

CUED AND DETACHED REPRESENTATIONS IN ANIMAL COGNITION

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Abstract

This paper analyzes the function of certain aspects of cognition, like planning, deceiving, self-awareness, and communication. I distinguish between two kinds of representations of information. A cued representation stands for something that is present in the current situation. Detached representations stand for objects or events that are neither present in the situation nor triggered by some recent situation. The inner environment of an animal is defined as the collection of all detached representations. The fundamental difference between signals and symbols is that the reference of a symbol is a detached representation, while a signal refers to a cued representation.

Detached representations make planning possible. I distinguish between immediate planning, where plans are made for present needs, and anticipatory planning, where future needs are predicted.

The evolution of self-consciousness is outlined as a series of steps. The first is when other agents are seen as having an inner environment of their own. This is when deception becomes possible. A further step is when the agent realizes that the other agents' representations of the external world includes a representation of the inner environment of the agent itself. Then the agent can become self-conscious since it can form representations of its own representations.

L' homo tient debout.

S' accouple, en toute saison, face à face.

*A le pouce opposable. Omnivore.
Capable d'attention, même à des objets absents.*

*Sous le nom de pensée, réflexion, obsessions,
etc., il peut rêver durablement pendant la
veille, combiner ses rêves à ses perceptions,
en tirer des projets d'actes, des coordinations
de mouvements, une sorte de réorganisation
des instincts, des désirs, etc..*

*Il modifie le milieu. Il accumule, conserve,
prévoit, innove; il a des moyens de parvenir.*

Paul Valéry, Mauvaises Pensées et Autres

form of consciousness that includes functions like imagining, planning, deceiving, choosing, being aware of other minds, and maybe even being self-conscious. Our naive understanding of such cognitive functions derives from our understanding of the corresponding human functions.

In this paper, I want to examine these features of cognition from an evolutionary perspective. Rather than directly comparing, e.g., animal planning with human planning, I will ask, firstly, what could be the evolutionary value of having a capability for planning, and, secondly, what other cognitive functions are required for such a capacity to evolve. My focus in this paper will be to analyze the evolutionary *functions* of certain aspects of cognition rather than to study their neurophysiological foundations or their behavioral correlates.

I will argue that in order to understand the functions of most of the higher forms of cognition, one must rely on an analysis of how animals *represent* various things, in particular the surrounding world and its possibilities. However, the very notion of a mental representation is one of the enigmas of contemporary cognitive science.

1. THE NOTION OF A REPRESENTATION: WHY A SNAKE CAN'T THINK OF A MOUSE

When analyzing the cognitive functions of the "higher" animal species, we often ascribe them a

Roitblat (1982, p. 354) characterizes representations, at the most general level, as those things “that allow past experience to affect later behavior.” This definition seems to be too liberal since it includes, as Roitblat himself recognizes, even the behaviorists’ approach. Whiten and Byrne’s (1988, p. 235) proposal is equally liberal: “By “representation” we mean simply a neurally coded counterpart of some aspect of the world.”

Yet another definition is proposed by Vauclair (1990, p. 312): “Representation is an individual phenomenon by which an organism structures its knowledge with regards to its environment. This knowledge can take two basic forms: either reference to internal substitutes (e.g., indexes or images) or use of external substitutes (e.g., symbols signals, or words).” Again, I find the general characterization too encompassing. However, Vauclair presents Hockett’s (1960) notion of “displacement” and von Glasersfeld’s (1977) criticism of it in his discussion of animal communication, which comes close to the proposal made here (see Section 7).

I have no elaborated theory of representation to present, but a distinction that seems to capture an important aspect is that between *transduced* and *inferred* information (compare Fodor 1986). Some kinds of animal behavior, like phototaxis, is determined directly by psychophysical mechanisms that transduce information about the environment. In such cases no representations are involved. In other cases, the animal uses the incoming information as cues to “perceptual inferences,” which *add* information to what is obtained by the psychophysical transducers. That which adds information to sensory input I propose to call a *representation*.¹

In order to illustrate the distinction between transduced and inferred information, let me present an example borrowed from Sjölander (1993, pp. 3-4) of how the different kinds of information will affect animal behavior. It seems that a snake does not have a central representation of a mouse but relies solely on transduced information. The snake exploits three different sensory systems in relation to prey, like a mouse. To strike the mouse, the snake uses its *visual* system (or thermal sensors). When struck, the mouse normally does not die immediately, but runs away for some distance. To locate the mouse, once the prey has

been struck, the snake uses its sense of *smell*. The search behaviour is exclusively wired to this modality. Even if the mouse happens to die right in front of the eyes of the snake, it will still follow the smell trace of the mouse in order to find it. Finally, after the mouse has been located, the snake must find its head in order to swallow it. This could obviously be done with the aid of smell or sight, but in snakes this process uses only *tactile* information. Thus the snake uses three separate modalities to catch and eat a mouse. It has no central *representation* of a mouse since there is no communication between the three systems (except that one takes over when the other finishes).

Compare this with a cat chasing a mouse! The cat relies on a combination of information from several sensors: eyes, ears, nose, paws, and maybe even whiskers. It can predict that the mouse will appear at the other side of a curtain when it disappears on one side. It can “infer” information about the mouse even if there is no immediate sensory information, like when it is waiting outside a mouse-hole. In this sense it has a central representation of a mouse that is, at least to some extent, independent of the information that is transduced from any of the sensory modalities. In more technical terminology borrowed from Piaget, one can say that the cat has achieved *object permanence*. In contrast, the snake has no unified representation of a mouse (if it is appropriate to say that it has a representation at all).

One conclusion to draw from this comparison between the cognitive powers of a snake and a cat is that a central representation is tightly connected with *cross-modality*, i.e., that information received via one modality is coordinated with information from other modalities. Davenport (1976) presents some major results on cross-modal perception in apes and monkeys (see also Murray 1990). He has the following remarks on the evolutionary value of cross-modality:

“First, it appears that multimodal information extraction of environmental information is likely to result in more veridical perception, and may facilitate cognitive functioning. Second, in my view, cross-modal perception requires the derivation of modality-free information, a “representation.” That an organism can have the same representations, concepts or percepts, regardless of the method of peripheral reception, confers great advantage on that animal in coping with the demands of living.” (Davenport 1976, p. 147)

Categorization is, in general, exploiting representations. When, for example, a bird not only sees a particular object, but sees it *as* food, the bird’s brain is adding information about the perceived object

¹Fodor (1986, pp. 15-16) argues that transduced information is equivalent to information about *nommic* properties. He prefers nonnomicness as a characterization of representations since “there is independent reason to suppose that nomicness is the more fundamental notion: unlike transduction nomicness is a concept that we need outside the information sciences.” (p. 16) I don’t accept this argument, since I, among other things, don’t share the scientific realism that underlies his notion of nomicness. Hence I stick to transducibility.

that, e.g., leads to the conclusion that the object can be swallowed. Since information is added, *mistakes* become possible, i.e., the inferences drawn from the representation may turn out to be wrong (“Pardon me,” said the the hedgehog and climbed off the scrubbing-brush). When I speak of inferences, I am in no way implying that they are made in an explicit form, symbolic or otherwise (see Gärdenfors 1994). Nor am I assuming that the animal is, in any sense, *aware* of the representation, only that there is some generalizing factor that determines its behavior.

2. CUED VS. DETACHED REPRESENTATIONS: WHY A CHIMP CAN MAKE A TOOL

My primary aim in this article is not to demarcate representations from non-representations. However, I want to emphasize that there are different *kinds* of representations. The central thesis of this paper is that in order to give an accurate analysis of many phenomena in animal and human cognition, it is necessary to distinguish between two kinds of representations: *cued* and *detached*.

A *cued* representation stands for something that is present in the current external situation of the representing organism. A cat that hears a crunching sound in the closet and comes to believe that there is a mouse there is using its perceptual stimuli as a cue for its mouse representation. In general, the represented object need not be actually present in the situation, but the representation must have been triggered by something in a recent situation. Delayed responses, in the behaviorist’s sense, are based on cued representations according to this characterization.

In contrast, *detached* representations may stand for objects or events that are neither present in the current situation nor triggered by some recent situation. A detached representation thus requires no perceptual cue in order to be activated. A memory of something, that can be evoked independently of the context where the memory was created, would be an example of a detached representation. For another example, consider a chimpanzee, who performs the following sequence of actions: walks away from a termite hill, breaks a twig, peels its leaves off to make a stick, returns to the termite hill, and uses the stick to “fish” for termites. This behavior seems impossible to explain unless it is assumed that the chimp has a detached representation of a stick and its use.

I am not claiming that it is possible to draw a sharp line between cued and detached representations. There are degrees of detachment, and, as will be seen below, there are different types of detachment. However, I still believe that the rough distinction between the

two major kinds of representations is instrumental in that it directs our attention to key features of the representational forms.

A closely related distinction is proposed by Gopnik (1982, p. 378) who wants to “distinguish representations in which there is some direct causal connection between the states from those in which there is no direct causal connection.” In most cases this will give the same results as distinguishing between cued and detached representations. However, there are many kinds of causal links which are not separated by Gopnik, for example the distinction between transduced and inferred information. Furthermore, I will try to show that it is fruitful to separate different kinds of “detachment.” I thus believe that my analysis is more fine-grained than what would have resulted from applying Gopnik’s distinction.

A caveat concerning my use of the notion of representation is that I view representations as *theoretical terms*, in the way conceived of in philosophy of science (e.g., Sneed (1971)). Representations are theoretical idealizations, similar to “forces” in Newtonian mechanics, that are introduced to predict and explain empirical generalizations (see Lachman and Lachman 1982).

3. THE INNER ENVIRONMENT: WHY LIZARDS DON’T DREAM

What is the main advantage of detached representations in comparison to cued ones? In order to answer this question, I will elaborate on an idea introduced by Craik (1943, p. 61):

“If the organism carries a “small-scale model” of external reality and of its own possible actions within its head, it is able to try out various alternatives, conclude which are the best of them, react to future situations before they arise, utilize the knowledge of past events in dealing with the present and future, and in every way to react on a much fuller, safer and more competent manner to the emergencies which face it.”

Under the heading of the *inner environment*, this kind of “small-scale model” has been made popular by Dennett: “the inner environment is simply any internal region that can affect and be affected by features of potential behavioral control systems” (1978, p. 79). Such an environment is necessary for representing objects (like food and predators), places (where food or shelter can be found), actions (and their consequences), etc., even when these things are not perceptually present. The evolution of this kind of representational power will clearly increase the survival value of the animal.

As a tentative definition, the inner environment of an animal will in this paper be identified with *the system of all detached representations* of the animal and their interrelations. In particular, the dynamic features of the objects represented are included in the inner environment. Such features are essential for inferring *consequences* of possible actions. Again, I am not assuming that the animal is *aware* of its inner environment, or of the processes utilizing this construct. This would amount to self-awareness as will be discussed in Section 6.

Like all theories of mind, the inner environment is a metaphor. Metaphors are neither true nor false, but they can be more or less productive as heuristics for developing more precise theories. In what follows, I want to show that the metaphor of the inner environment can help us explain the evolutionary value of several cognitive functions.

It seems that many species of animals have inner environments. For example, the searching behavior of rats is best explained if it is assumed that they have some form of “spatial maps” in their heads. Evidence for this, based on their ability to find optimal paths in mazes, was collected by Tolman already in the 1930’s (see Tolman 1948). However, his results were swept under the carpet for many years since they were clear anomalies for the behaviorist paradigm. Vauclair (1987) provides a more recent analysis of the notion of a “cognitive mapping.”

It is difficult to assess when the inner environment first appeared in the animal kingdom, but a wild guess is that it is coordinated with the development of the neocortex, i.e., roughly with the appearance of mammals. However, it is only with the development of crossmodal representations that we obtain advanced forms of an inner environment (Davenport 1976, Murray 1990). Sjölander (1993) notes that mammals *play*, but reptiles don’t. There is also evidence of *dreaming*, which clearly presumes an inner environment, only among the mammals (see Fagen 1981). Thus dogs can dream about hunting, but lizards cannot.

Also, *birds* seem to have cognitive capacities that presuppose something like an inner environment (interestingly enough, it is only mammals and birds who have a constant body temperature). For example, their advanced spatial representations are well documented. It should be noted though, that even if several other taxa have spatial abilities, by being able to utilize landmarks etc., this does not entail that they have an inner environment. One operational test for the existence of a spatial inner environment is the ability to take *shortcuts* when previous hindrances are removed.

My aim in the remainder of the paper is to establish that existence of an inner environment is a prerequisite for the evolution of many higher cognitive functions. The functions I will consider are planning, deception, self-awareness, and linguistic communication.

4. PLANNING: WHY THE SQUIRREL DOES NOT MAKE ANY PROVISIONS FOR THE WINTER

One of the main evolutionary advantages of an inner environment is that it frees an animal who is seeking a solution to a problem from dangerous trial-and-error behavior. Jeannerod (1994, p. 2) says that “actions are driven by an internally represented goal rather than directly by the external world.” By exploiting its inner environment, the animal can *simulate* a number of different actions in order to “see” their consequences and evaluate them. After these simulations, it can choose the most appropriate action to perform in the outer environment. Of course, the *success* of the simulations depends on how well the inner environment is matched to the perceptions of the outer. A monkey who imagines a branch where there is none is soon a dead monkey – evolutionary selection pressures will, in the long run, result in a sufficient correspondence between the two environments.

The ability to envision various actions and their consequences is a necessary requirement for an animal to be capable of planning. Following Gulz (1991, p. 46), I will use the following criterion: An animal is planning its actions if it has a representation of a goal and a start situation and it is capable of generating a representation of a partially ordered set of actions for itself for getting from start to goal. The representations of the goal and the actions must be detached, otherwise the animal has no *choice*. In brief, planning presupposes an inner environment.

There are several clear cases of planning among primates and less clear cases in other species (see e.g. chapters 5, 7, 8 and 9 in Ellen and Thinus-Blanc, eds., 1987, and pp. 58-61 in Gulz 1991). The termite-fishing chimpanzee mentioned earlier is one such example. By the way, this is an example of *planned tool-making*.

However, all evidence for planning in non-human animals concerns planning for *present* needs. Apes and other animals plan because they are hungry or thirsty, tired or frightened. Oakley (1961 p. 187) notes that “Sultan, the chimpanzee observed by Kohler, was capable of improvising tools in certain situations. Tool-making occurred only in the presence of a visible reward, and never without it. In the chimpanzee the mental range seems to be limited to

present situations, with little conception of past or future.”

Humans seem to be the only animal that can plan for *future* needs. Gulz (1991, p. 55) calls planning for present needs *immediate planning* while planning for the future is called *anticipatory planning*. Humans can predict that they will be hungry tomorrow and save some food, and we realize that the winter will be cold, so we start building a shelter already in the summer. The crucial distinction is that for an animal to be capable of anticipatory planning it must have a *detached representation of its future needs*. In contrast, immediate planning only requires a cued representation of the current need. There is nothing in the available evidence concerning animal planning, notwithstanding all its methodological problems, that suggests that any species other than *Homo sapiens* has detached representations of their desires.

But the squirrel who is gathering and storing food for the winter, isn't it engaged in anticipatory planning? No, it is not planning at all. It has no *detached representation* of the winter, let alone its needs during the winter. The gathering behavior is routine behavior of an instinctual nature that appears stereotypically without sensitivity to varying circumstances. For example, if one fills the squirrel's stores, it still continues gathering until the “urge” is gone.

5. DECEPTION: WHY THE PARTRIDGE FEIGNING A BROKEN WING ISN'T FOOLING THE FOX

I want to analyze the evolution of self-consciousness as a series of comparatively small steps. A good planner must consider the actions of other individuals (in particular if the planner belongs to a social species). A special case of representations in the inner environment concerns the minds of other individuals. In my opinion, the first step in the evolution of self-consciousness is when other agents are not only seen as acting things, but as having an inner environment of their own, with beliefs, desires, etc.

It is only when this representational capacity is accomplished that *deception* becomes possible. Deception, in the intentional sense, presumes a representation of other minds. To see this, let us turn to the worthwhile survey of tactical deception in primates by Whiten and Byrne (1988). After their initial attempt to define “tactical deception” was criticized in the commentary, they ended up with the following definition: “Acts from the normal repertoire of the AGENT, deployed such that another individual is likely to misinterpret what the acts signify, to the advantage of the AGENT” (1988, p.

271). The key word in this definition is “deployed.” When this word refers to human behavior, it refers to an *intentional* act. I submit that the ordinary use of deception presupposes that the deceiver has some *representation* of how the individual to be deceived will *interpret* the deceiving act. In other words, deception presupposes that the inner environment of the deceiver contains some form of *representation of the inner environment of the target individual*. Note that deception presumes all the cognitive functions of (immediate) planning, and some more, i.e., an inner environment containing a model of the inner environment of other individuals. Thus, this analysis predicts that deception will occur later than planning in the evolution of cognitive functions. This thesis is most naturally interpreted as a statement about phylogeny, but can also be given an ontogenetical meaning.

Whiten and Byrne (1988) present a series of examples of potential cases of deception among primates. Most examples come from field observations of chimpanzees and baboons.² However, almost all evidence is based on more or less anecdotal material. Lacking controlled experiments, it is therefore strongly debatable whether the evidence can establish that deception in the intentional sense occurs among animals other than humans (see Bennett 1988).

However, there are cases when it is clear that deception is *not* taking place: The partridge feigning a broken wing to lure away the fox from her chicks is *not fooling* the fox. “Fooling” presumes an intention to make somebody else misinterpret the fooling act. There is no evidence that the partridge has any *representation* of what the fox thinks. She merely acts instinctively when the fox approaches and can hence not have any intention to fool.

6. SELF-AWARENESS: WHY BABOONS DON'T WEAR LIPSTICK

Deception, in the full intentional sense, presupposes that the deceiver has a representation of the deceived one's inner environment. On this level, an animal can have goals concerning the intentions of other individuals, e.g., *want* somebody to *believe* that an attack would fail. This is an example of a second-order intention.

²Gallup (1988, p. 255) notes that “the absence of any evidence of deception in orangutans, who, like chimpanzees, can also correctly decipher mirrored information about themselves, is not surprising in so much as they lead a rather solitary existence in the first place. In fact, I have even conjectured [...] that the reason orangutans are so reclusive may be because they have learned that other orangutans cannot be trusted!”

But a smart agent will not be duped: he will realize that somebody is trying to deceive him and counteract. Hence, the really smart deceiver will foresee the reasoning of such a smart agent (see Dennett 1988). The important aspect of this escalation in smartness is that it can only work if the potential deceiver realizes that the agent he wants to deceive not only has her own representations of the external world, but that her inner world *contains a representation of the deceiver himself*.

Do animals other than humans have self-awareness? Gallup's (1977) experiments show that chimpanzees and orangutans, but no other primates, can recognize themselves in mirrors.³ And when it comes to recognizing oneself in a photograph, only chimpanzees seem to be successful.

Bodily decorations only make sense when you have some form of awareness of your own body. Such decorations occur in all human cultures, but in no other species in an intentional way. Thus, baboons could never come up with the idea of using lipstick.

But recognizing oneself in a mirror or in a photograph only requires awareness of one's own *body*, not of one's own mind. The final step in the evolution of higher-level inner representation is small but crucial for self-awareness in its proper sense: I must realize that the inner environment of my opponent does not only contain a representation of myself as a bodily agent, but as *an agent with inner representations as well*. I propose that it is only after this insight that the agent can become self-conscious in the sense that it can form representations of its own representations. Some support for this evolutionary point can also be obtained from recent results in developmental psychology (see e.g. Wimmer and Hartl 1991 and Gopnik 1993).

As a final step, *self-awareness* can then develop as a shortcut in the representations involved in the deception game: I can, in my inner environment, have a representation of my own inner environment. However, I submit that this kind of self-awareness could never develop without the previous establishment of a representation of the inner environment of other individuals. In other words, I claim that an "I"-experience must be preceded by a "you"-experience (see also Mead 1934, Gärdenfors 1992, to appear b, and Gomez 1994). This position contradicts the traditional Cartesian view on mind

³Epstein, Lanza and Skinner (1980) performed a similar experiment intending to show that also pigeons can learn the same kind of behavior. Davis (1989) argues, in my opinion convincingly, that their experiment does not show that pigeons have any form of self-awareness.

where humans are supposed to have direct access to their thoughts.⁴

7. LANGUAGE: WHY BEES DON'T TELL STORIES TO ONE ANOTHER

Thinking does not presume a language. Humans, as well as animals, can simulate sequences of actions in their inner environments. Such simulations are, among other things, necessary for planning. I shall argue that language is a very late phenomenon on the evolutionary scene. As I have tried to show in the previous sections, an individual can have a great deal of cognitive functions, including self-awareness, without having a symbolic language.⁵

In contrast, I submit that language presumes the existence of an intricate inner environment. In order to make this clear, I will propose a definition of the distinction between *signals* and *symbols*. Both signals and symbols are tools of communication. The fundamental difference between them is that *the reference of a symbol is a detached representation, while a signal refers to a cued representation*. In other words, a signal refers to something in the outer environment, while a symbol refers to the inner environment. Language consists of symbols — it can be used to talk about things not present in the current situation. This idea can be traced back to Hockett's (1960) notion of "displacement." Sjölander (1993, pp. 5-6) expresses the point as follows:

"The predominant function of language is to communicate about that which is not here and not now. A dog can 'say' : I am angry, I want water, I want to go out, I like you, etc. But it has no communicative means enabling it to 'say' : I was angry yesterday, nor can it 'say' : I

⁴Gopnik (1993) calls this "the illusion of expertise." She writes: "The commonsense picture proposes that we have intentional psychological states, then we have psychological experiences of the intentionality of those states, then we observe our own behavior that follows those states, and finally, we attribute the states to others with similar behavior. I suggest a different sequence: First we have psychological states, observe the behaviors and experiences they lead to in ourselves and others, construct a theory about the causes of those behaviors and experiences that postulates intentionality, and then, in consequence, we have experiences of the intentionality of those states." (1993, p. 12)

⁵A similar point is made by Donald (1991). In Gärdenfors (to appear a), I write: "We all have the experience of something like an omnipresent inner monologue (or dialogue) while we are engaged in thinking. I believe that this experience is deceptive. Firstly, we can "think" without language. Consider, for example, the previously mentioned mental simulation of a high jumper. Secondly, and more importantly, the inner speech is best interpreted as just parts of the *simulations* in the inner environment. The inner soliloquy is part of what we *perceive* in the inner environment."

will be angry if you lock me up tonight again, and I will chew up the carpet. Likewise, the dog can ‘ say’ : There is a rat here! but it cannot ‘ say’ : There is a rat in the next room.

[...] Clearly, if you live in the present, communicating mainly about how you feel and what you want to do in the moment, the biological signals inherent in each species are sufficient.”

Symbols referring to something in one person’s inner environment can be used to communicate as soon as the listeners have, or are prepared to add, the corresponding references in their inner environments. For a model theoretic account of how such communication can be established, see Gärdenfors (1993).

Many animals have intricate systems of signals, for example, the dances of bees. However, even if their dances seem to have a kind of grammar, it still consists only of *signals*. The bees categorize, in a sophisticated way, places where nectar can be found. The crucial point is that they only use their dances in a situated manner, and thus the dances are not symbols according to my criterion. The same point is made by von Glasersfeld (1976, p. 222): “In my terms, the bees do not qualify for symbolicity, because they have never been observed to communicate about distances, directions, food sources, etc., without actually coming from, or going to, a specific location.”

In spite of all attempts to teach apes various forms of symbolic codes (see e.g. Savage-Rumbaugh and Rumbaugh 1993), humans seem to be the only animals that use language in a fully detached way. Even though the pygmy chimpanzee Kanzi’s performance is quite impressive, his use of symbols is dependent on the context: they mainly express requests to “direct teacher’s attention to places, things and activities” (Savage-Rumbaugh et al., 1985, p. 658). Human children, in contrast, very early use language outside the context of request. Vauclair (1990, p. 319) notes that “the use of symbols by apes is closely tied to the achievement of immediate goals, because the referents occur in the context of behavior on their objects.” This is congenial with Gulz’ (1991) conclusion that only humans are anticipatory planners. My conjecture is that this capability is required for the complete detachment of language. We are still waiting for Kanzi to tell us a story by the camp fire.

8. CONCLUSION: THE DETACHMENT OF MIND

My main point in this paper has been to introduce the distinction between cued and detached representations. Using this distinction as an analytic tool, I have tried to provide an outline of the “later”

parts of the evolution of cognition. I have tried to show that the notion of an inner environment can serve as a basis for all higher cognitive functions like planning, deception, self-awareness, and language.

Each of these functions is based on different kinds of assumptions concerning the detached representations that are involved. Anticipatory planning, in contrast to immediate planning, presumes a detachment of the representation of the needs of the individual. For deception one must postulate an inner environment that contains representations of other individuals’ inner environments. Self-awareness assumes detached representations of one’s own inner environment. Finally, the referents of linguistic symbols are to be found in the inner environment, in contrast to signals which refer to things in the actual outer environment.

If the behaviorists were right, it would be questionable whether we would need the notion of representation at all (see Epstein 1982). In my opinion, however, there is convincing evidence that the behaviorists are wrong and that animals have not only cued representations but also detached ones. I have defined the inner environment of an animal as the collection of all its detached representations. As I have tried to show, the general trend in the evolution of cognition is that more and more representations become detached. This will, by large, lead to increasing cognitive flexibility. In other words, the evolution of cognition is the story of the detachment of mind.

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