Gestalt experiments and inductive observations

Konrad Lorenz's early epistemological writings and the methods of classical ethology

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Abstract. **During the 1940s Konrad Lorenz formulated his early epistemological views, focusing on the cognitive mechanisms induction and Gestalt perception. After the war he used this philosophical framework to defend the approach of classical ethology against other approaches to animal behavior. The present paper examines the relationship between Lorenz's ethological methodology and his philosophy of science and knowledge. The main aim of Lorenz's post-war epistemological writings is to provide an epistemological and cognitive theory of observation in order to defend the observational approach of classical ethology against the view that it was no rigorous science.**

Ethology brought some crucial insights and perspectives to the study of behavior, in particular the idea that behavior can be studied within a comparative-evolutionary framework by means of homologizing components of behavioral patterns and by causal analysis of behavior components and their integration. Early ethology is well-known for its extensive use of qualitative observations of animals under their natural conditions. These observations are combined with experiments that try to analyze behavioral patterns and establish specific claims about animal behavior. Nowadays, there is still disagreement about the significance of observation and experiments and their relation.

Allen (forthcoming) points out that in debates about the interpretation of animal cognition the interpretations of those ethologists who have actually spent time watching the animals are favored by some biologists. In fact, some practitioners of cognitive ethology feel that experiments at best just confirm what one already knows, while others are more skeptical about interpretations of observations without experiments.

As a major representative of ethology Konrad Lorenz not only shaped its approach and made the methods and theories of ethology known to the biological community and the interested public, he also embedded his defense of the ethological and comparative approach in a philosophical theory of scientific knowledge. Gestalt perception and induction are the main elements of Lorenz's epistemology. These ideas were originally formulated during the second world war (see for instance the *Russian Manuscript*, Lorenz 1948). In the post-war period Lorenz emphasized his epistemological ideas as part of an attempt to justify his ethological approach and his views about the role of observation and experiment. The aim of the present paper is to call attention to Lorenz's philosophical account and how it integrates with his biological methodology.

Observation and experiment

Lorenz's account of the general character of observation and experiment remains unchanged throughout his writings. The specific relationship between these two aspects is exhibited by Lorenz's early biological work as well as his later explicit methodological account of them (Lorenz 1935; Lorenz/Tinbergen 1938; Lorenz 1948, 1981). Lorenz emphasizes four distinctive features of classical observational practice: observations are to be carried out in a hypothesis-free way; the approach consists in doing qualitative observations rather than quantitative measurements; animals are to be observed in their natural environment; and observations include all features of the organisms and their environment and rely on a large observational basis. One should not

think that ethology (in particular the more developed ethology of the post-war period) always proceeded in this fashion. Instead, Lorenz's bold claims about how ethology is done are based on some of his opinions as to how science should be done or how a science should develop (see Burkhardt 1981). In any case, the way classical ethology was done was noticeably different from other contemporary approaches to animal behavior such as comparative psychology or later on sociobiology. In fact, Lorenz encountered methodological critique from both groups.

Lorenz defends the ethological approach of gathering observational data without having a hypothesis in mind against the view that scientific accounts must be based on a theory (1948, p.216; unless otherwise indicated, references refer to a publication of Lorenz). Lorenz thinks that it is not only possible to make observations devoid of a theoretical framework, he also points to the possibility of confirmation bias as a disadvantage of basing one's observational approach on a hypothesis (1948, pp.31, 71). Instead of forming theoretical considerations at an early stage of inquiry, scientific inquiry has to start with "observation pure and simple" (1958, p.246). Lorenz calls this "presuppositionless observation" (1981, p.47) or often "unbiased observation" (1958, p.250; see also 1948, p.213; 1950 p.131; 1959, p.281). Now, even amateur naturalists who dedicated all their time to field observations of animals did not necessarily refrain from interpreting their observations and relate them to biological theories. Edmund Selous, for instance, used his extensive observations to justify theories of sexual selection. In the case of Lorenz, the theoretical assumption that behavioral characters can be used to characterize taxonomic groups and reconstruct phylogenies guided his observational practice from very early on. But Lorenz is right insofar as before 1935 he and Tinbergen completely lacked an interpretative framework, unlike most people working in animal psychology. After the war ethology became more theoretical, but compared to other approaches such as comparative psychology or sociobiology

ethology was not that much an enterprise driven by explicitly formulated theories and hypothesis that were put to empirical test. In particular sociobiology took quantitative hypotheses based on models from population genetics as the starting point and used observations primarily to test these hypotheses.

In addition, early ethology relied on qualitative observations of behavior. Instead of making quantitative measurements and recording them, observations are recorded using written descriptions (1935, pp.112ff), drawings and photographs (Lorenz/Tinbergen 1938). This qualitative approach of classical ethology has to be defended against an understanding that *only* allows for quantitative measurement and statistical evaluation as a means of scientific objectivity (1958, pp.246, 256; 1959, p.281; 1963a, p.1; 1981, pp.40ff, 68ff). Despite Lorenz's emphasis on qualitative observation, post-war ethology did very well make use of quantitative measurements, but connected them with qualitative observations (Schleidt and Schleidt 1958 is an example).

A further emphasis of the ethological way of observing is to systematically study animals in their natural ecological environment. Animals are kept "in an environment as close as possible to their natural habitats, for the purpose of general biological and specifically ethological observations" (1935, pp.108–109). Keeping animals under laboratory conditions suffers from the drawback that the organisms do not exhibit their natural adaptive behavior patterns and thus functional and artifactual behavior are likely to be confused. This approach of observing animals under natural conditions continues the "amateurism" of the forerunners of classical ethology (1981, p.47). However, for Lorenz the optimal method is *not* to study animals in the field. For in this case, it is difficult and extremely time-consuming to be able to observe the relevant behavior patterns (1948, p.222). The chapter "Animal Keeping as a Research Method" of the *Russian Manuscript* gives a detailed account of how the study of animal behavior has to be organized (1948, pp.221ff). Several animals of a species have to be kept so that they

live in proximity to the researchers and in a controllable environment. Apart from conducting observations in that way, animal keeping makes it possible to conduct experiments under otherwise natural conditions (1948, p.222). Lorenz's practice of raising and keeping animals was quite similar to the practice of his mentor Oskar Heinroth or the American zoologist Charles Otis Whitman. Whitman's and Lorenz's practice of animal keeping enabled them to simultaneously observe the behavior of several closely related species, which is hard to achieve in the field. But Lorenz's approach differed from the early field naturalist in the British tradition (Selous and Howard) or in the Dutch tradition (Röell 2000). In particular Niko Tinbergen heavily relied on field observations (and experiments) instead of animal keeping (Tinbergen 1932, 1935, 1951), while Lorenz viewed field work as a control for observations gained from animals kept in semi-natural conditions (1981, pp.47ff). Thus Tinbergen represented the ecological dimension of ethology more fully than Lorenz did.[1] Despite the fact that Lorenz was not a field naturalist, his approach was quite distinct from the American tradition of animal psychology and animal behavior studies. Lorenz often labeled the American scientists 'behaviorists', despite the fact that scientists such as John Watson or Robert Yerkes had quite different views of animal minds and behavior. But apart from theoretical differences, the American tradition was definitely characterized by laboratory studies. Observations and experiments under laboratory or controlled conditions dominated (Watson 1914, Yerkes 1925), field studies were an exception (e.g., Watson 1908 or Yerkes' student Nissen 1931). This is due to the fact that in the United Studies animal behavior was studied at universities and institutes from

[1] See Burkhardt (1999) for a historical comparison of the ways animals and behavior was studied (in museums, in zoos, and in the field) and how this related to and influenced research approaches. Burkhardt (2003) compares the research practices of Lorenz and Tinbergen.

early on, while some of the forerunners of European ethology were amateur naturalists. (In the United States, there were a few important field naturalist among the zoologists, rather than the psychologists. But even zoologists primarily studied behavior in laboratories; Dewsbury 1988.)

Ethological observations do not simply focus on specific aspects of animal behavior. Instead, according to Lorenz's ideal ethological analysis start with considering all features of an individual including its natural environment (1981, pp.52–53). Observation has to give an overview of the complete behavioral system of a species (1948, pp.221f). Only in this manner it is possible to obtain knowledge about the relevant substructures of the system, its functions and relations to other organisms and the environment (1950, p.120). Lorenz calls this approach that tries to take all features into account an "analysis on a broad front". It is justified by the fact that the object under study is a complex entity whose parts interact mutually. The chapter "The Organism as an Entity and Analysis on a Broad Front" of the *Russian Manuscript* (1948, pp.137ff) gives a discussion and defense of this method (see also 1958, p.249). To achieve this general overview of the whole behavioral complex of a species it is necessary to have a large observational basis that often may require years to obtain (1935, p.109; 1948, p.222; 1981, p.48). Even before Lorenz, the naturalist Edmund Selous claimed that in his field notes he really wrote down everything he saw (Burkhardt, forthcoming). While this is literally impossible, in particular the early practitioners in ethology are characterized by spending most of their time observing animals. Charles Otis Whitman, for instance, kept detailed notes of his extensive observations, and carried out observations for years before he published his results (Lillie 1911). Like Lorenz, he emphasized that a detailed and extensive knowledge of the behavioral repertoire of a species is crucial to avoid false interpretations and conclusions (Whitman 1899a, 1899b).

The role of experiments within ethology is nicely illustrated by Lorenz's and Tinbergen's classical study of the egg-rolling behavior of the Greylag goose (1938). (Tinbergen was in fact the person who was more skilled in devising and conducting experiments. Compare Tinbergen 1932, 1935, Tinbergen/Kuenen 1939 with Lorenz's more observational and theoretical papers Lorenz 1932, 1935, 1937.) On Lorenz's account, experiments are to be preceded not only temporally, but also methodologically and logically by observations that are not goal-directed. For an experiment only makes sense if the natural units and their interaction are known to a sufficient degree (1981, p.53). An encompassing observational basis is necessary to have a grasp on the structure and function of the system under consideration. Knowledge about the structure of organisms and the function of behavior is needed for having a biologically meaningful classification of the parts of the system studied. These elements identified by observation can one after the other analyzed in more detail and substantiated by experiments designed for addressing such particular questions (1935, pp.110f). Thus, in the ethological approach, the experiment is necessarily posterior to observation.

Lorenz is for instance impressed by the detailed observational work of the ornithologist Margaret M. Nice, and he states that one should always have such a detailed knowledge of an animal before one starts to conduct experiments.

> Ich war begeistert von der Forschungsweise dieser Dame. So müßte man eben jedes Vieh kennen, bevor man mit ihm „Versuche" anzustellen beginnt. (Lorenz, letter to Stresemann, Blatt 94–97)[2]

[2] The correspondence between Konrad Lorenz and Erwin Stresemann is archived at the Staatsbibliothek zu Berlin, Preußischer Kulturbesitz (Germany) as 'Nachlaß 150 (E. Stresemann), Kasten 40'. Any letter from Lorenz that is part of this source is referred to in the paper as 'Lorenz, letter to

The purpose of experiments is to analyze the subcomponents of an overall behavioral pattern (1935, pp.105, 233; 1937, p.293). The experiment enables one to keep the constitutive elements of behavior apart, and to study a largely dissociated component in detail. A certain experimental design allows the researcher to answer specific questions about the function of behavioral component and the causal relationship between the components. Dummy experiments serve to determine the specific stimulus that triggers an innate releasing mechanism and thus help to determine whether this stimulus is learned or innate (1935, pp.143, 228; Lorenz/Tinbergen 1938, pp.333). Other experiments figure out whether a stimulus or drive is of external or internal origin (1950, pp.135f). A type of experiment that was very important for classical ethology is the deprivation experiment. It consists of depriving animals of certain environmental stimuli during their development. This is to show that behavioral components which nonetheless are exhibited after the deprivation period are not learned but must be innate (1965, pp.83ff; 1981, pp.57ff). Lorenz's mentor Heinroth made extensive use of this technique by hand-rearing birds in relative isolation to discern their instinctive behavior features (Heinroth and Heinroth 1924–1933).

Induction and Gestalt perception

Induction, on Lorenz's account, is a rational cognitive process, which means for Lorenz that inductive reasoning is a conscious process (1948, p.30). More precisely, a rational cognitive process is characterized by the fact that the individual is aware of the assumptions made and in particular can verify the steps of reasoning. Throughout Lorenz's writings, induction is conceptually clearly contrasted with non-rational

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Stresemann'. The letter quoted from above is not dated (it is probably from the end of 1933), 'Blatt 94–97' refers the sheet numbers given by the archive.

processes such as intuition and Gestalt perception (1948, p.55; 1950, p.166; 1954, p.198; 1959, pp.302, 306; 1981, pp.43f). Rational cognitive processes are in principle open to introspection and the individual has control over the way of reasoning, which contrasts them to subconscious processes (1959, pp.283, 312f; 1981, p.41). A general feature of induction is it abstracts regularities and principles from knowledge about single facts (1954, p.198). The distinctive feature of inductive science is that it aims at proving assertions by collected evidence (1948, p.54). The last word on verifying the correctness of a scientific hypothesis has to be achieved by quantitative analysis (1958, p.246).

The advantage of induction stems from the fact that it is a rational cognitive process. The inductive base is explicitly known, the single steps in inductive reasoning can be analyzed and verified. In particular the way of reasoning that led to the conclusion can be communicated to other persons in a manner that allows for critical assessment of the scientific claim. The bigger inductive basis, the better the scientific result is substantiated (1948, p.64). The main disadvantage of induction consists in the difficulty of anticipating empirically important or theoretically fundamental results. Induction provides good evidence for the results obtained from data, but it is unlikely that induction arrives at scientifically relevant conclusions that might be substantiated by an adequate inductive basis (1948, p.65).

A central view of Lorenz on empirical science and research is the idea that inductive research proceeds in three stages. The terms used to describe this categorization (the idiographic, the systematic and the nomothetic stage) are adapted from the philosopher Wilhelm Windelband (1894). An early detailed account of this philosophy of science is given in the chapter “Induction” of the *Russian Manuscript* (1948, pp.28ff) and it is maintained throughout Lorenz’s writings (1958, p.251; 1959, p.283; 1963a, p.2). The first phase of inductive science is the idiographic stage. It consist of gathering data,

observations, and descriptions in a loose manner. The aim is to obtain an inductive basis that is as large as possible. The systematic stage is the next step. It proceeds by analyzing the data, comparing the various bits of evidence, finding interrelations among the single items, and categorizing them. In the first two stages, the inductive basis gets assembled in a hypothesis-free and theory-independent fashion (1950, p.129). The final phase is the nomothetic stage, which consist in formulating laws and general principles supported by the evidence. It is characterized by a process of abstraction (1948, p.30). Whereas the idiographic and the systematic stage cannot by kept clearly apart, the nomothetic phase can be more sharply separated from the foregoing stages (1948, p.29). Observation, description, comparison, and systematization are "indispensable steps that must have been gone through before the first attempt at the abstraction of natural laws, of nomothesis in Windelband's classical term, is undertaken" (1958, p.262). The reliability of the results obtained by induction is proportional to the broadness and the scope of the inductive basis (1948, p.31; 1950, p.194; 1959, pp.302, 315). Lorenz claims that early ethology developed just in this three stage fashion (1950, p.131; 1948). However, one needs to keep in mind that such statements are due to the fact that Lorenz thought that any real science has to emerge in this fashion. Burkhardt (1981) makes clear that some of Lorenz's historical statement should not be viewed as an attempt to reconstruct the history of ethology, but they stem from Lorenz's attempt to create ethology as a discipline, including a defense of ethology as a discipline that developed the way a real science ought to develop on Lorenz's view.[3]

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[3] Some of Lorenz's views on epistemology and philosophy of science – in particular as formulated in the *Russian Manuscript* – might appear naive, given the fact that there were much more sophisticated approaches to these topics. At the same time Lorenz developed his philosophical views in the pre-war period in Vienna, philosophers and scientists that were members of the Vienna circle or associated with it

A peculiar feature of Lorenz's epistemology is *Gestalt perception*, a cognitive process that is of paramount importance for the post-war defense of his approach. The notion of Gestalt perception is present in Lorenz's early ethological writings, but as an epistemological idea explicitly formulated for the first time in early philosophical works such as the *Russian Manuscript* and defended throughout Lorenz's philosophical, methodological, and biological writings (1942, 1948, 1950, 1958, 1959, 1963a, 1963b, 1977, 1981). The most elaborated account is given in the article *Gestalt perception as a source of scientific knowledge* (1959). In Germany and Austria Gestalt psychology was an influential school before the second world war (Ash 1998), and so Lorenz could make use of ideas available from the German-speaking psychological tradition. In fact, as a student Lorenz took classes and interacted with the Vienna psychologist Karl Bühler and his assistant Egon Brunswik, both of whom studied the psychology of perception. On Lorenz account, the distinctive feature of Gestalt perception is that it is a *ratiomorphic* process. Lorenz borrows this term in the post-war period from Brunswik (1952, 1955), but the idea was present in Brunswik's post-war work even though he did not use this particular term for it (see Brunswik 1934). Before using Brunswik's term Lorenz makes reference to Hermann von Helmholtz's concept of unconscious inference (1948, p.57; see Helmholtz 1925, vol. 3.) Talking about ratiomorphic mechanisms means that we are dealing with a non-rational, subconscious process, that nonetheless exhibits strong analogies to rational thought—in particular *induction*—with respect to how it operates (1948, p.55; 1959, pp.296, 302; 1981, p.41). For Lorenz Gestalt

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developed detailed accounts as to how understand scientific rationality and the justification of empirical knowledge. Lorenz did not pay attention to these developments probably because he and the members of the Vienna circle belonged to different philosophical, scientific, and social-political communities. I will later on point to some useful features of Lorenz's epistemological framework.

perception as a special kind of perception is obviously a neurophysiological mechanism. Lorenz uses form constancy as an example to illustrate a simple type of Gestalt perception (1959, pp.302f). When an observer sees an object from different sides (e.g., because the object moves and turns), the object is recognized as the same entity with the same form even though the image on the retina changes continuously. The human perceptual apparatus is able to extract from the different sensory data the relevant information that makes one see the same object at different instances. This process obviously works unconsciously. The individual is not aware of the steps taken by the nervous system to process information; only the result (e.g., the recognition of the object) is mediated to consciousness (1959, p.296; 1981, p.43). Nonetheless, this subconscious mechanism exhibits analogies to reasoning (1959, p.302; 1981, pp.42f). The process starts by using incoming data as 'evidential basis', it draws 'inferences' from this data and comes to a 'conclusion'. As this procedure must make certain implicit 'assumptions' as to how objects in the external world behave, this kind of perception can be fooled by experimentally creating a situation that is unlikely to occur under normal conditions and violates these 'assumptions' (1959, pp.297ff; 1981, p.41). In the preceding description of a ratiomorphic process the use of terms refering to rational thought in scare quotes indicates the analogy with rational cognitive processes. The ratiomorphic cognitive apparatus – which is evolved – has built-in 'assumptions' and 'hypotheses' about how the external world looks like. As Lorenz assumes that Gestalt perception is important for *hypothesis-free* observation, these built-in implicit 'hypotheses' need to be kept apart from the hypothesis that a scientists consciously entertains. Both in rational and ratiomorphic mechanisms the reliability of the inference is proportional to the broadness of the inductive basis (1959, p.315). Lorenz repeatedly mentions that Gestalt perception is analogous to rational thought in that it makes *inferences* and *conclusions*, albeit in an unconscious manner (1948, pp.57, 59; 1958,

p.253; 1959, p.283). His discussion of constancy mechanisms shows that the kind of inference that is made is similar to *rational abstraction*, which is an important part of induction (see also 1958, p.252). Form constancy is a mechanism of pattern recognition; from various bits of incoming stimuli the features enabling the recognition of objects are mediated. At a few places Lorenz explicitly states that Gestalt perception is analogous to rational abstraction (1951, p.173; 1958, p.252; 1959, pp.283, 304).

Form constancy is a simple example of Gestalt perception, but there are more complicated types of it. Gestalt perception is able to extract similarities and regularities out of data sets consisting of miscellaneous items. For instance, it is able to recognize objects and individuals given by perceptual information. Moreover, it can detect natural kinds and categories that exists in nature. By means of Gestalt perception different individuals are perceived to belong to the same species, genus, or family (1959, pp.306f). Gestalt perception is an important tool in systematics. This is of fundamental importance for Lorenz because he views biological features as taxonomic characters that can be homologized. Ethology as a comparative-phylogenetic approach to behavior can makes fruitful use of Gestalt perception. In Gestalt perception "many elements are always combined into one entity" (1948, p.58). This is an issue where the idea of the quality of a Gestalt is stressed by Lorenz. On his account a Gestalt quality is a type, something beyond concrete individuals (1959, pp.306ff). Finally, this cognitive process can even be used to discover empirical principles and law-like relations out of a large amount of information containing otherwise irrelevant data (1948, p.64; 1959, pp.282f, 310). This makes Gestalt perception a powerful cognitive mechanism. In short, Gestalt perception detects natural units and unexpected principles and lawful regularities. For this reason, in the *Russian Manuscript* this latter complex function of Gestalt perception is called *intuition* (1948, pp.30, 54).

Gestalt perception is claimed to be important for all three stages of empirical research, as it seems because Gestalt perception takes in the data from the first two stages (operating independent of hypotheses) and creates the abstractions and general principles that are characteristic for the third, the nomothetic stage (1948, p.30; 1963a, p.7). In addition, Lorenz says that not only research based on rational induction proceeds according to the three stage model, but that Gestalt perception itself implicitly proceeds in this fashion (1959, p.283).

Comparing Lorenz's views on Gestalt perception with the theory of the early Egon Brunswik, by whom Lorenz was probably influenced, reveals some commonalities.[4] Brunswik emphasizes the fact that perception is analogous to reasoning (1934, pp.2, 50, 127), but in contrast to reasoning it is immediate, i.e., only the result of the perceptive process is mediated to consciousness, but intermediate steps are not (p.1). Like Lorenz, Brunswik assumes that perception is directed at gaining knowledge about the objective properties of objects (1934, p.V; Brunswik 1937), which was an important issue for Karl Bühler's general approach, too. Even though perception can be fooled under experimental conditions, Brunswik states that under normal conditions perception is very reliable. In fact, he compares perception with instinct/conditioning. Instincts and conditioned behavior operate reliably in standard cases, but in contrast to insight they are inflexible so that they cannot adapt do new situations. Perception has a performance that is similar to instincts or conditioned behavior (1934, pp.114ff). While Lorenz might agree with this analogy he does not make use it, but contrasts ratiomorphic processes –

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[4] Both were of the same age and working on their Habilitation thesis at the University of Vienna. While Brunswik was Karl Bühler's assistant, Lorenz took his psychology classes with Bühler. Brunswik gave Lorenz comments on the *Companion* (Lorenz 1935) as regards issues dealing with the psychology of

which are usually reliable but cannot adapt to new situations – just with rational processes. Brunswik assumes that there is continuum between measurement and perception, so that measurement is just a limiting case of perception (1934, p.9). Lorenz, in contrast, seems to make a sharper distinction between rational and ratiomorphic processes.

The cognitive capacities that are important for Lorenz are induction and Gestalt perception. In this sense, Lorenz's epistemology includes nothing but these two features. This is clear from the *Russian Manuscript* (1948) and from *Gestalt perception…* (1959). Lorenz's more general *evolutionary epistemology* (see for instance Lorenz 1977) is well-known, so one needs to give some remarks about the relationship between evolution and the already discussed cognitive processes. In fact, Lorenz formulated some of his ideas about evolutionary epistemology before giving his first detailed account of induction and Gestalt perception in the *Russian Manuscript* (see Lorenz 1941, 1943). For Lorenz it is clear that our perceptive apparatus, including Gestalt perception, and its capacities to generate reliable knowledge is the product of evolution (1958, pp.252f; 1959, p.289; 1963a, p.6). However, Lorenz does not give an elaborated account of the evolution of the human ratiomorphic apparatus. Gestalt perception is discussed section 7.2 of *Behind the Mirror* (1977), but the discussion is very short (6 pages) and does not go much beyond Lorenz's usual remarks. Gestalt perception is not only evolved, but there are learned aspects of it (1951, pp.166ff; 1977, p.216). Gestalt perception needs training and it is differently developed in different individuals (1959, p.313; 1973, p.8). So Lorenz could have given an account of how the innate and learned aspects of Gestalt perception integrate. In addition, not only

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perception (Lorenz, letter to Stresemann, November 21, 1934). See Hofer (2001) for a discussion of the personal and intellectual relationship between Bühler, Brunswik, and Lorenz.

ratiomorphic, but also rational cognitive processes are evolved and part of Lorenz's evolutionary epistemology. But Lorenz does not give a detailed account of how rational and ratiomorphic processes integrate and how the distinction between these different types of cognitive processes came about in the course of evolution. Independent of evolutionary issues, in the post-war period Lorenz stresses the impotence of Gestalt perception as a cognitive mechanism. However, he does not offer a development and elaboration of his ideas and does not refer to the psychological literature (in particular new results) on perception. Rather, Lorenz repeats what are in his view the basic features and faculties of Gestalt perception and sometimes mentions a few classical ideas of Gestalt psychologists.

Mapping Gestalt perception/induction onto observation/experiment

The first issue to be discussed is the question of in what manner the epistemological apparatus (ratiomorphic Gestalt perception and rational induction) relates to the ethological methodology (observation and experiment) as Lorenz viewed it. Some of Lorenz's writings (especially the *Russian Manuscript*) suggest an epistemic asymmetry between Gestalt perception and induction and attribute different roles in scientific research to these mechanisms, so that a straightforward Gestalt perception–observation and induction–experiment correspondence seems plausible.

The different epistemic roles of induction and Gestalt perception are due to the fact that the former is a rational process, but the latter is not. Induction is a tool for scientific analysis and for the confirmation of scientific claims. It is a cognitive process that aims at *objective* knowledge. The Gestalt, on the other hand, is a "purely subjective

phenomenon" (1948, p.140).[5] The result of this perceptive cognitive process is mediated as a whole to subjective experience. Without its parts being open to analysis, the Gestalt is seen and the received entity accepted (1948, p.58). This epistemic difference is in particular shown by the fact that a result obtained by Gestalt perception is refuted by inductive evidence contradicting that result (1948, p.68). The strength of induction is its accountability, while Gestalt perception is characterized by its incorrigibility and unaccountability (1948, p.64). For this reason, Gestalt perception and induction play a different role in scientific research. Whereas induction is shortsighted and therefore not a good tool for scientific discovery (1948, p.65), Gestalt perception is able to see unexpected regularities and unforeseen lawfulness (1948, p.63; 1959, p.282; 1981, p.44). It is a good "hunch generator" (1963a, p.7). As only Gestalt perception is really able to fulfill this function, its role in scientific research is to lead the way of discovery (1948, p.56, 64; 1963a, p.8). Gestalt perception is only a means of discovery. A detected principle has to be substantiated by induction, it is the job of rational processes to confirm scientific claims.

> Therefore, only induction can increase the reliability of a result and only induction can validate a result that has been obtained exclusively through intuition! (1948, p.65)

This yields the following account. *The (subjective) discovery of scientific principles is achieved by Gestalt perception, while the (objective) confirmation and justification is obtained through induction.* So far the identification of this epistemic relationship between Gestalt perception and induction in Lorenz's work has mainly been based on

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[5] It is not quite clear what Lorenz means by saying that the Gestalt is just subjective. Gestalt psychologists often assumed that Gestalt perception aims at objective features of the world (see Ash 1998) and Lorenz does not seem to disagree with this in general.

the Russian Manuscript. Whereas these two different roles are very explicit in this piece of work, some passages of the later article *Gestalt perception*… give the same picture (1959, p.316).

On the one hand, Lorenz three stage model of science sounds like a sort of naïve Baconianism, according to which one first needs to collect in an unbiased and theory-independent manner as much data as possible and only then one can generalize laws and theories from it. On the other hand, the idea of Gestalt perception proposing hypothesis to be rationally tested might incline one to assume that Lorenz has a hypothetico-deductive account of science. Neither is really the case. Lorenz definitely is not a Popperian falsificationist. On his account, hypothesis cannot only be disconfirmed, but also confirmed by evidence. Lorenz accepts induction, in fact, he states that one can "use the breadth of the inductive basis to assess with genuine mathematical accuracy a probability value for the correctness of the result. Where that breadth is sufficient, the probability is so close to certainty that we can confidently equate the two." (1948, p.64) This makes him sound somewhat like a proponent of the modern Bayesian approach to theory confirmation by evidence. However, Bayesianism is just about confirmation and does not tell us how to come up with theories to be verified. The same applies for a naïve Baconian approach, which cannot make sure that anything theoretically useful emerges from unbiased and unfocussed data gathering. The discovery of theories was somewhat neglected by traditional philosophy of science, but Lorenz addresses this issue by pointing to Gestalt perception, which is supposed to deliver unexpected principles and hypotheses. This is maybe the most fruitful aspect of Lorenz's epistemological perspective (besides the fact that he makes use of an evolutionary framework). Lorenz proposes processes that generate theories as well as confirm them. Rational and ratiomorphic processes are considered psychologically founded

mechanisms, which in combination address the two most important aspects about scientific rationality – discovery and justification of theories.

As discussed in the preceding section, experiment are methodologically and logically posterior to observation. Useful experiments can only be conducted *after* a good deal of observation has been undertaken. In fact, observation gives a *meaningful* account of the structure and function of the observed system and experiments can only then *verify* details about the components of the behavior of a species and analyze their causal interaction. In an analogous manner, Gestalt perception has to be employed first to detect interesting principles that are to be confirmed by induction. This suggests that the two step procedure Gestalt perception–induction can be mapped onto the observation–experiment procedure in a manner such that both correspond to each other. This interpretation means that observation in the ethological approach is largely driven by the cognitive process of Gestalt perception, while mainly the cognitive function of induction is used in the experimental phase. The fact that the experiments fulfill the analytic demands of inductive science became clear in my exposition of this method. As will be discussed in more detail in the next section, Gestalt perception actually corresponds in several respects to observation. Indeed, a main function of Lorenz's account of the importance of Gestalt perception is to defend his observational approach.

However, both in the *Russian Manuscript* and in *Gestalt perception…* there are passages that do not fit the simple interpretation given so far. The relation between Gestalt perception and induction is more complex. First, according to the references given above Gestalt perception and induction have an epistemically different status insofar as only the latter provides objective knowledge and in the case of conflict the result obtained by a rational process is to be preferred. Nonetheless, Gestalt perception and induction are not completely different with respect to their objectivity. In particular when defending the qualitative approach of ethology against views that consider only

quantitative measurements as objective, Lorenz's points out that all cognitive processes are in a sense subjective (1959, p.320). In addition, perception tells us about the properties of objects in the external reality (1959, p.301). In fact, it is the only source of knowledge about the reality surrounding us (1981, p.41). Under standard condition—given that the 'evidential basis' is right—results obtained by Gestalt perception are true (1948, p.62). Thus Gestalt perception is reliable, despite the fact that its results need to be rationally verified by induction.

Second, in *Gestalt perception…* Lorenz explicitly states that the ratiomorphic mechanism of Gestalt perception and the rational process of induction cannot be sharply separated and that their functions (discovery/verification) intergrade.

> It is quite definitely a simplification of this kind to represent the interaction between the various cognitive processes, as I have done above, as if there were always a distinct separation between the prior discovery of an inherent principle through ratiomorphic processes and its subsequent verification through rational processes. (1959, p.320)

Quantification, which belongs to inductive analysis, is claimed to be dependent on Gestalt perception (1958, p.256; 1959, p.320). In fact, Gestalt perception is a precondition for rational reasoning at all (1948, p.30). On the other hand, "rational, quantifying, statistical and surveying pre-treatment is necessary to permit Gestalt-formation" (1959, p.320). There is a necessary cooperation of Gestalt perception and analysis/experiment (1981, p.54). Rational and ratiomorphic processes are strongly entangled and that the different steps of inductive science need Gestalt perception (1948, pp.28ff). In the *Russian Manuscript* there are passages that sometimes suggest a strict separation and at other places an interdependency of both types of processes. *Gestalt perception…* proceeds by first suggesting a clear distinction between rational

and ratiomorphic functions, which is then explicitly relativized (compare pp.304–319 with 319–322).

Thus Lorenz states that the relation between rational and ratiomorphic processes is complex and that both processes need to be highly entangled in the effective generation of knowledge. Nevertheless, he does not explain sufficiently how he views the interplay between these two processes in detail. (In *Gestalt perception*… he basically devotes two pages to this issues; see 1959, pp.320f). The difficulty is that Lorenz tries to combine rational and ratiomorphic processes (which are of a different nature on his account) without a clear account of how they combine in practice. Despite these complexities, on my interpretation Lorenz still sees a parallel between the ethological methodology (observation and experiment) and the philosophical epistemology (Gestalt perception and induction). Not only are Gestalt perception and induction strongly entangled, observation and experiment also intergrade. Both are needed for ethology and in practice there is an interplay between them. Observation usually precedes experiment and suggests relevant experimental questions. Correspondingly, Gestalt perception leads the way of scientific investigation by proposing hypotheses that need to be confirmed by means of induction. Lorenz makes clear that Gestalt perception is crucial for observation, whereas experiments fulfill the role of scientific induction.

Lorenz's justificatory efforts

A good deal of Lorenz's writings are devoted to the defense of his views on biology and scientific knowledge. The next question with respect to the relationship of observation, experiment, Gestalt perception, and induction is how these items justify each other. For instance, does Lorenz's position on how observations are to be made imply the need for Gestalt perception as a cognitive mechanism used in ethological research, or rather are philosophical remarks on Gestalt perception intended to justify the specific ethological

observational approach? In Lorenz's writings two groups of ideas can be identified that function as justificatory primitive principles. This means that they are ideas which play an important role in justifying other items of the framework, but which are not themselves justified by other ideas. A group of primitive principles is largely taken for granted or justified internally by claims from the same group of ideas. (At the end of the paper there is a diagram giving a rough illustration of the justificatory relationships existing between the different items of Lorenz's theoretical account.)

The first group of ideas are Lorenz's views on *induction*, which have already been discussed. These are his general ideas on science and rational reasoning, including rational induction as a cognitive mechanism and in particular Lorenz's views of how empirical science works, i.e., the distinction between the idiographic, systematic, and nomothetic stages of science. (There are obviously other views of science that do not assume a theory-free idiographic stage.) The second complex of primitive principles—which despite its paramount importance for Lorenz has not yet been discussed—are related to Lorenz's understanding of "Ganzheit", often translated as *entirety* or (systemic) entity (see 1948, pp.137ff; 1950, pp.120f; 1958, pp.248f; 1959, pp.281f; 1981, pp.36ff). The main ideas in this complex are claimed to stem from the recognition that biology deals with complex wholes. A systemic entity or an entirety is a system that has subsystems that mutually interact which each other. Every part depends on the other parts. For Lorenz this implies that it is indispensable to study the complex system as a whole. In the case of biological entities this means that one has to take both the structure and the functions of the entirety and its subcomponents into consideration. Research on

organisms includes the study of their overall behavior and their environment. Lorenz calls this approach 'analysis on a broad front'.[6]

Entirety → Gestalt perception. Lorenz's uses this second complex—the ideas about entirety—to justify the need for Gestalt perception as a cognitive tool. Gestalt perception is ideal for studying complex systems and the nervous system/behavior are especially complex (1959, p.283; 1981, p.46). One of the main steps in dealing with an organic entirety is to get an overview of its parts. The best way to do so is to make use of Gestalt perception (1981, p.47). The entirety approach makes it necessary to study the function of a system in its context as well, and Gestalt perception is a good tool for this. In addition, Gestalt perception is a cognitive capacity that is ideal for a comparative approach. As already outlined, it is able to detect generic kinds and natural units (1948, pp.60f; 1959, pp.306ff; 1981, pp.45f). In general, Gestalt psychology was a very useful approach for Lorenz's perspective. It was a tradition that – for the most part – aimed at a rigorous and scientific causal-explanatory framework, in accordance with Lorenz emphasis on causal-analytical thinking in science as opposed to psychological-teleological speculations (1942). But Gestalt psychology was not just reductionistic and instead provided an objective account of holistic features inherent in the perception of the Gestalt as a quality. The perception of some objects is different from the collection of individual perceptions; the Gestalt is a unity. Thus Gestalt psychology allowed Lorenz to maintain his rigorous-scientific attitude and emphasize the fact that biological objects also need to be understood and studied as complex wholes (see 1948, 1951).

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[6] In a letter from 1936 Lorenz complains that so many physiological chemists are incapable of viewing animals as organic entireties ("Ich kenne aber so viele Physiologische Chemiker, die alle ganz unfähig sind, im Tier eine organische Ganzheit zu sehen.", Lorenz, letter to Stresemann, October 4, 1936).

Entirety → Observation. The ideas about entirety also justify observation as Lorenz understands this method. The recognition of an individual as an organismic entity that has a functional context and a history implies the need for studying healthy animals in their natural environment (1948, pp.213, 221, 223; 1981, p.40). Another point constitutive of Lorenz's observational approach is the fact that the researcher has to be familiar with all details of the behavioral patterns of an organism. Again, the systemic entity approach makes this obvious (1948, p.215; 1981, p.38). In other words, recognizing the demands of an analysis on a broad front in the case of organisms and their behavior means that observations have to be performed (at least in some aspects) in the manner of classical ethology.

Induction → Gestalt perception. The preceding discussion has already pointed to the fact that Lorenz's views on induction justify the use of Gestalt perception. Induction has the function of confirming scientific claims. But as it is shortsighted, Gestalt perception as a mechanism that finds unforeseen lawfulness is needed to carry out successful inductive science. Gestalt perception leads induction the way (1948, pp.56, 64). Lorenz's account of how the rational and ratiomorphic processes operate makes clear that induction can hardly do without Gestalt perception.

Induction → Observation. The claims about induction justify directly the approach to observation. Lorenz emphasizes that the nomothetic stage can only be reached after the hypothesis-free idiographic phase (1948, p.216; 1950, p.129). The crucial function of the idiographic stage is to provide an inductive basis that is as broad as possible including all relevant features (1948, p.213; 1950, p.131). New explanatory principles can only be abstracted from a sufficiently broad base (1958, p.250). Furthermore, the premature formation of a hypothesis can distort the inductive basis. When a researcher has a specific theory in mind it is likely that the data of the idiographic stage are biasedly evaluated so that the scientist sees his or her own hypothesis supported (1948,

pp.31, 71). This gives a justification for the idea that observation has to provide a large body of data, that it includes all features of the organism and its environment, and in particular that it has to be conducted in hypothesis-free way (1959, p.281).

Induction → Experiment. Induction also implies the need for experiments. An important part of scientific induction is to provide an account of the details of the object under study, to give a causal analysis, as well as to confirm hypotheses. As has already been discussed the main function of ethological experiments is to establish claims about the specific components of behavior and to examine their (causal) relationship.

Experiment → Gestalt perception. I argued above that the inductive approach justifies the use of Gestalt perception because successful induction presupposes Gestalt perception. The analogous relation that experiment is subordinated to observation might suggest that the conduct of experiments justifies the need for observations. Some of Lorenz's remarks to the effect that experiments do not make sense without observation seem to amount to a direct justification of observation by experiment. However, it hardly amounts to a justification of the specific characteristics of Lorenz's observational approach. I prefer the interpretation that the need for experiments mainly justifies the use of Gestalt perception, which in turn calls for observation (as we will se below). In other words, the necessity of experiments justifies the specific aspects of the observational approach only indirectly, namely insofar as Gestalt perception is the tool for conducting observations. The use of Gestalt perception follows from the need of doing experiments because experiments are useful only if the substructures and functions of a system are known to a certain degree (1981, pp.53, 65). Gestalt perception is the best cognitive mechanism to tackle this question (1981, p.47). It can break down a complex system into meaningful parts on which an experiment can focus.

Gestalt perception → Observation. The following quotations illustrate how self-evident it is for Konrad Lorenz that observation and Gestalt perception go together:

> … in the observation of complex animal behaviour patterns, one can literally see the same process thousands of times without noticing the inherent principle until – quite abruptly – on the following occasion the Gestalt is distinguished from the background of accidental features … (1959, p.306)

> At the other extreme are the died-in-the-wool behaviourists who deny that Gestalt perception – and thus observation of organisms in their natural environment – has any value or even scientific character. (1959, p.319)

In fact, the use of Gestalt perception actually justifies the ethological approach to observation. First, the effectiveness of Gestalt perception in finding important regularities and principles is proportional to the amount of data of which Gestalt perception can make use (1948, p.63; 1959, p.305; 1981, p.46). An advantage of this ratiomorphic process is its retentive memory and the large amount of data it can take into account (1959, pp.309, 314f; 1981, p.44). Gestalt formation can suddenly occur after a long period of data collection (1959, p.306; 1981, p.45). This lends support to the habit of observing animals over a long span of time (1959, p.315; 1981, p.45). In addition, Gestalt perception deals with the whole (1948, p.139; 1959, p.306; 1981, p.46). It is able to get an overview of a multitude of aspects of a system and can extract a lawful relationship out of it (1948, p.64). For this reason, effective use of Gestalt perception can be made if all behavioral patterns of organisms are observed in their natural context. As a perceptual mechanism Gestalt perception has qualitative information as input. This justifies the qualitative approach to observation (1948, p.64). Finally, Gestalt perception does not need a hypothesis (1948, p.63). It works best when the researcher is relaxed and contemplates his object of study while unconsciously collecting data (1959, p.316; 1981, pp.45f). In fact, rational reasoning about details of the object negatively influenced the operation of Gestalt perception (1959, pp.314, 317). In this case, the features of Gestalt perception show that observation has to be

conducted without rational influences based on theories or hypothesis. To sum up, Lorenz tries to make clear that the distinctive aspects of the ethological observational approach is chosen in accordance with a cognitive enterprise that relies on Gestalt perception. Observations yield effectively knowledge because this powerful ratiomorphic mechanism is employed. The idea that Gestalt perception is predominantly used for ethological observations (as well as for systematics) can be found throughout Lorenz's writings (1948, pp.61f, 213ff; 1954, pp.197ff; 1958, pp.251ff, 278; 1959, pp.306ff, 311, 315; 1963a, pp.8f; 1981, pp.40ff).

Conclusion

I have argued that on Lorenz's view the observation–experiment relation is largely analogous to the Gestalt perception–induction relation. Experiment needs foregoing observation so that it can be conducted meaningfully. Similarly, induction needs Gestalt perception that leads induction the way. Observation and Gestalt perception discover new principles, whereas experiment and induction have to give an analytic confirmation. Gestalt perception is the crucial cognitive tool for ethological observation, while rational induction is important for experimental analysis and confirmation. Lorenz makes clear that the relation between Gestalt perception and induction is very complex. However, he does not give a concrete account of the interplay between these two cognitive mechanisms and their relation to the biological approach. For this reason, while the Gestalt perception–induction relation can be largely mapped onto the observation–experiment relation, it is not clear in detail what the actual role of rational processes in observation is and to which extent Gestalt perception is also important for ethological experiments.

The result of my reconstruction of Lorenz' justificatory relationships between the ideas of entirety, Gestalt perception, induction, observation and experiment are

illustrated in the diagram below.[7] Lorenz's work exhibits a justificatory system in which all of his relevant ideas are logically related. What becomes clear is the fact that the ideas about entirety/systemic entity (Ganzheit) and the claims about induction and inductive science function as primitive principles. They are not justified by other items, but both are used to justify the need for Gestalt perception as a cognitive tool and the necessity of observations in an ethological manner. Furthermore, three different items lend support to the use of Gestalt perception as a cognitive tool: the views about entirety, induction, and experiments. It is not very surprising that Gestalt perception is justified from different perspectives. While this cognitive mechanism is very important for Lorenz's epistemology, it is hardly endorsed by other post-war biologists. On Lorenz's account Gestalt perception has very strong capacities, e.g., finding scientific hypotheses. Lorenz needs to justify the use and need of this non-rational (albeit ratiomorphic) process that he uses to stress as a tool for scientific inquiry.

Finally, my analysis shows that the primary aim of Lorenz's justificatory efforts is the ethological approach to observation. Even though Lorenz associates Gestalt perception with observation, it is not the case that the specific features about the observational approach are used to justify the use of Gestalt perception. Rather, the ideas about Gestalt perception justify the way observations were carried out by the founders of ethology. Indeed, Lorenz's remarks about Gestalt perception are intended to show that there is an important and powerful cognitive mechanism that is able to get knowledge out of what has been observed. The discussion shows that there exist several

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[7] The use of three kinds of justificatory arrows in the diagram are a rough classification. A more detailed and qualified account can be found in the above discussion. Note for instance that an arrow justifying the observational approach refers to some subset of the features peculiar to the observational approach.

items that are used to justify the observational approach, but the tenets about observation are not employed to justify any of the other items. Induction and Gestalt perception justify the hypothesis-independency of observation, and the qualitativeness of the approach is substantiated by Gestalt perception. The ideas about entirety justify the fact that organisms are to be studied in their natural environment, while the view that all features have to be observed is supported by all three items (induction, Gestalt perception, and entirety).

From a historical point of view it is highly plausible that the observational method is the main target of Konrad Lorenz's justificatory efforts. For one of the main intentions of Lorenz's post-war defense of his works was to show that non-quantitative, largely theory-independent observations are in fact scientific (this is explicit in 1958, pp.246, 256; 1959, p.281; 1963a, p.1; 1973, p.1; 1981, pp.40, 68ff). Lorenz felt that his ideas on observation were not taken seriously by many animal psychologists and that he had a difficult task of making clear that qualitative observations are a necessary step of research. Indeed, in his view the biological community as whole focused alone on measurement and statistical evaluation of data as the ideal of rigorous science.

Originally Lorenz discussed the importance of Gestalt perception without suggesting that his methodological approach might be in need of defense (1948, 1951). In the 50s and 60s, however, he criticized especially behaviorist and American animal psychology in the context of defending his views. Lorenz states, for instance, that the paper *Gestalt perception…* is targeted at American animal psychologists (1958, p.256). However, it is not just the case that Lorenz had to defend his methodological views against the influential tradition of behaviorism and other theoretical approaches that had a radically different approach. Some of the remarks in the writings of the 60s and 70s were directed at biologists in general, because Lorenz felt that his observational approach was considered by many biologists (including German-speaking biologists) as not being

really rigorous science. For instance, Lorenz complained about recommendations given by reviewers about a grant application to the Deutsche Forschungsgemeinschaft (German Research Council).

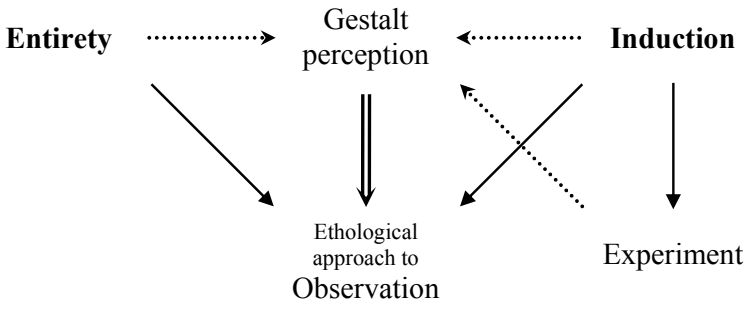
> The grant was approved, but not without the advisory board adding a little benign admonition: care should be taken, lest the investigation lapse into merely being descriptive, "daß die Untersuchung nicht ins Deskriptive *abgleitet*" (Italics mine). (1973, p.5)

In addition, Lorenz reacted furiously to the attempt to remove Otto Koenig as the director of the Austrian Institut für Vergleichende Verhaltensforschung (Institute for Comparative Ethology). Some of the board members stated that the research at the institute was in bad shape. The justification is revealing. On their account, comparative ethology is a amateur program instead of rigorous biology – just making photographs does not presuppose a university degree and the crucial feature of making measurements is not seriously pursued.

> In einer Sitzung des Kuratoriums für das Institut für Vergleichende Verhaltensforschung haben Marinelli und der Physiologe Prof. Kment den Versuch unternommen, Otto Koenig hinauszuschmeißen … Marinelli: Tierhaltung sei nur ein Hobby, die Herstellung von Filmen verlange kein Hochschulniveau (das Wort Hochschulniveau kommt in dem sechs Seiten langen Protokoll der Sitzung 7 x vor.) Die vergleichende Verhaltensforschung sei ein Dilletantenprogramm. Kment (S. 2 unten) gibt eine völlig falsche Vorstellung von unserem Institut und seiner Arbeitsweise. Kment meint, "entscheidend sei die Messung, man müsse messend vorgehen" und der alte Blödsinn usw. (Lorenz, letter to Stresemann, February 17, 1971; the letter to Stresemann includes a copy of the minutes of the board meeting, showing that these accusations were actually raised)

Thus the main target of Lorenz's justificatory efforts is his observational approach, and he felt the need to defend his methodological views against general trends and conceptions in biology and behavioral science. Despite the fact that Lorenz recognized the importance of experiments and quantitative techniques he viewed the scientific contempt for qualitative observation as part of a generally increasing disregard for nature. While we may wonder whether Gestalt perception is really as important for ethological observations as Lorenz maintained, we are still not quite clear about the epistemic significance and relation of observation and experiment (Allen, forthcoming). Lorenz's achievement is to make clear that we need to have an account of the cognitive mechanisms that are at work in observation to generate scientific knowledge.

Overview of Lorenz's justificatory system



$A \longrightarrow B$ the necessity of *B* is conceptually contained in *A* accepting *A* means also doing *B*

$A \cdots\cdots\rightarrow B$ *B* fulfills ideally the demands of *A*

$A \Longrightarrow B$ the cognitive mechanism *A* is a powerful tool for obtaining knowledge from the biological method *B*

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