

# From Group Selection to Ecological Niches

## Popper's Rethinking of Evolution in the Light of Hayek's Theory of Culture<sup>1</sup>

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**Abstract** Hayek's *The Sensory Order* contains a physicalistic identity theory of the mind. Popper criticized it, saying that it could not explain the higher functions of language. Hayek took up that challenge in a manuscript but failed to refute Popper's arguments. Drawing upon the same manuscript, Hayek developed a theory of behavioural rules and cultural evolution. Despite his criticism of the theory of mind on which this evolutionary theory was based, Popper adopted Hayek's idea of group selection. He transformed it into a theory of the selective power of ecological niches. This became a central element of Popper's theory of evolution. The chapter traces the influence Popper and Hayek had on each other in the fields of the philosophy of mind and evolutionary theory. This is documented, *inter alia*, by their correspondence. Popper's theory of evolution, which is based on his dualistic theory of mind, is presented in its various stages of development. The chapter concludes with a possible application of that evolutionary theory, some thoughts about David Hume as the source of the differences between Popper and Hayek, and on the possible impact Popper's criticism had on Hayek's role in artificial intelligence.

### Introduction

Karl Popper and Friedrich Hayek were close personal friends and intellectual comrades-in-arms. For example, both were opposed to reducing explanations in social science to psychological regularities; both criticized relativism and collectivism; they shared the conviction that our knowledge, particularly of society, is limited, from which both drew the conclusion that we should proceed with extreme caution when trying to change the world. Given these shared ideas, it is surprising that no systematic comparison between these two great intellectuals has been made so far. William Bartley might have done so, but he did not live to complete the planned biographies of both men. Malachi Hacohen only hints at what united – and what

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divided – Popper and Hayek.<sup>2</sup> Bruce Caldwell asked whether Popper and Hayek influenced each other's thought and concluded that they didn't.<sup>3</sup>

I come to a very different conclusion: Popper and Hayek had a profound influence on one another. That is not a thesis that can be proved. Instead, I will give arguments that show its plausibility.

Popper himself observes that there are different forms of intellectual influence:

[I]f I say "Brouwer's thought was influenced by Kant" or even "Brouwer rejected Kant's theory of space" then I speak at least partly about acts of thought in the subjective sense: the word "influence" indicates context of thought processes or acts of thinking. If I say, however, "Brouwer's thought differs vastly from Kant's", then it is pretty clear that I speak mainly about contents. And, ultimately, if I say "Brouwer's thoughts are incompatible with Russell's", then, by using a *logical term* such as "*incompatible*", I make it unambiguously clear that I am using the word "thought" only in Frege's objective sense. (Popper 1967, p. 110)

I will argue here that Popper and Hayek influenced each other both "subjectively" and "objectively" with regard to the mind–body problem and evolutionary theory.<sup>4</sup> In order to find out who suggested what to whom, dates matter. With correspondence that is not much of a problem. It is more difficult to date unpublished papers and first and later versions of manuscripts. In the case of Popper even the dating of ideas in published work poses a problem since he kept rewriting, and adding to, subsequent editions of his publications. I will refer to Popper's and Hayek's texts and ideas with the year in which, to the best of my knowledge, they were first presented orally or in writing. As a complement to this little piece of intellectual history I will go into some of the similarities and differences in the contents of Popper's and Hayek's ideas. But let me first say something about the background or historical context of their thought.

## Mind and Evolution

From early on, Popper and Hayek were interested in psychology and the philosophy of mind. Later, in the 1960s, both started to elaborate their ideas on evolution. I will argue that a particular idea of Hayek's, on group selection, gave an important impulse to Popper's ideas on evolution. More specifically, Popper took over from Hayek the idea of group selection and transformed it into a theory of ecological niches. Popper's and Hayek's ideas on evolution are interesting in their own right. No less interesting is the fact that they originated out of Popper's criticism of Hayek's theory of mind. That criticism has also far-reaching consequences for the rather widely diffused idea that they agreed on almost everything, but this is not the place to go into this.<sup>5</sup>

Popper's and Hayek's interest in the theory of mind and psychology dates from long before they first met, which was, apparently, in 1936.<sup>6</sup> In their early work, they both investigated the relationships between psychology and the philosophy of mind on the one hand, and epistemology on the other. Popper submitted a doctoral dissertation on the methodological problems of cognitive psychology in 1928.<sup>7</sup>

Both men were influenced by Moritz Schlick's *Allgemeine Erkenntislehre*, but they find themselves on opposite sides of Schlick's thought: Popper rejects Schlick's idea that mental processes can be reduced to physical processes<sup>8</sup>; Hayek makes it the starting point of his theory of mind. He does so in a manuscript that dates from 1920, "Beiträge zur Theorie der Entwicklung des Bewusstseins".<sup>9</sup> That text was elaborated, without fundamental changes, into *The Sensory Order*, published in 1952.<sup>10</sup> I will argue that this book played an important role in the exchange of ideas between both authors.

Finally, both combined an interest in cognitive processes with biology, but as I mentioned above, neither actively elaborated a theory of evolution until much later in their careers. Hayek, however, mentions the need for an evolutionary approach in *The Sensory Order*.

The book describes the working of the human mind in terms of the development of the connections of neural networks. Although Hayek does not give an evolutionary explanation of the mind, he puts it on the research agenda:

[I]t should be pointed out ... that in one respect in which the task we are undertaking is most in need of a solid foundation, theoretical biology is only just beginning to provide the needed theoretical tools and concepts. An adequate account of the highly purposive character of the action of the central nervous system would require as its foundation a more generally accepted biological theory of the nature of adaptive and purposive processes than is yet available. (Hayek 1952, 4.5)

In later years, Hayek dedicated himself to evolution, though not evolution in general. What he did instead was to elaborate the idea that the evolution of the mind and of human behaviour has an important social component. He first did so in "Notes on the Evolution of Systems of Rules of Conduct; The Interplay between Rules of Individual Conduct and the Social Order of Action" of 1967. Behavioural rules are presented as originating in the mental processes that Hayek had described in *The Sensory Order*. The article elaborates the ideas of that book in the direction of theory of cultural evolution.

Four years earlier, in "Rules, Perception and Intelligibility", he had investigated the function of rules. There, Hayek gives a description of how rules guide human perception and behaviour, and to what extent the communication and learning of rules involve a shared mental framework. He argues that the "ground rules" that enable individuals to communicate and interact are part of a complex and complementary set of rules. These rules are mostly implicit, which implies that they cannot be consciously taught.

In a letter of July 18, 1962, Popper expresses his admiration for the manuscript of the *Rules* article ("the first pages, which greatly impressed me", "your very beautiful paper", "I am greatly impressed by this paper"). He is particularly full of praise of the last section, "Supra-conscious Rules and the Explanation of Mind": "Section 9 is the best, in my opinion. It is really exciting..." And after writing that the ideas expressed there would need to be elaborated, he corrects himself by saying that this might "spoil the impression of freshness", adding: "As it is, it is most excellent."<sup>11</sup> Why is Popper so enthusiastic? Before addressing this question, I would first like to discuss another matter.

## The Mind–Body Problem

In the same letter Popper gives Hayek the advice to make the text of the paper independent from *The Sensory Order* and to put references to the book in the footnotes. That suggestion is not as innocent as it looks. In order to see this, let us consider Popper's reaction to *The Sensory Order* just after it had been published. In a letter in which he thanks Hayek for sending him a copy of the book, Popper writes:

I am not sure whether one could describe your theory as a causal theory of the sensory order. I think, indeed, that one can. But then, it would also be the sketch of a causal theory of the mind.

But I think I can show that a causal theory of the mind cannot be true (although I cannot show this of the sensory order); more precisely, I think I can show the impossibility of a causal theory of the human language (although I cannot show the impossibility of a causal theory of perception).

I am writing a paper on the impossibility of a causal theory of the human language, and its bearing upon the body–mind problem, which must be finished in ten days. (letter of 2 December, 1952, Hayek Archives, box 44/1, Hoover Institution on War, Revolution and Peace, emphasis deleted, missing parenthesis supplied)

It is not immediately clear what Popper means by a causal theory of the mind. His discussion in the paper that he refers to suggests that it includes determinism and a behaviouristic stimulus-response or inductivist model of the mind. And certainly, even though he does not say so in his letter, Hayek's neural-network model of the mind must have had too inductivist a flavour for Popper's taste.<sup>12</sup>

The article was published in 1953 as “Language and the Body–Mind Problem.”<sup>13</sup> Popper criticizes all theories of the mind–body problem that combine a denial of the existence of the mental and the physical as distinct realms with the thesis that we need two different languages to talk about them. Hayek's theory belongs to this category. His theory of mind is a physicalistic identity theory, and his “language dualism” is based on the idea that we, with our human minds, can only talk about mental phenomena in a psychologistic language that cannot be fully translated into physical terms.

Popper criticizes this position by arguing that if the two languages are not intertranslatable, they are about different kinds of facts or events. His main criticism, however, is that a causal, physicalistic theory of linguistic behaviour cannot explain the higher functions of language, *viz.*, description and argumentation. This goes back to Karl Bühler, who distinguishes the expressive, the signalling and the descriptive functions of language. To these three Popper has added the argumentative function. In addition, Popper argues that the impossibility of behaviourism, epiphenomenalism, psycho-physical parallelism, the two-languages theory, physicalism and materialism to explain argument or criticism makes these theories self-defeating. This is because the arguments of these theories imply the non-existence of arguments.

Then Popper goes on to show that even very complex machines that seem to simulate human linguistic behaviour are limited to expressing their inner

states and to signalling (for instance the temperature in the case of a thermometer); any possible semblance of description or argument would be due to the intentions of the human designer of the machine. According to Popper, this also solves the “problem of other minds”: “In arguing with other people ... we cannot but attribute to them intentions, and this means mental states.” (Popper 1953, p. 297)<sup>14</sup>

In the light of what happened next, Popper’s introduction of the machine argument is particularly interesting. Hayek started working on a thought experiment with two communicating machines or automata (Hayek refers to von Neumann) that function according to the principles of his theory of mind.<sup>15</sup> He shows that these systems<sup>16</sup> are capable of performing the first two functions of language in Bühler’s hierarchy,<sup>17</sup> expressing their internal states and signalling them. His purpose is to show that these machines are also capable of description. So it looks as if Hayek took Popper’s criticism very seriously indeed.

But he failed to counter it. He reminisces:

[I]n the first few years after I had finished the text of [*The Sensory Order*], I made an effort to complete its formulations of the theory in one respect. I had then endeavoured to elaborate the crucial concept of “systems within systems” but found it so excruciatingly difficult that in the end, I abandoned the longish but unfinished paper that apparently nobody I tried it upon could understand. (Hayek 1982, p. 290)

Hayek is referring to a manuscript with the title “Within System and about Systems; A Statement of Some Problems of a Theory of Communication”<sup>18</sup>. That Hayek was wrestling with the subject matter may be gathered from the often convoluted (even for Hayek) formulations – and from the fact that the manuscript is indeed unfinished. The text breaks off in the middle of an argument that serves to demonstrate that two causal systems are capable of communicating descriptions to each other. The systems stand for minds, and description is modelled as the capability of one system to generate “signs” (which unlike symptoms and signals stand for the same classes of events for the emitting and the receiving systems) capable of changing the other system’s dispositions to act. Not only is the part on description unfinished, a discussion of the argumentative function of language is completely lacking. The abrupt end of the manuscript is consistent with Hayek’s comment that he abandoned work on the paper; he had failed to explain one or more higher functions of language within his own theory – *as Popper had predicted!*<sup>19</sup>

In case any doubt remains as to whether the manuscript is a reaction to Popper’s criticism, here are some further arguments. The first sentence states the purpose of the paper as “deriving from the study of certain kinds of causal systems conclusions concerning the character of our possible knowledge of our mental processes.” Not only is this the problem Popper had argued could not be solved, it also mentions causal systems, an expression of Popper’s which Hayek had never used before. On the next page Hayek writes that he will concentrate on communication and particularly description “because these raise in the clearest form the problems involved when we talk about mental phenomena...”. Neither communication nor description were discussed in *The Sensory Order*, and now Hayek mentions them as the main problems of the paper (p. 19). On p. 3 he states that his endeavour will be successful

if he can reproduce an instance of what “such mental functions as “thinking” or “having an intention”, or “naming”, or “describing”, or “communicating meaning”, or “drawing an inference” and the like” have in common. Hayek does not mention arguing, but all the other functions are mentioned in Popper’s article. Hayek had never before written about describing or naming, to which Popper dedicates an entire section of his article.<sup>20</sup>

## The Tale of the Framework

Let me now turn to the question why Popper, despite his criticism of *The Sensory Order*, had such a high opinion of Hayek’s *Rules* article, that was based on the same book. In the last section, which Popper specially liked, Hayek elaborates some of the ideas of the *Systems* manuscript. The main message is that “[i]f everything we can express (state, communicate) is intelligible to others only because their mental structure is governed by the same rules as ours, it would seem that these rules themselves can never be communicated” (*Rules*, pp. 60–61). It is not clear what Hayek exactly means; he seems to vacillate between two different positions. In some passages he suggests that we cannot explicitly state the rules upon which the working of the human mind and communication are based *as a matter of principle*, or absolutely (“never”). In others, however, he seems to intend that we cannot make *all* such rules explicit *at the same time*; in order to discuss, or analyze, these “constitutional rules”, we must always take some others as given.<sup>21</sup>

Is the reason for Popper’s praise the bare fact that Hayek had responded to his criticism of Hayek’s theory of mind (in public, moreover, which was highly unusual between the two friends<sup>22</sup>)? That seems too futile a motive to me. I find it more plausible that Popper saw in Hayek’s discussion an elaboration of something that he himself had suggested in “Language and the Body–Mind Problem” and that I have already referred to above, *viz.*, the idea that we cannot communicate (Popper says “argue”) with others unless we attribute mental states to them. Hayek’s argument in *Rules* is an elaboration in the sense that it emphasizes the need for *similar* mental states. He formulates this in terms of the existence of general rules that communicating individuals must share, and he raises the problem whether this implies that such rules cannot be communicated themselves.

An alternative explanation of Popper’s praise is that Hayek’s emphasis on the “absolute” impossibility to communicate the common framework that we need for communication set Popper thinking about the ideas that he later published as “The Myth of the Framework”.<sup>23</sup> In fact, it is on this point that Popper in his letter shows himself to be critical, saying that the unconscious frame of assumptions “can become conscious, especially if it is challenged and criticized; it is criticizable in principle, otherwise we end in relativism (and in Mannheim’s Total Ideology!).”

This last conjecture takes us back to Hayek’s theory of mind, on which the *Rules* article is based. One of the conclusions of *The Sensory Order*, namely, is that the human mind can never fully understand or explain its own working. Hayek draws

this conclusion from the following premises: (1) The mind is a (dynamic) system of hierarchical classifications. (2) Explanations are classifications. (3) In order to classify something, that which does the classifying must have a higher degree of complexity than that which is classified. Therefore, the most that we can achieve are “explanations of the principle” according to which the mind works. From this argument<sup>24</sup> Hayek arrives at a stronger conclusion than Popper:<sup>25</sup> for explanations in the social sciences, we have to assume the similarity of minds: “In the study of human action, in particular, our starting point will always have to be our direct knowledge of the different kinds of mental events, which to us remain irreducible entities.” (Hayek 1952, 8.88).

## Cultural Evolution

If, as Hayek had argued in *Rules*, the ground rules on which communication is based are implicit, they cannot be taught explicitly. So, how are they transferred? He only gives a very partial answer in the next article on rules, *Evolution of Rules* (Hayek 1967). He mentions – in passing – imitation (“a process of which we know very little”, p. 78) as a learning process.<sup>26</sup>

His main interest in the article is the question how rules of individual conduct may give rise to a stable social order. In his discussion Hayek invokes an evolutionary framework. Rules of behaviour are *transferred* from one individual to another; but which rules survive, or are *selected*, depends on how efficiently the group that is sustained by a particular pattern of behavioural rules reacts to changes in its internal and external environment. What Hayek discusses here is cultural evolution and group selection.

Individuals may not even be aware of what rules are conducive to the survival of the group to which they belong. The mechanism of selection is impersonal and we are usually not even aware of it; more efficient groups replace less efficient ones. The survival of the group depends partly on the capability of a particular complex of rules to correct internal or external disturbances of the stability of the group. Earlier, in “Individualism: True and False” (1945), Hayek had argued that not only are individuals often not aware of the behavioural rules on which the survival of the social order depend, they may even endanger the survival of the spontaneously emerged order if they deliberately try to change the rules on which it is based.

Rules are interdependent or complementary (which is why Hayek speaks of systems of rules); a change in one particular rule may increase or diminish the contribution other rules make to the stability of the order:

[C]hanges in one rule may make beneficial other changes, *both of a behavioural or somatic character*, which before were harmful. It is thus likely that even culturally transmitted patterns of individual behaviour (or the resulting patterns of action of the group) may contribute to determine the selection among *genetic changes of a behavioural or somatic kind*. (Hayek 1967, p. 71, my italics)

The reference to genetic and somatic aspects looks out of place in Hayek's discussion of social or cultural evolution. I suggest that they indicate Popper's influence: the emphasized passages show a striking resemblance with the distinction that Popper had introduced in "The Aim of Science" of 1957 and "Evolution and the Tree of Knowledge" of 1961 (both published in *Objective Knowledge*) under the name of genetic dualism. Popper had introduced this idea in order to answer the question why, despite the randomness of variations, evolutionary processes often look as if they were guided by a goal or a purpose (an idea known as orthogenesis). Genetic dualism refers to the idea that each organism has two distinct parts: one part controls behaviour, the other executes the behaviour. Mutations in the one take place independently from mutations in the other. Popper's hypothesis is that variations in the control system have a lead over those in the executive system. This means that changes in the executive system without changes in the control system may get out of hand (literally "run out of control") and hence are likely to be lethal. Changes that first occur in the control system, on the other hand, do not have to be lethal; they may provide an adequate governance of parts of the executive system that are already active, or they may activate dormant parts of the executive system. Popper says that this hypothesis may be tested. That would imply that the theory of evolution is a scientific theory and not a historical prophecy, as he had argued in *The Poverty of Historicism*.

It seems clear that Hayek took over the distinction between (possibly genetic) changes in behavioural and somatic features from Popper. What he did not adopt, however, was the idea that the former need to precede the latter to make a positive contribution to survival value. Instead, he concentrates on the role of the group in the selection of rules of behaviour, an example of what Campbell later has called downward causation.<sup>27</sup>

### More on Popper on Evolution

In *The Poverty of Historicism* Popper discusses evolution in the context of his criticism of the idea that in the social realm there are laws of evolution (a position which he calls historicism). What he says there about the theory of evolution in general is that evolution is a unique process and therefore no law of evolution exists. In 1961, in "Evolution and the Tree of Knowledge", Popper starts to investigate the implications of an evolutionary approach to knowledge. What he writes about the evolution of knowledge is inspired by his criticism of inductivism. His aim is to develop a "largely [*sic*] Darwinian theory of the growth of knowledge" (Popper 1961, p. 261) which should be capable of "simulating" Lamarckian explanations of the growth of knowledge, i.e., explanations that appeal only to instruction. What Popper means is that the Darwinian approach to knowledge should be capable of explaining everything that a Lamarckian account can explain. In addition, it should explain some phenomena that Lamarckism cannot explain. (Popper had discussed this "principle of correspondence" between two theories in general in "The Aim of

Science,” 1957, Chap. 5 of *Objective Knowledge*.) He repeats the idea that he had already expressed in *The Poverty*, viz., that the theory of natural selection describes a unique historical process and that hence there is no universal law of evolution.

“Of Clouds and Clocks” (1965) addresses the problem how abstract entities (such as rules) can influence physical reality. Popper calls this Compton’s problem. He considers it to be more important than Descartes’ problem, by which he means the question how the mind can influence bodily processes. According to Popper, Compton’s problem presupposes physical indeterminism. It has been solved by the evolution of the higher functions of language, which allow for better control of the world. Abstract meanings and contents are products of this process of linguistic evolution.

In the development of his ideas on evolution, Popper keeps moving back and forth between the evolution of knowledge and evolution in general. *Epistemology Without a Knowing Subject* (1967) starts with a discussion of the evolution of knowledge and then generalizes this to biological evolution. For instance, Popper describes animals and plants as problem solvers. It is in this context that he introduces ecological niches, which he describes as potentialities that may be activated by the discovery of new solutions. What he means is that a new theory, a new organ or a new behavioural pattern may be adapted to an existing environment that the organism had not discovered so far.<sup>28</sup> Popper hints at the selective influence of the environment: “selection is a two-edged sword: it is not only the environment that selects and changes us – it is also we who select and change the environment, mainly by discovering a new ecological niche.” (p. 149). As far as I know, this is Popper’s first attempt to integrate ecological niches, and what amounts to group selection (he does not use the expression), in his own, neo-Darwinian, theory of evolution.

Or should we call it Popper’s neo-Darwinian research programme? Popper had already shown a (mainly methodological) interest in the theory of evolution in *The Poverty*. The discussion above provides arguments for thinking that Popper’s interest in the content of evolutionary theory was revived as a consequence of discussions with Hayek, especially between 1962 and 1967. In the latter year both Popper and Hayek introduced the idea of group selection in their publications.

In 1969 Popper gave a series of lectures on the mind–body problem at Emory University (published in 1994 as *Knowledge and the Body–Mind Problem*). The third lecture, “World 3 and Emergent Evolution”, contains the most complete statement of Popper’s theory of evolution. He introduces it by drawing attention to the similarities between his theory of World 3 – more in particular the idea that it is both man-made and autonomous – on the one hand, and ecological niches on the other. Popper says that these are the two “decisive insights” that led him to publish his ideas about World 3 and evolution (Popper 1969, p. 52). The theme of the autonomy of World 3, in the form of the descriptive and argumentative functions of language, had played an important role in his criticism of Hayek’s theory of mind. As I have argued above, Hayek’s theory of cultural evolution in *Evolution of Rules* arose out of Hayek’s reaction to this criticism. My conjecture is that Popper adopted group selection from this article and transformed it into a theory of the

emergence and selective influence of ecological niches.<sup>29</sup> In doing so, Popper wanted to demonstrate that evolutionary theory, which now includes group selection, has no need for Lamarckian instruction, even in the cultural domain (which is what Hayek discusses in *Evolution of Rules*<sup>30</sup>).

But Popper does not limit himself to a criticism of Lamarckism. In the same lecture he tries to repair what he thinks are defects of neo-Darwinism. As such he considers its failure to explain specific mixes between hereditary stability and variability. Popper also criticizes the idea, known as evolutionary ascent, that the organisms that survive in the course of evolution are the higher forms of life. His argument is that higher life forms are not always more adapted than more primitive organisms, and he mentions overspecialized organisms in a changing environment as a counterexample. He also repeats his earlier criticism that if adaptation is defined as the ability to survive, evolutionary theory is a tautology. The theory of evolution that Popper presents answers these criticisms, and integrates ideas that he had proposed earlier. Its main features are as follows. All organisms are problem solvers whose instruments, or solutions, consist of schemes of behaviour which they try to adapt. Behavioural schemes (or complexes of rules, as Hayek would have called them), the most important of which is language, are part of the control system. The control system and variations in it are more important than anatomical variations (or variations in the executive system). Mutations in the latter can only be successful if they are compatible with a behavioural scheme that already exists (genetic dualism).

There is a hierarchy in evolution in which parts act as possible solutions to problems of the wholes to which they belong: individual organisms are the “instruments” of the species just like types of behaviour are the instruments of individuals.

Behavioural novelty is caused by changes in the aims or preferences of individual organisms, and these “behavioural spearheads” precede anatomical changes (or changes in the executive system). New behavioural patterns have the advantage that they may be tried out “virtually” in the mind before being applied. So they do not immediately endanger the survival of the individual. In addition, not all problems are problems of survival.

Behavioural novelty may create new ecological niches. These in their turn will act as units of selection. New ecological niches are examples of emergent evolution.

Finally, evolution does not proceed from primitive to superior or higher organisms, but from less to more complex ones. This is the major prediction of evolutionary theory. Since it is falsifiable, evolutionary theory is a scientific theory.

The spearhead idea was developed further in a paragraph that Popper added to “Evolution and the Tree of Knowledge” when it was published in *Objective Knowledge* in 1972. Its title is “The Hopeful Behavioural Monster.” Here Popper seeks to complete the integration of his earlier ideas on evolution. First of all he says that in earlier publications he should have talked about genetic pluralism rather than dualism. What he refers to is the idea that evolution may take place at more than two different levels. Thus, while genes are the sources of variation for individual organisms, organisms may be the sources of variation of species, species the

sources of variation of clades, etc. Popper then combines genetic pluralism with a theory that is due to Richard Goldschmidt. It says that whereas most big mutations are lethal, some may survive. Goldschmidt calls these mutations “hopeful monsters”. New and “monstrous” behaviour may be due to genetic mutations, to changes in the ecology of the organism, or may occur “without any observable anatomical novelty.” (Popper 1972, pp. 282–283). But whatever its origin, behavioural monstrosity is less likely to be lethal than anatomical monstrosity.

I thus submit a variation of Darwinism in which behavioural monsters play a decisive part. Behavioural novelty leads, if successful, to the selection of those ecological niches which in their turn operate selectively – operate, that is, to make use of these behavioural novelties and thus exert a selection pressure in a partly predetermined direction: in the direction determined by some genetically possible undetermined *aim*, for example a taste for a new kind of food, or an enjoyment of utilizing light-sensitive regions in the skin. Thus we may get orthogenesis. (Popper 1972, p. 284)

Popper repeats the idea of the primacy of changes in behaviour over changes in the anatomy of the organism:

The anatomical structure can change only slowly, in the main. But its changes will for this reason remain insignificant if they are not guided by those in aim-structure and skill-structure. Thus the evolution of a genetic apparatus establishing a primacy of aim-structure and skill-structure over anatomical structure might, in principle, be explained on Darwinian lines.

It will be seen that this Darwinian theory of hopeful behavioural monsters “simulates” not only Lamarckism, but Bergsonian vitalism also. (Popper 1972, p. 284)

Popper’s emphasis on the slowness of anatomical changes suggests a contrast with the speed with which changes in the control system may succeed each other. As to the evolution of knowledge, he often writes about the importance of inventing our conjectures and correcting them as fast as possible. In general, changes in people’s ideas might explain why cultures evolve more rapidly than biological entities.<sup>31</sup>

## Tradition and Entrenchment

Popper argues that if new forms of behaviour are successful, i.e., if they contribute to the survival of the organism, they may give rise to a *tradition*. Popper defines a tradition as a set of behavioural patterns that remain stable even if and when alternative (and presumably viable) patterns of rules are available. A tradition may degenerate into a *genetically entrenched* pattern of behaviour when viable alternative rules are no longer available or accessible. If a tradition in a particular ecological niche “becomes the spearhead of genetic entrenchment”, the organisms in that niche risk extinction as a consequence of a change in the environment. Popper predicts that every genetic entrenchment becomes lethal in time (Popper 1994, p. 61).

In the context of his lecture Popper is thinking of the extinction of living organisms. But his idea can be generalized using Popper’s own multi-level idea of evolution: preferences may be the spearheads of behavioural patterns, behavioural patterns the spearheads of individual organisms, organisms the spearheads of the

species, etc.<sup>32</sup> If, due to a change in preferences or aims, all behavioural patterns but one are selected against, the set of rules of behaviour (to use a Hayekian term) that was a tradition becomes *behaviourally entrenched*. If the environment of the ecological niche changes, the behavioural pattern may become extinct. I will give a possible example of this in my last Afterthought.

In Popper's later work on evolution the spearhead function of behavioural monsters is not mentioned as such.<sup>33</sup> The theory of the selective power of ecological niches is presented as a form of downward causation.

We may speak of downward causation whenever a higher structure operates causally upon its substructure...

I suggest that downward causation can sometimes at least be explained as *selection* operating on the randomly fluctuating elementary particles. The randomness of the movement of elementary particles – often called “molecular chaos” – provides, as it were, the opening for the higher-level structure to interfere. A random movement is accepted when it fits into the higher-level structure; otherwise it is rejected.

I think that these considerations tell us a lot about natural selection. While Darwin still worried that he could not explain variation, and while he felt uneasy about being forced to look at it as chancelike, we can now see that the chancelike character of mutations, which may go back to quantum indeterminacy, explains how the abstract invariances of the environment, the somewhat abstract selection pressures, can, by selection, have a downward effect on the concrete living organism – an effect that may be amplified by a long sequence of generations linked by heredity. (Popper 1977, p. 147)

Next, Popper passes to human behaviour:

The selection of a kind of behaviour out of a randomly offered repertoire may be an act of choice, even an act of free will. ... A choice process may be a selection process, and the *selection* may be *from* some repertoire of random events, *without being random in its turn*. This seems to me to offer a promising solution to one of our most vexing problems, and one by downward causation. (*ibid.*, italics in the original)

The problem that Popper refers to is the compatibility between the goal-directedness of rationality and the randomness of variations.

## Conclusion

I have argued that Popper transformed Hayek's concept of group selection into a theory about the emergence and the selective power of ecological niches in a Darwinian framework. The niches may emerge from changes in behavioural patterns, and these new rules of behaviour are responses to random<sup>34</sup> variations in the aims or preferences of individual organisms. In order for a theory of cultural evolution to account for the role of human knowledge and creativity it must be indeterministic and non-materialistic.

Popper's theory of behavioural monsters that create ecological niches, which subsequently act as units of selection, may be adapted to the domain of social and cultural evolution. Rational responses of individuals to random changes in their

goals and preferences may give rise to new institutions that influence the survival of a social order. New institutions, and new social orders, if they continue to exist side by side with other institutions or orders, may develop into traditions. If, for some reason, for instance because of the competitive success of a particular tradition, other traditions disappear, the only surviving one becomes entrenched. This, according to Popper, will lead to its extinction when the environment changes in ways to which the entrenched tradition itself has no adequate response, because the individuals that are part of that tradition can no longer resort to others.

### First Afterthought: Back to Hume

Popper's theory of evolution as applied to the social realm has a place for creative individuals who act rationally and critically. Hayek on the contrary stresses that individual man is irrational and that "Reason" is a characteristic of the social system or the culture or the group,<sup>35</sup> i.e., of tradition. In his later work,<sup>36</sup> he develops this into a conservative social philosophy that warns against the dangers of irrational individuals' tinkering with traditions whose function they cannot understand (approvingly referring to David Hume<sup>37</sup>). This stands in stark contrast with what Popper writes about tradition:

The assertion that we have an irrational inclination to be impressed by habit and repetition is something quite different from the assertion that we have a drive to try out bold hypotheses which we may have to correct if we are not to perish. The first describes a typically Lamarckian procedure of instruction; the second a Darwinian procedure of selection. The first is, as Hume observed, irrational, while the second seems to have nothing irrational in it. (Popper 1972, pp. 96–97)

Popper argues that Hume was right in thinking that there is no solution to the logical problem of induction. But he was wrong in thinking that induction is psychologically necessary. From this paradox, as Popper calls it (Popper 1972, p. 95), Hume draws the wrong conclusion that man is irrational and a product of "blind habit" (*ibid.*):

The solution of the paradox is that not only do we reason rationally, and therefore contrary to the principle of induction. We do not act upon repetition or "habit", but upon the best tested of our theories which, we have seen, are the ones for which we have good rational reasons; not of course good reasons for believing them to be true, but for believing them to be the *best available* from the point of view of a search for truth or verisimilitude (Popper 1972, p. 95)

He adds that "[t]his solution of Hume's paradox does not, of course, say that we are thoroughly rational creatures. It only says that there is no conflict between rationality and practical action ..." (*ibid.*).

Popper had raised the same criticism in correspondence with Hayek:

And as to Hume, his irrationalism was based, exclusively, upon his correct finding that induction is impossible – exactly as Polanyi's anti-rationalism. But this perfectly correct finding has no anti-rationalist consequences – except if you are (as Hume and Polanyi) a disappointed inductivist. (letter of 11 November, 1958)<sup>38</sup>

Popper's wording may suggest that he is accusing Hayek of being a disappointed inductivist, too. (I have already suggested in the above that Popper thought that Hayek's theory of mind was inductivist.) Whether or not that was his intention, I think that all differences between Popper and Hayek go back to Hume. Hume's work indicates two directions. Popper took the road of skepticism and anti-inductivism. Hayek took the empiricist and conservative direction.<sup>39</sup>

### **Second Afterthought: How Beneficial Was Popper's Influence on Hayek?**

This article is about Hayek's influence on Popper, which can only be understood by considering Popper's influence on Hayek. I do not want to sign off without adding something about the latter question. In the light of later developments in artificial intelligence, we may ask whether Hayek was not put on the wrong track by Popper's criticism of his theory of mind. Hayek was the first to elaborate a neural-network model of the mind.<sup>40</sup> But Popper gave Hayek a very difficult problem to solve: to explain the descriptive and argumentative functions of language with that same neural-network theory. Given the state of the art in psychology and computer science in the 1950s, that problem would have been too difficult even for the (very few) specialists in these fields. It has not even been solved today. Had Hayek limited himself to developing his ideas on learning by neural networks, he might have made important contributions to AI.<sup>41</sup>

### **Third Afterthought: Critical Rationalism: Tradition or Entrenchment?**

In "Popper today: far from forgotten or irrelevant", Ian Jarvie argues that the survival of critical rationalism is endangered by the fact that its practitioners have failed to create the social conditions for a school of thought. That may be explained by Popper's "generalized" idea of entrenchment (see above).

Here is the explanation. By its very nature, critical rationalism attracts philosophers who believe in the force of critical argument. Let us assume (realistically, I think) that the type of personality with a firm belief in the power of criticism is less prone than the average academic to devote resources to the social networking and academic politicking that are needed to create an environment in which his or her intellectual offspring can survive. Perhaps it is even contrary to the critically-minded character to sacrifice resources for breeding a sufficiently numerous and robust intellectual offspring at all.

Until recently not only philosophers but some (outstanding) practising scientists (who are more likely to cultivate the social conditions that are necessary to carry on with their work), too, supported critical rationalism. This allowed critical rationalism

to become a tradition for at least a couple of generations. In the mean time, however, the number of scientific disciplines, journals and scientists has increased. The professionalization of science has gone hand in hand with a drop in interest in philosophy on the part of scientists. The academic environment has changed and selection pressures have increased greatly. In this new environment, the support of scientists is lacking while the contents of critical rationalism continue to select against the type of personal characteristics that make it possible for individuals to adopt or have access to at least elements of different traditions. The situation of carriers of the tradition of critical rationalism being incapable of adopting or having access to alternative traditions is tantamount to the non-existence of alternative traditions. If critical rationalists continue to fail to adopt alternative traditions, or at least elements of them, critical rationalism risks becoming entrenched – and extinct.

## Notes

1. I thank Gunnar Andersson for critical comments and Rob de Vries for a suggestion that led to my second afterthought.
2. Hacoen (2000), see the entry “Hayek” in the index.
3. Caldwell (2006).
4. A fuller comparison between Popper and Hayek can be found in Birner (2001), on which the current article is based. Parts of it have been published in Birner (1999).
5. I will briefly discuss this below, in the First afterthought. For a more complete analysis cp. Birner (2001).
6. Cp. Hacoen (2000, p. 316).
7. “Zur Methodenfrage der Denkpsychologie”; cp. Hacoen (2000, Chap. 4, and particularly pp. 156–163).
8. Cp., for instance, Hacoen (2000, p. 158) and further below.
9. “Contributions towards a theory of the development of consciousness.”
10. For a discussion of Hayek’s manuscript and its history, including the role of Schlick, see Birner (2004).
11. Popper repeated his praise after he had received an offprint of the published article (letter to Hayek of November 11, 1962, Hayek Archives, Hoover Institution on War, Revolution and Peace, box 44/2).
12. Cp. for instance Popper’s criticism of “[c]lassical epistemology which takes our sense perceptions as “given,” as the “data” from which our theories have to be constructed by some process of instruction...” (Popper 1967, p. 145). This has always been his criticism, but in this particular article he adds that this “can only be described as pre-Darwinian. It fails to take account of the fact that the alleged data are in fact adaptive reactions, and therefore interpretations which incorporate theories and prejudices and which, like theories, are impregnated with conjectural expectations...” (*ibid.*).
13. In *Proceedings of the XIth Congress of Philosophy*, 7, North-Holland, pp. 101–107. It was later included in *Conjectures and Refutations*. The main criticism contained in it is repeated, in stronger terms, in *The Self and Its Brain* (Popper and Eccles 1977, p. 58).
14. Attributing mental states to individuals is also a necessary part of explanations in social science and historiography, as Popper argues in *The Poverty of Historicism* and *The Open Society and Its Enemies*.
15. This, together with the neural-network theory of *The Sensory Order*, entitles Hayek to be recognized as one of the pioneers of artificial intelligence. For a possible reason why he wasn’t, cp. my “Second afterthought” below.

16. Which he defines, with a reference to von Bertalanffy, as “coherent structure[s] of causally connected parts” (p. 4).
17. On p. 20 Hayek refers to Popper for the English translations of Bühler’s terminology.
18. Hayek Archives, box 94/51, Hoover Institution on War, Revolution and Peace.
19. The first page of the typescript bears the comment in Hayek’s handwriting: “seems incomplete.” The ms. breaks off in the middle of a sentence. That may suggest that part of it has been lost (perhaps it has been filed in a different folder). But even though some part may have gone physically missing, Hayek’s own comments seem convincing.
20. That Hayek did not take Popper’s rejection of his theory of mind and psychology of perception lightly may also be concluded from the fact that years later he writes to Popper that he feels “that some day you ought to come to like even my psychology” (letter of 30 May, 1960, Hayek Archives, Hoover Institution on War, Revolution and Peace, box 44/2).
21. Cp. for instance: “there will always be some rules governing a mind which that mind *in its then prevailing state* cannot communicate...” (p. 62, my italics).
22. And admitting that he had failed to answer it. Cp. the last sentence of the last paragraph of *Rules*, where Hayek says that the task of bringing his endeavour to a satisfactory end “would exceed ... the powers of its author.”
23. After Kuhn’s philosophy of science had made a criticism of the argument more urgent?
24. One should have expected Popper not to share Hayek’s premises because he considers explanation to be more than classification. But he found Hayek’s “impossibility theorem” worthy of mention in *The Self and Its Brain*. It should be noted, however, that Popper replaces Hayek’s reference to classification by explanation: “It has been suggested by F.A. von Hayek (1952, p. 185) that it must be impossible for us ever to explain the functioning of the human brain in any detail since “any apparatus ... must possess a structure of a higher degree of complexity that is possessed by the objects” which it is trying to explain.” (Popper and Eccles 1977, p. 30).
25. See the text to Note 14.
26. Much later, in *The Fatal Conceit*, the mechanisms mentioned are tradition, learning and imitation (Hayek 1988, p. 12).
27. Cp. Campbell (1974).
28. “A new tentative solution ... may discover a new virtual ecological niche and thus may turn a virtual niche into an actual one.” (Popper 1967, p. 145).
29. Without attracting much attention. Commentators are divided on the question whether group selection gained a foothold in biology. Thus, Hertel says it hardly did (Hertel 1997), while Gould dedicates many pages of his monumental *The Structure of Evolutionary Theory* to “the revival” of group selection (p. 624), “not[ing] with delight that [it] has risen from the ashes to receive a vigorous rehearing ...” (Gould 2002, p. 623) from the 1970s and 1980s.
30. Hayek attached great importance to group selection. In an unpublished ms. with the title “The origins and effects of our morals: a problem for science” (box 96/126 of the Hayek Archives at the Hoover Institution of War, Revolution and Peace) he writes: “A chapter in the draft of a book on cultural evolution [*The Fatal Conceit*] threatened to explode in the process of revision ... till I found the key to mastering the unmanageable complexity of the process by making the starting point a fact I had already established in an earlier chapter. ... Namely that cultural evolution, *unlike Darwinian evolution*, rests almost entirely on group selection instead of the selection of individuals. What has sometimes been called a “collective mind” group [*sic*] is nothing but the common morals of its members, something very different from and autonomous of the mind proper though of course in constant interaction with it.” (I have added italics to draw attention to an important difference between Hayek and Popper, who thinks he can fit group selection into a Darwinian framework.)
31. Those who are familiar with the work of Stephen Jay Gould will have noticed many similarities between the latter’s theory of evolution and Popper’s. This is not the place to go into this; suffice it to say that neither refers to the other.
32. Gould (2002) dedicates much space to multi-level evolution. Cp. for instance Chap. 9, “Species as Individuals in the Hierarchical Theory of Selection.”

33. According to Watkins, Popper said that he had forgotten about it (Watkins 1995, p. 192). That should perhaps not be taken too literally. In Popper (1977) the control function of the mind and language play an important role. That Popper does not mention the complementary executive parts of functions of organisms may be explained by the fact that the lecture is an evolutionary defence of an interactionist theory the mind–body problem. It is not about evolution in general.
34. I think much confusion in the discussion of cultural evolution and the evolution of knowledge could be avoided by using the term “isotropic” instead of random, as Gould proposes. Isotropic variation is “variation [that is] unrelated to the direction of evolutionary change; or, more strongly, ... nothing about the process of creating raw material biases the pathway of subsequent change in adaptive directions.” (Gould 2002, p. 144, italics deleted)
35. “[H]uman Reason, with a capital R, does not exist in the singular, as given or available to any particular person, as the rationalist approach seems to assume, but must be conceived as an interpersonal process in which anyone’s contribution is tested and corrected by others.” (Hayek 1945, p. 15)
36. Cp. for instance *Law, Legislation and Liberty*.
37. Hume is one of Hayek’s intellectual heroes. Cp. for instance Hayek 1945, 1963a.
38. Hayek Archive, Hoover Institution on War, Revolution and Peace, box 44/1.
39. This is elaborated in Birner 2001. As is argued there, Popper is, of course, an empiricist, too. But his empiricism goes together with the “principle of theoretism”; (cp. Milford 1994, p. 336). Hayek prides himself on his radical empiricism, saying that all previous empiricist efforts to explain knowledge had not been empiricist enough; (cp. Hayek 1952, Chap. 8, p. 27).
40. I remind the reader that he did so in 1920.
41. Hayek may also have been discouraged from developing his ideas in this direction because Donald Hebb’s *The Organization of Behavior*, which contains a neural network model of the mind that is very similar to Hayek’s, was published 3 years before *The Sensory Order*. Cp. Hayek’s comment in the Preface to *The Sensory Order*.

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