

Neurobiology of “Umwelt”

RESEARCH AND PERSPECTIVES IN NEUROSCIENCES

Fondation Ipsen

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Neurobiology of “Umwelt”

How Living Beings Perceive the World

 Springer

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Foreword

At the beginning of the 20th century, German biologist Jakob von Uexküll created the concept of *Umwelt* to denote the environment as experienced by a subject. This concept of environment differs from the idea of passive surroundings and is defined not just by physical surroundings, but rather is a “subjective universe”, a space weighted with meaning. Based on this perspective, a living organism, no matter how basic (such as the tick studied by von Uexküll), creates its own universe when it interacts with the world and as this same time the organism reshapes it. Today, neuroscience provides a new way to look at the brain’s capability to create a representation of the world. At the same time, behavioral specialists are demonstrating that animals have a richer mental universe than previously known. Philosophical reflection thus finds itself with more experimental and objective data as well. This is why we have chosen the theme of *Umwelt*, nearly a century after the publication of von Uexküll’s founding work (*Umwelt and Innenwelt der Tiere* was published in 1909), for the 16th international “Colloque Médecine et Recherche” in neuroscience organized by the Fondation Ipsen. This meeting bring together neurobiologists, psychologists, sociologists, anthropologists, ethologists, and philosophers, in Paris on February 18, 2008.

*Alain Berthoz
Yves Christen*

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Contents

Anthropological Physiology: von Uexküll, Portmann, Buytendijk	1
Anne Fagot-Largeault	
Essentialist Reasoning about the Biological World	7
Susan A. Gelman	
The Human Brain “Projects” upon the World, Simplifying Principles and Rules for Perception	17
Alain Berthoz	
Umwelt: A Psychomotor Functional Event	29
Rodolfo R. Llinás	
The Brain’s View of the World Depends on What it has to Know	39
Wolf Singer	
The Biology of Variations in Mammalian Color Vision	53
Gerald H. Jacobs	
The Evolution of Social Categories	69
Robert M. Seyfarth and Dorothy L. Cheney	
What is the Effect of Affect on Bonobo and Chimpanzee Problem Solving?	89
Brian Hare	
Dogs (<i>Canis familiaris</i>) are Adapted to Receive Human Communication . .	103
Juliane Kaminski	
What Do Jays Know About Other Minds and Other Times?	109
Nicola S. Clayton and Nathan J. Emery	

Blind as a Bat? The Sensory Basis of Orientation and Navigation at Night 125
Richard Holland

Point, Line and Counterpoint: From Environment to Fluid Space 141
Tim Ingold

Index 157

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Anthropological Physiology: von Uexküll, Portmann, Buytendijk

Anne Fagot-Largeault

Abstract The notion of Umwelt originates in a (continental, ‘anthropological’) tradition of studying the behaviour of animals in their natural environment, contrasting with the (anglo-saxon, behaviorist) tradition of breeding mice in the laboratory and testing their achievements in mazes, that is, in artificial environments. Chapter 1 outlines the contributions of three major European scientists to modern psychophysiology and ethology.

“Philosophical anthropology” refers to a trend of thought that flourished around the middle of the 20th century (between 1920 and 1960) on the European continent, especially in Germany, Switzerland and the Netherlands. It comes as a humanistic reaction against positivistic naturalism in science, especially the new experimental sciences of human and animal behaviour. It strives to build a bridge between *Naturwissenschaften* and *Geisteswissenschaften*, that is, between the science of nature and the science of the human mind. The basic concern is to initiate a philosophical way of practicing science. It aims at understanding how the human race “builds its nest” in the world (Gehlen, posth., 1986). The philosophical inspiration lies both in existentialism (Karl Jaspers) and phenomenology (Edmund Husserl). Most of the literature is in German. *Ethology* and *physiological anthropology* belong to that trend of thought.

After world war 2, continental biologists who had emigrated to England reckoned that the study of animal behaviour had developed along so divergent paths in the anglophone world and in the german world, that researchers did not understand each other any more. They had published in different journals, writing different languages, using different technical vocabulary, and different methods of research and measurement. On the Anglo-american side, the research had mainly been the job of psychologists, the typical animal was the laboratory mouse (or rat), the main focus was learning, the explanatory scheme was Pavlov’s conditioning. That was the *behaviorist* school. On the German side, research had been conducted mainly

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by zoologists. Animals - even humble animals such as insects - had been studied outdoor, within their natural environment; learning was not the focus of interest; German researchers were interested in innate behaviour, instinctive (often complex) animal reproductive (or other) strategies. That was *ethology*. In 1950 a meeting took place in Cambridge, England, during which researchers of the two traditions met and discussed with each other. Paul Schiller, a psychologist from Hungary, offered to translate the German literature in English. He died before the work was done, but his wife completed it (Coll., *Instinctive Behaviour*, 1957). That is when the two schools merged, and when, in animal research, the Darwinian scheme of explanation (*trial and error*) definitely replaced the behaviorist scheme (*conditioning*).

“In the behaviorist’s Umwelt the body produces the mind, and in the psychologist’s world the mind builds the body” (von Uexküll 1934, p. 80).

The promoter of German ethology was **Jakob von Uexküll** (1864–1944), who says that he took his inspiration from Johannes Müller, the initiator in Germany of *physiology* as a science. Note that there has been two von Uexküll working in the field : the father Jakob, who was born in Estonia, studied zoology in Tartu, and later did most of his research in Heidelberg and the Zoological Institute in Rostock; and his son Thure von Uexküll (1908–2004), also a partner of the philosophical anthropology movement.

The famous description, by Jakob von Uexküll, of the phenomenal world of the tick (Uexküll 1921), is meant to convey the idea that even such a humble animal is not only “a collection of perceptual and effector tools connected by an apparatus which mechanically ... carries on the life functions”, but that there is a pilot in the machine, *i.e.*, a *subject*, “whose essential activity consists in perceiving and acting”. The functional cycle is very simple. To carry it out (she can wait 18 years) she has three receptors (a photosensitive skin, a sense of the smell of butyric acid, a sense of warm temperature) and three effectors (climb up the tip of a branch, drop on a passing mammal, drink its warm blood). Then the cycle is over: “nothing left for her to do but drop to earth, lay her eggs and die” (p. 7). What is the tick’s *Umwelt*? “Perceptual and effector worlds together form a closed unit, the Umwelt”, says von Uexküll (1934, in: Coll., p. 6). And he goes on: “Now we might assume that an animal is nothing but a collection of perceptual and effector tools, connected by an integrating apparatus which, though still a mechanism, is yet fit to carry on the life functions. This is indeed the position of all mechanistic theorists, whether their analogies are in terms of rigid mechanics or more plastic dynamics. They brand animals as mere objects. The proponents of such theories forget that, from the first, they have overlooked the most important thing, the *subject* which uses the tools, perceives and functions with their aid” (J. von Uexküll, 1934, in: Coll., p. 6).

What the author means is that the animal actively builds her Umwelt, and that such a construction reveals a living strategy. “As the spider spins its threads, every subject spins his relations to certain characters of the things around him, and weaves them into a firm web which carries his existence” (J. von Uexküll, 1934, p. 14). While weaving their niche, living beings prepare themselves to be responsive to certain cues in the world around them, and even though their behaviour may not be consciously planned, it is obviously meaningful, to the extent that it serves a

survival or reproductive end. The author distinguishes between innate and learned behaviour, but neither behaviour is mechanically triggered off by the environment. “If we choose to call significant only what is given to the subject by the evidence of his senses, then, of course, only the familiar path will be called meaningful, not the innate. Even so, it remains planful to the highest degree” (J. von Uexküll, 1934, 70).

There is a counterpart to such an analysis of the living being as a perceiving-and-acting subject. The subject is locked in her niche. For the tick there is nothing beyond the edge of her Umwelt; for her, all mammals reduce to some thing with a smell of butyric acid. Von Uexküll invites the reader to imagine an oak tree, with squirrels running and birds nested on its branches, a fox living between its roots, a bunch of beetles on its bark, each with their own Umwelt, and an ant. “Each Umwelt carves a specific section out of the oak, whose qualities are suitable bearers for both the receptor and effector cues of their respective functional cycles. In the ant’s world all the rest of the oak vanishes behind its gnarled bark, whose furrows and heights become the ant’s hunting ground” (von Uexküll, 1934, p. 75).

Adolf Portmann (1897–1982) was a zoologist known for having developed the idea that human beings were born *premature*, and that the extra-uterine embryos we all were, found a *second uterus* in their social environment. Biological development in interaction with a human milieu offers a possibility of vast diversification. Understanding biological development requires both an analysis of particular developmental mechanisms, and a holistic view of organic structures and strategies: “Das lebendige Geschehen zeigt in jedem Ausschnitt den Doppelaspekt, der einerseits die Untersuchung dienender Strukturen und Wirkweisen erfordert, und der andererseits verlangt, dass wir zugleich um das übergeordnete Ganze wissen, das diese dienenden Strukturen benützt” (Portmann 1951, p. 90). In other words, biologists when studying human embryological and postnatal development cannot ignore the regulating influence of the psychological and social ‘Umwelt’ on physical development, just like psychologists when studying the mind cannot ignore that the mind is *embodied*, that is, enveloped in a totality: the body. In his book on *The Animal as a Social Being (Das Tier als soziales Wesen*, Chap. 1), Portmann starts with a minute description of the *Libellenwelt* (the world of a dragonfly).

Note that the idea of the social milieu being a second uterus had already been expressed by Antoine Augustin Cournot (in his book: *Mechanism, Vitalism, Rationalism*, 1875, §8). Cournot mentions what must have been a lecture by Claude Bernard, as a reference for such an idea. Portmann does not mention either Cournot or Bernard. He seems to have developed the idea independently.

Frederik Jacobus Johannes Buytendijk (1887–1974) is the main scholar representative of anthropological physiology in the Netherlands. He was not a zoologist. After studying medicine in Amsterdam, he went into experimental physiology, and became an expert in animal behaviour, or, to be precise, in animal psycho-physiology. He radically disagreed with John Watson’s mechanistic model of conditioning, and with the ways of experimenting on animals common in the behaviourist school. His inaugural address on “understanding living phenomena” when, in 1925, he was established as professor of physiology at the university of Groningen, makes it explicit that his research programme consists in studying

animals and/or humans as “psycho-somatic units” in other than artificial environments. From then on he concentrated more and more on psychophysiological phenomena which may be qualified as “modes of being”, such as pain, fatigue, hunger, thirst, anger and other emotional states, and on organic regulations (for example, of blood pressure, or equilibrium). In so doing he used both cybernetic models and notions borrowed from phenomenology, especially the notion of an intentionality inherent in behaviour. Buytendijk assumes that there is in animals a living *subjectivity*, and that subjectivity does not necessarily imply *consciousness*: “The concept of a lived subjectivity which is bodily unconscious is in accordance with the experiences we have of the behaviour of animals” (*Prolegomena*, A, I, § 6).

Methodologically speaking, Buytendijk’s main thesis is that the living being, which is the *object* of scientific study, is at the same time another *subject*, and that he must be treated as such, that is, not be experimented on, but be a partner in experimental research. One does not do research *on* an ape, one does research *with* (the cooperation of) an ape. The other subject does not react to *stimuli*, he reacts to the *meaning* the stimuli have for him. The experiment is an *encounter*. Buytendijk’s ideas on experimental research have been most influential on the ethics of medical research during the late twentieth Century. Buytendijk himself is clearly aware of the potential impact on medicine of his concept of a *research partnership*, when he compliments the French psychiatrist Henry Ey for translating German works into French, and understanding that, in order to do good science, one does not need to reify (that is, treat as a thing) the object of research : “*The reintroduction of the subject into physiology and biology is the chief concern of modern thought*” - The import of this statement by the psychiatrist Henri Ey - in his introduction to the French translation of *Der Gestaltkreis*, the pioneering work of von Weizsäcker - can only be understood if we withdraw from the activity of technically-oriented medical science” (*Prolegomena*, A, I, § 7).

Buytendijk’s *Prolegomena to an anthropological physiology* is available in English. Buytendijk was a wonderfully learned researcher, speaking and writing several languages. When he turned seventy, colleagues from all over Europe composed a book in his honor, in three languages, under the title of “Rencontre, Encounter, Begegnung”. Maurice Merleau-Ponty (1908–1961) borrowed much of his empirical data from Buytendijk (see Dekkers’ paper, 1995). Buytendijk generously expressed admiration for Merleau’s theory of the human body as a mode of ‘being-in-the-world’. It seems, however, that Buytendijk’s notion of *Leiblichkeit* (bodiliness) goes further than Merleau’s: “*Spirit manifests itself through the body*” - the basic thesis of Merleau-Ponty. We add to this: “The body of man organizes itself in its human performances and structurations through the mind” (*Prolegomena*, A, I, § 7).

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Essentialist Reasoning about the Biological World

Susan A. Gelman

Abstract Essentialism is the idea that certain categories, such as “dog,” “man,” or “gold,” have an underlying reality or true nature that gives objects their identity. Essentialist accounts have been offered, in one form or another, for thousands of years, extending back at least to Aristotle and Plato. Where does this idea come from? I address this question from a psychological perspective and argue that essentialism is an early cognitive bias. Young children’s concepts reflect a deep commitment to essentialism, and this commitment leads children to look beyond the obvious in many converging ways: when learning language, generalizing knowledge to new category members, reasoning about the insides of things, contemplating the role of nature versus nurture, and constructing causal explanations. I suggest that children have an early, powerful tendency to search for hidden, non-obvious features of things. Parents do not explicitly teach children to essentialize; instead, during the preschool years, children spontaneously construct concepts and beliefs that reflect an essentialist bias. I explore the broader implications of this perspective for human concepts, children’s thinking, and the relation between human concepts and the biological world.

1 Introduction

One important task that humans face as they experience the biological world is to organize it into categories. Categorization serves two important functions: it provides an efficient system for storing the endless variety of sights, sounds, and events that we encounter, and it provides a structure for making new inferences and predictions (Smith 1989). All animals use categories in these ways. Detecting food, enemies, or prey all require responding to new and perceptibly distinct items as if they were comparable to previously viewed items.

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