary with the tasks to be performed.

There is a contemporary tradition in epistemology that whether a thinker has knowledge as opposed to true belief is determined in part by a serendipitous relation between thinker and environment. Contrary to Plato's claims, there is cognitive luck involved in knowing. I want now to argue that cognitive luck is required also for success in thinking OF things, for success in entertaining coherent propositions. Environmental luck is required for the cognitive systems to maintain a coherent inner representational system. Thus cognitive psychology must be the study of happy interactions with the environment, an essentially ecological study. This fits with an externalist view of mental semantics.

The argument for the need for cognitive good luck is straightforward and quite unavoidable. It goes like this. Assume that the central job of the cognitive systems is to collect information over time, to amplify this information through inference, and to bring it to bear in determining action. Note that amplificatory inference always depends on a middle term. Syllogistic inference is the classical example here, but other multiple-premise inferences have middle terms too, for example, P is the middle term when moving from P and P implies Q to Q. In order to make valid amplificatory inferences, then, the cognitive systems must be able to tell when various separate bits of information that have been collected over time concern the same thing and when they concern different things. Similarly, whenever information that has been collected is brought to bear upon action, a middle term is involved. For it is necessary to recognize that this information concerns the very same item as does information about the whereabouts of the item as presented in perception. For example, if you know that the Konstanz train leaves from Weinfelden and you wish to take the Konstanz train, you need to be able to recognize when you have reached Weinfelden. Here Weinfelden is the middle term. From this we conclude that a crucially important task that must continually be performed by the cognitive systems is managing to recognize when new information coming in concerns the very same thing again, something one already knows something about. Without this, none of the information it takes in can be used.

Given this, the cognitive systems must have some way to store information so as to mark when different bits stored concern the same thing. For example, it will not help to know that Tom found your wallet and that Tom's phone number is in the book unless you also represent for yourself that these Toms are one and the same. Whatever way the cognitive systems have of marking sameness will determine what counts for the system as the same representation again. It will determine, for example, whether having a common property (compare the shape of a word) determines two mental representations to be of the same mental semantic type, and if so which kind of property does this. Only the cognitive systems' own usages, their own way of determining what forms are to count as the same term, hence as a middle term for inference, could possibly determine such a thing. A coordination must be effected then between the systems that take in information and those that use it, so that what is recognized during inference as being about the same is in fact about the same.

Suppose, however, that the system should fail at the task of recognizing what a particular piece of incoming information was about, so that the information is stored using a token of the wrong representational type? If the cognitive systems were subject to chronic failure of this sort, continually storing information about different things under the same representation type, information about the same under different types, the representational system would soon become wholly corrupted. Its types would cease to have any clear meanings, becoming hopelessly referentially equivocal or, at the limit, referentially empty. Suppose that seeing John I mistake him for Jim, later mistake Bill for Jim, then Dan, Sam, and Tim, collecting information about each of these men but putting it all in one place. Or suppose that I see Jane, a stranger, in London, then later that day see Jan, another stranger, in Paris, taking her to be the same person. I conclude that she, like me, must have flown from London to Paris. But who is "she"? Who is it that I think flew from London to Paris? It seems that the capacity correctly to recognize sources of incoming information is a requirement for having any coherent thought at all. This then is the question I would press. Does this capacity rest merely on the same mundane set of stable supporting conditions that sustains the human body from hour to hour, or does it have its own special environmental needs, differing perhaps from task to task?

That our powers of recognition can fail is obvious enough. Take places or spouses, colors, minerals, tunes, species, buildings, diseases--you name it and it is possible to misidentify it. It is possible to construct conditions--external conditions--under which even someone completely familiar with it may still fail to recognize it. Are such failures the fault of the cognitive systems, or is it epistemic bad luck that sometimes puts these systems where their powers give out?

In considering this question it is important to keep clearly in focus what the cognitive systems are for. Their mission is not, for example, the acquisition of justified certainty. They are not at fault or malfunctioning when they take risks, when they rely on environmental stability. As modern skeptics are well aware, no one lives by justified certainty. Justified certainty is not what is needed to help advance the life line. Instead, once again we find at work here the principles of multiplication and division. Having many different fallible methods of recognizing the same person, the same mineral, the same species, the same disease, some methods that can be used under some conditions, others under other conditions, employing these methods redundantly whenever possible, employing each whenever an opportunity for it happens to arise--this is the strategy that gets us by. Much of the time it gets us by. But every one of these diverse methods requires its own unique sort of environmental support. For example, we recognize people sometimes by their faces, sometimes by their stature and walk, sometimes by their voices, sometimes by their names. But an uncooperative environment can produces two people who look (at least for the moment, or at least from here) just too much alike, or sound (in this context) just too much alike, or who have exactly the same name. No matter how carefully our recognizing abilities are tuned, and no matter how clever the various mechanisms by which they work, providence will sometimes put up misleading signs. Thus coherent thinking rests, not on some one steady set of normal environmental circumstances, but on a vast variety of special circumstances, each required for proper exercise of a different recognition skill.

Like the species lines, and the individual life lines, and the little lines representing behaviors, the cognitive lines too often get broken off by the environment. Just as the ability to live on and to multiply requires environmental support, the ability to maintain coherent thoughts--to have clear and distinct ideas --requires environmental support.[2]

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[2] For considerably more along these lines, see Millikan (1993, 1994).

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