

GESTALT PSYCHOLOGY: ITS PARADIGM-SHAPING INFLUENCE ON ANIMAL PSYCHOLOGY

Regina A. Kressley

The impact of the work of various German Gestalt psychologists or scholars influenced by Gestalt psychology conducting experimental work with animals into the first half of the 20th century has been duly acknowledged, including for example Wolfgang KÖHLER, Mathilde HERTZ, and Paul von SCHILLER. However, their contributions as outlined in biographical sketches are often portrayed in a disjointed manner, thereby belying the existence of a coherent field of comparative psychology in Germany prior to the institutionalization of a biologically-based field of comparative animal research, or ethology, which itself was significantly shaped and dominated by Gestalt psychology (cf. GARCIA 2003). Even in more recent and otherwise enlightening accounts of ethology or its founder, Konrad LORENZ (BURKHARDT JR. 2005), the influence of Gestalt psychology on LORENZ during the formative years of ethology - even in comparison to LORENZ's own earlier claims (LORENZ 1959) - remains perceptibly understated.

The current article emphasizes the contributions of Gestalt psychology to a vital and intact research discipline of comparative psychology in pre-World War II Germany prior to the institutionalization of ethology around 1936 with the establishment of a German society for animal psychology [*Gesellschaft für Tierpsychologie*] founded by biologists. The over-arching contributions of Gestalt psychology were most visible with regard to the conceptual orientation regarding the research program for early animal psychology and corresponding experimental methods. Thus, in a departure from other biographical works, the present article will highlight how Gestalt psychology had a paradigm-shaping influence on the field of animal psychology, both in terms of conceptual orientation and methodology. This orientation and methodology had a profound and sweeping influence on contemporary animal psychology, even into modern day research. Although Gestalt psychology never attained the popularity and status in North America that it did in Germany (SOKAL 1984), its international influence can be recognized most easily by noting influential scholars, who incorporated methods or a conceptual orientation borrowed from Gestalt psychology.

The Conceptual Orientation of German Comparative Psychology

Nearly two decades after Wolfgang KÖHLER published the results of his work at the anthropoid station in Tenerife Konrad LORENZ (1937) denounced the work of psychologists conducting animal research in 1936 as lacking a comparative *and* biological perspective (see also BURKHARDT JR. 2005, 183). This claim was incorrect in every conceivable way. Looking at a more recent definition of comparative psychology, it is apparent that Gestalt psychologists most aptly incorporated the comparative viewpoint into their work.

DEWSBURY (1992) defined 'comparative psychology' as one specialization within the field of animal psychology, which especially explores the evolutionary and developmental approaches to instinctive behavior and to the nature and evolution of the animal mind, and which can be differentiated from 'physiological psychology' and 'process-oriented learning studies.' This definition of 'comparative psychology' places emphasis on the study of the animal mind, which in itself necessitates a number of fundamental assumptions about animals and their cognitive capacities. Whose work in animal psychology in the first half of the 20th century embodied this perspective more than Wolfgang KÖHLER's?

Ethology or comparative behavioral research, on the other hand, examines the behavior of living organisms with regard to physiological, ontogenetic, and evolutionary factors (ELLGRING 1984). Ethology relies heavily on biological principles and methods and has been characterized by an emphasis on field research. Ethology utilizes a comparative approach for investigating the common origins and principles governing human and animal behavior (ELLGRING 1984). Thus, although it would appear that there is a certain degree of overlap in the content of ethology and comparative psychology with regard to the study of animal behavior and a certain reliance on comparative methods, it is valid to claim that comparative psychologists were far more interested in studying the nature and evolution of the animal mind than ethologists (i.e., problem-solving behavior among animals). Furthermore, comparative psychologists developed and employed unique methods to investigate these aspects of animal behavior. In the current article this emphasis on the study of the animal mind will serve as a distinctive and - more importantly - *defining* characteristic of the field of research referred to collectively as 'comparative psychology'.

The study of the animal mind implies certain underlying preconceptions about animals and necessitates certain methods to investigate these aspects of animal behavior. Modern researchers have pointed out that while methods, apparatus, and prevailing theoretical viewpoints have a circular relationship, perhaps the most significant characteristic of KÖHLER'S work was his predisposition to believe that animals are capable of insightful learning (WASHBURN, RUMBAUGH & PUTNEY 1994). Despite the case of Clever Hans, the 'gifted' horse that was ultimately reacting to a questioner's subtle movements, which led some to ascribe to the amazing mental capabilities of animals and might have served to confirm others' skeptical views regarding the mental capacities of animals, KÖHLER maintained a moderately optimistic view of animals' problem-solving abilities in contrast to many of his contemporaries (i.e., THORNDIKE).

Detour and Problem-Solving Tasks as a Prototypical Experimental Method

Stipulated by the research question at hand KÖHLER developed detour problems in order to investigate problem-solving abilities in animals (KÖHLER 1917). A simplified hand-drawn sketch of such a typical detour scenario, which KÖHLER implemented with the orangutan Catalina, is provided in Figure 1 (KÖHLER 1917, in JAEGER 1988, 158-159).

This method and its infinite derivatives became a popular measure of learning implemented not only with animals, but with children as well (K. BÜHLER 1919; GOTTSCHALDT 1933). Notable psychologists beginning to incorporate detour problems into their experimental work included Mathilde HERTZ (1891-1975) (JAEGER

1996; KRESSLEY-MBA & JAEGER 2003) and Paul von SCHILLER (1908-1949) (DEWSBURY 1994, 1996).

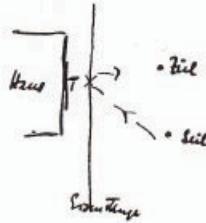


Figure 1: In the sketch above KÖHLER has drawn the relative positions of a suspended goal (Ziel) and jump rope as a potential tool (Seil), which are located roughly 2 m away from Catalina’s cage (Haus) and cage bars (Eisenstange) (KÖHLER, in JAEGER 1988, 158-159). KÖHLER observed not only whether Catalina succeeded in obtaining the out-of-reach goal, but also noted her exact movements in climbing and utilizing the rope. He concluded in this case that Catalina achieved the goal out of trial-and-error and apparently without insight.

Pioneer and Gestalt psychologist Mathilde HERTZ (1933) employed detour problems in her work with numerous animal species and stated explicitly that her methods were inspired by KÖHLER’s work. Schematic examples of the experimental design in her detour and problem-solving experiments with birds are provided in Figures 2 and 3.

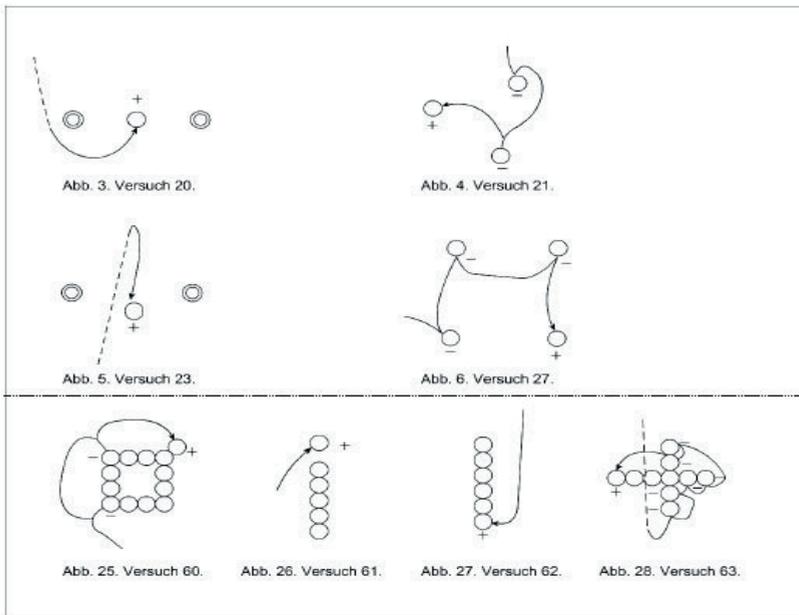


Figure 2: Pictured above are several trials in an experiment testing how jays locate hidden food among several different containers or over-turned plant pots (top figures: HERTZ 1928a, 154), or among many stimuli presented in close proximity (bottom figures: HERTZ 1928a, 161). The schematic drawings not only show the experimental configuration of the stimuli, but they also provide a protocol of observed flight patterns indicated by the dotted and curved lines. Incorrect (-) and correct (+) attempts are designated in the sketches with arrows indicating the direction of movement between stimuli.

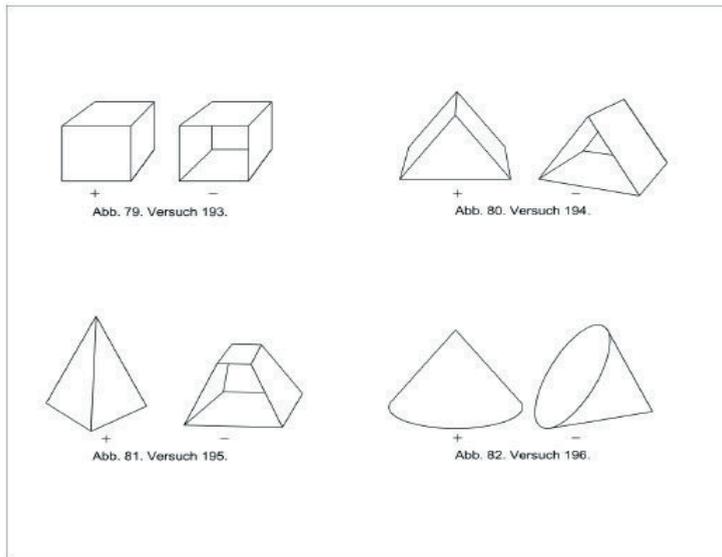


Figure 3: In conjunction with HERTZ's early food-finding experiments with jays she also investigated what role the geometric shapes of occluding objects played in the jays' searching behavior (HERTZ 1928a, 190).

Despite their significance for verifying Gestalt principles of visual perception among animals, HERTZ's experiments were valued in yet another light by Gestalt psychologists and zoologists alike, namely as central examples of problem-solving behavior in animals (DUNCKER 1945).

In her experiments on the visual perception of ravens, HERTZ altered the location of food rewards within identical configurations so that she was able to determine, among other things, how jays depend on memory and sensory input to locate the critical area and retrieve bounty by removing debris hiding the food (HERTZ 1928a, b). Derived from similar experiments, which KÖHLER had employed with anthropoids, HERTZ hid a peanut or hazelnut while the bird was watching and then observed the bird's behavior (see Figure 2 for an example of how HERTZ tracked flight patterns). The methods employed by HERTZ with ravens were later implemented in studies examining the problem-solving capacities of primates, for example, by the Gestalt psychologist and KÖHLER student Johannes von ALLESCH (1892) as well as the Dutch ethologist Johan Abraham BIERENS DE HAAN (1883-1958).

Of the remaining chimpanzees from the anthropoid station on Tenerife that were transported to the Berlin Zoo, Rana gave birth to a male chimpanzee. Von ALLESCH (1921) made detailed observations of the infant's development and the mother's behavior, referring to KÖHLER's observations where appropriate. Later von ALLESCH conducted an extensive series of problem-solving and learning experiments with lemurs as a function of spatial perception inspired in large part by KÖHLER's work and in part modelled on hidden food experiments conducted by Mathilde HERTZ (1926) with ravens (von ALLESCH 1931, 140). Examples of the food-searching problem-solving tasks von ALLESCH implemented with lemurs are provided in Figure 4.

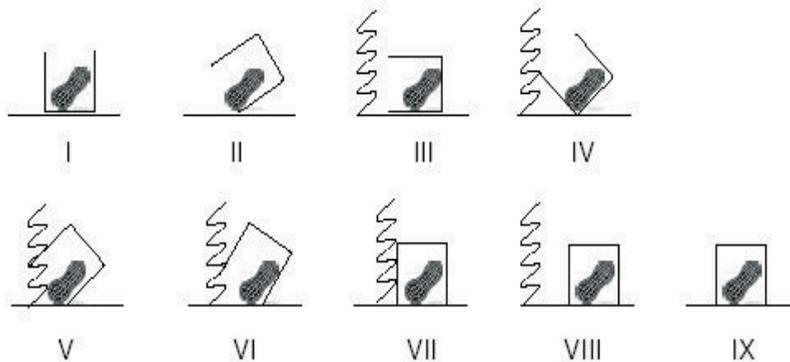


Figure 4: Sketches of the experimental setup for problem-solving tasks with the lemur ‘Maki’ based on experiments by Mathilde HERTZ (von ALLESCH 1931, 141). The variations show different positions of a box relative to Maki’s cage with one open end which contains or conceals food.

(The illustrations above re-created from von ALLESCH’s depictions do not accurately depict relative sizes of the container and food reward.)

The previous examples briefly demonstrate the impact of Gestalt psychology on comparative psychology in Germany. However, by the 1930s this influence was exported by German nationals to the United States. Another German psychologist and forerunner of modern neuroscience, Heinrich KLÜVER (1897-1979), extended KÖHLER’s work with monkeys. He is credited with bringing the Gestalt movement to the continental United States by combining rigorous experimental methods with a phenomenological spirit of investigation (NAHM & PRIBRAM 2005). KLÜVER started his studies at the University of Hamburg before transferring to the University of Berlin in 1922, where he spent three years working with Max WERTHEIMER studying the nature of visual perception in children. Later he continued his studies at Stanford and received his Ph.D. in 1924. KLÜVER’s behavioral work (1933, 1936) with primates centered on visually-guided tool use and relational learning - two topics which were very ‘fashionable’ after KÖHLER’s work in Tenerife received so much attention. KLÜVER’s work is again indicative how the work of early Gestalt psychologists in animal behavior shaped topics of interest.

Paul Harkai SCHILLER was also inspired by KÖHLER’s work and the Gestalt orientation. SCHILLER obtained a fellowship to the University of Berlin where he worked in KÖHLER’s lab between 1928-1932. After immigrating to the United States in 1947, when he was offered a position by YERKES at the Laboratories of Primate Biology in Orange Park, Florida, von SCHILLER conducted the same problem-solving experiments as KÖHLER with chimpanzees, including KÖHLER’s legendary box-stacking experiments. He also implemented detour problems and employed delayed-response situations with a number of other species, including rats, fish, cats, and octopuses. Von SCHILLER’s interpretation of the results represents an interesting fusion of the Gestalt orientation with more biological approaches and even traces of a behavioristic learning theory approach (DEWSBURY 1996). For example, consistent with the Gestalt perspective, von SCHILLER (1957, 5) claimed that actions are

embedded in a continuous interaction between the organism and the environment, hence...”action follows not from external conditions, but from the individual’s relation to them.” On the other hand, for example, with respect to learning, von SCHILLER attributed it to the appetitive aspects of behavior and stressed that achievement of a goal is based to a certain extent on the learning mechanism of shaping, whereby learning is incremental and occurs by trial-and-error. Most unfortunately, von SCHILLER died in a tragic accident two years after immigrating to the United States, and the potential impact of Gestalt psychology in North America by someone who may have become one of the most influential psychologists of his time (DEWSBURY 1996) was in this case never fully realized.

Contributions of Comparative Psychology to Sensory Physiology

Part of the reason that Gestalt psychology had such a paradigmatic influence on animal psychology was because although Gestalt psychologists were very interested in the cognitive capacities of animals, they also made fundamental contributions to sensory physiology based on Gestalt theory. Here again it is evident that there was no justification for LORENZ’s (1937) sweeping claim that psychologists conducting work in animal psychology lacked a biological perspective. Borne out of experiments to test animals’ abilities to find hidden or out-of-reach goals, key comparative psychologists extended their work to examine the visual perception of various animal species in conjunction with such experimental tasks. KÖHLER himself contributed significantly to the heuristic value of his work by being the only scientist who, in his behavioral interpretations, made any attempt to account for the structural demands of the problems (SIMONS 1984). For example, in conjunction with experiments on problem-learning behavior KÖHLER (1918) determined that chickens and chimpanzees were able to distinguish between two stimuli based on relative differences on one dimension. Such results had tremendous heuristic value for further experiments. KÖHLER frequently cited KATZ’s studies about visual discrimination in his own work.

David KATZ, who is closely associated with Gestalt psychology and comparative psychology, began his studies in 1902 in Göttingen and later transferred to the University of Berlin where he completed his doctorate. His dissertation, published in 1907, dealt with the comparative study of how time is experienced. In 1911 KATZ published the book *Aufbau der Farbwelt* published in 1935 in English as *The World of Color* about how the entire visual range structures the perception of colors. KATZ’s (1952/1968) work on the visual perception of colors and the comparative perception of time was derived from his interest in the formation of comparative judgments. In conjunction with this work, KATZ conducted a number of experiments on sensation and perception and memory in chickens with his assistant Geza RÉVÉSZ.

The observation and measurement of animal behavior to stimuli varying more or less in magnitude on one or more dimensions is characteristic of the pioneering work of Mathilde HERTZ, whose seminal work regarding the vision of honeybees was so favorably cited by von FRISCH (1937). HERTZ’s findings on visual perception in honeybees subsequent to her food-finding experiments with ravens probably represent her most significant contribution to animal sensory perception. While Gestalt theory

offered the theoretical foundation for explaining organization in human perception, Max WERTHEIMER viewed HERTZ's work as providing indispensable empirical evidence for Gestalt principles of visual perception among animals. Prior to HERTZ's work von FRISCH had concluded that bees cannot distinguish between basic geometric forms. HERTZ modified von FRISCH's method by eliminating the conditioning of the bees prior to the experiments. HERTZ (1931) covered a table with black and white figures varying in form and degree of contour and observed flight patterns relative to the forms - namely, which sources of food next to which form were frequented by the most bees, most quickly, and most often. If bees could not distinguish between triangles and squares as von FRISCH had observed, then it was because they preferred shapes full of contour, which was supported by independent findings that bees could distinguish flowers. HERTZ was able to determine the visual preferences of bees with regard to patterns (see KRESSLEY-MBA & JAEGER 2003, for examples of stimuli employed by HERTZ).

The Interdisciplinary Appeal of Gestalt Comparative Psychology

The paradigmatic influence of Gestalt psychology on animal psychology with regard to conceptual orientation and methodology was not only apparent among psychologists, but also among biologists and zoologists. This was evident in a number of different ways including the fact that zoologists and psychologists shared a conceptual basis in the early part of the 20th century, which more closely mirrored Gestalt psychological imperatives in animal research; a shared interest in physiological issues by both psychologists and biologists; and a mutual interest in certain animal psychology topics, such as problem-solving behavior.

Until roughly the third decade of the twentieth century there were basically two opposing tendencies in the natural sciences: those who tried to reduce everything to its physical and chemical components and sought mechanical explanations and those who accounted for phenomena, behavior, and life processes as a result of vital forces (WUKETITS 1995). Ethologists fought against both of these tendencies (purely mechanical and vitalistic explanations) and were initially also influenced by philosophical ideas, particularly elements of Gestalt psychology, which also influenced Konrad LORENZ's conceptual orientation (WUKETITS 1995). LORENZ (1959) even addressed the issue in an article entitled "*Gestaltwahrnehmung als Quelle wissenschaftlicher Erkenntnis*" (Gestalt Perception as a Source of Scientific Knowledge). In other words, a biologically-oriented animal psychology in the late 1930s in Germany resembled its German psychological-phenomenological counterpart more closely than schools of animal psychology that reduced animal behavior to sensory-motor reflexive actions, physiological processes, or associative learning. The shift away from phenomenological explanations of behavior and the emphasis on instinctive behavior developed later.

Further evidence of Gestalt psychology's interdisciplinary appeal within the field of animal psychology is the significant overlap in both the work and interest in sensory physiological topics by psychologists and biologists. Examples of Gestalt psychologists conducting such work were provided in the subsection of an article entitled

'Contributions of Comparative Psychology to Sensory Physiology.' A further indication of this is illustrated by the fact that work in comparative psychology was most frequently published in biological journals. For example, HERTZ's first articles about ravens were published in the Gestalt psychology journal *Psychologische Forschung* [*Psychological Research*]. Thereafter, her work appeared in biological periodicals, foremost in the *Zeitschrift für vergleichende Physiologie* [*Journal of Comparative Physiology*], edited by Karl von FRISCH, Erich von HOLST, and H. H. WEBER, and the *Biologisches Zentralblatt* [*Biological Newsletter*] edited by C. CORRENS, R. GOLDSCHMIDT, and O. WARBURG.

Finally, the legacy of Gestalt comparative psychology was also visible in the work of biologists, who in the wake of KÖHLER's work increasingly employed his methods to study problem-solving behavior in primates (KRESSLEY-MBA 2000). This included work by TRENDELEBURG and colleagues (DRESCHER & TRENDELEBURG 1927; NELLMANN & TRENDELEBURG 1926) and Werner FISCHER (FISCHER 1936), to name just a couple of examples of biologists working with primates. Another example is apparent in the work of the comparative physiologist Bernhard HASSENSTEIN (1922-present), who was Otto KOEHLER's (1889-1974) successor as Chair at the University of Freiburg. Although HASSENSTEIN was Erich von HOLST's (1908-1962) doctoral student, his dissertation on the physiological consequences of movement as a result of shifted images on the retina based was inspired by and based on HERTZ's work regarding the physiology of seen movement (B. HASSENSTEIN, personal communication, April 1, 2004; HERTZ 1934, 1935).

Summary and Concluding Remarks

David KATZ (1937/1971, 1) aptly stated once: "In science almost every inquiry is based, admittedly or not, on the comparative method. Applying this to psychology, how could we ultimately determine the nature of an animal without contrasting it with man? And with what measuring-rod shall we measure man if we do not compare him with his fellow creatures in the animal world? Thus human and animal psychology are in matter and method interdependent." Even by K. LORENZ's (1959) own claims it is obvious that he was influenced by Gestalt psychology. Still the impact of Gestalt psychology on early animal psychology in Germany is frequently understated. The current article suggested - providing very few but decisive and influential examples - that Gestalt psychologists provided much of the impetus for an interdisciplinary comparative psychology in pre-World War II Germany. It is very apparent to what extent Köhler's work in Tenerife served as a paradigm within the scientific community in Germany prior to 1940. WASHBURN, RUMBAUGH, and PUTNEY (1994) cite KÖHLER's method of detour problems as a major milestone in the history of comparative psychology. Quite analogous to the discrepancy of a *science* of psychology versus a *discipline* of psychology around the turn of the 20th century (GUNDLACH 2004), a coherent *science* of comparative psychology existed prior to WW II - largely shaped by Gestalt psychologists during the first two decades of the 19th century.

Ultimately, however, the field of animal psychology in Germany gained institutional status and international acclaim as a discipline based largely on the efforts of early ethologists (cf. KRESSLEY-MBA 2006). Perhaps the success of ethology in becoming institutionally established was in part due to the rhetorical strategies of its founding members (KRESSLEY-MBA 2006). Based on examples cited in the current article it is otherwise hard to understand why LORENZ (1937) would so boldly and unequivocally claim that psychologists lacked a comparative and biological perspective in their animal psychological work in the same (and first) volume of the German *Journal of Animal Psychology* [*Zeitschrift für Tierpsychologie*] in which von FRISCH (1937), for example, so obviously praised the work of Mathilde HERTZ.

In any case, methods and interpretive orientation employed by Gestalt psychologists in animal behavior research was applied by biologists and psychologists alike, and even by influential scholars in the United States. The enduring influence of Gestalt psychology with regard to animal psychology even until now has not yet been fully explored, although interesting work in the field continues (EHRENSTEIN, SPILLMANN & SARRIS 2003; SARRIS 1994; 2004; ZOEKE, SARRIS & HOFER 1990).

Summary

Although ethology is most frequently associated with a 'European science of animal behavior,' there was a coherent science of comparative psychology in Germany prior to the institutionalization of ethology. This field of comparative psychology was largely shaped by Gestalt psychologists such as Wolfgang KÖHLER, Mathilde HERTZ, and David KATZ. The paradigmatic influence of Gestalt psychology on early animal research was evident in both conceptual orientation and experimental methodology. This was manifested in the work of psychologists and biologists alike. The influence of Gestalt psychology on mainstream North American animal research made initial progress through the work of, for example, Heinrich KLÜVER and Paul von SCHILLER. Although the historical impact of Gestalt psychology on animal psychology is quite evident, assessing the multifaceted impact of Gestalt psychology on modern sensory physiological research with animals is still in its infancy.

Zusammenfassung

Ziel des vorliegenden Artikels ist es zu zeigen, wie beispielhaft und nachhaltig der Einfluss der Gestaltpsychologie auf die tierpsychologische Forschung Anfang des 20. Jahrhunderts war. Obwohl die europäische Tierpsychologie heute in erster Linie mit der vergleichenden Verhaltensforschung (Ethologie) in Verbindung gebracht wird, gab es davor schon eine vergleichende Tierpsychologie, die methodisch und inhaltlich durch bahnbrechende Arbeiten von Gestaltpsychologen wie Wolfgang KÖHLER, Mathilde HERTZ und David KATZ begründet wurde. Diese prägten die frühe Tierpsychologie einerseits durch eine konzeptionelle Orientierung, die einen impliziten oder expliziten Mensch-Tier Vergleich als unabdingbar betrachtete, andererseits durch ihre empirische Forschung im Bereich des tierischen Verhaltens und der Wahrnehmung. Experimentell-technisch setzten Gestaltpsychologen neue Methoden ein, die die Frage der tierischen Wahrnehmung in eine Vielzahl von Einzelfragen zerlegten und wichtige Ergebnisse brachten. Zentrale Forschungsarbeiten der Gestaltpsychologen fanden bei Kollegen anderer Fachbereiche große Anerkennung und wurden nach dem Zweiten Weltkrieg hauptsächlich von Biologen weitergeführt, zum Teil bis heute. Die thematische Kontinuität neuerer wahrnehmungspsychologischer Forschungsarbeiten zu den früheren tierpsychologischen Arbeiten der Gestaltpsychologen wird heute vielfach benannt, ist jedoch noch nicht ausreichend erforscht.

References

- ALLESCH, G. J. von (1921): Geburt und erste Lebensmonate eines Schimpansen. *Die Naturwissenschaften* 39, 774-776.
- ALLESCH, G. J. von (1931): *Zur nichteuklidischen Struktur des phänomenalen Raumes*. Jena: Gustav Fischer.
- BÜHLER, K. (1919): *Abriß der geistigen Entwicklung des Kindes*. Leipzig: Quelle & Meyer.
- BURKHARDT, JR., R. W. (2005): *Konrad Lorenz, Niko Tinbergen, and the founding of ethology*. Chicago: University of Chicago Press.
- DEWSBURY, D. A. (1992): Comparative psychology and ethology. *American Psychologist* 47, 208-215.
- DEWSBURY, D. A. (1994): Paul Harkai Schiller. *Psychological Record* 44, 307-350.
- DEWSBURY, D. A. (1996): Paul Harkai Schiller: The influence of his brief career. In G. A. Kimble, C. A. Boneau, & M. Wertheimer (Eds.): *Portraits of Pioneers in Psychology. Volume II* (281-293). Washington, DC: American Psychological Association.
- DRESCHER, K., & TRENDELENBURG, W. (1927): Ein weiterer Beitrag zur Intelligenzprüfung an Affen (einschl. Anthropoiden). *Zeitschrift für vergleichende Physiologie* 5, 613-642.
- EHRENSTEIN, W. H., SPILLMANN, L., & SARRIS, V. (2003): Gestalt issues in modern neuroscience. *Axiomathes* 13, 433-458.
- ELLGRING, H. (1984): Ethologie. In H. E. LÜCK, R. MILLER, & W. RECHTIEN (Ed.): *Geschichte der Psychologie. Ein Handbuch in Schlüsselbegriffen*, 211-217. Munich: Urban & Schwarzenberg.
- FISCHEL, W. (1936): Neue Versuche zur Feststellung des Anwendens erlernter Verhaltensformen bei Affen. *Zoologischer Anzeiger, Suppl.* 9, 261-265.
- FRISCH, K. von (1937): Psychologie der Bienen. *Zeitschrift für Tierpsychologie* 1, 9-21.
- GARCIA, A. (2003). The psychological literature in Konrad Lorenz's work: A contribution to the history of ethology and psychology. *Memorandum* 5, 105-133.
- GOTTSCHALDT, K. (1933): Der Aufbau kindlichen Handelns. Vergleichende Untersuchungen an gesunden und psychisch abnormen Kindern. *Beihefte zur Zeitschrift für angewandte Psychologie* 68 (XX. Folge).
- GUNDLACH, H. (2004): Die Lage der Psychologie um 1900. *Psychologische Rundschau* 55, 2-11.
- HERTZ, M. (1928a): Wahrnehmungspsychologische Untersuchungen am Eichelhäher I. *Zeitschrift für vergleichende Physiologie* 7, 144-194.
- HERTZ, M. (1928b): Wahrnehmungspsychologische Untersuchungen am Eichelhäher II. *Zeitschrift für vergleichende Physiologie* 7, 617-656.
- HERTZ, M. (1933): Über figurale Intensitäten und Qualitäten in der optischen Wahrnehmung der Biene. *Biologisches Zentralblatt* 53, 10-40.
- HERTZ, M. (1934): Zur Physiologie der gesehenen Bewegung. *Biologisches Zentralblatt* 54, 250-264.
- HERTZ, M. (1935): Zur Physiologie des Formen- und Bewegungssehens. II. Auflösungsvermögen des Bienenauges und optomotorische Reaktion. *Zeitschrift für vergleichende Physiologie* 21, 579-603.
- IMMELMANN, K. (1982): *Wörterbuch der Verhaltensforschung*. Berlin: Paul Parey.
- JAEGER, S. (Ed.). (1988): *Briefe von Wolfgang Köhler an Hans Geitel 1907-1920*. Passau: Passavia Universitätsverlag.
- KATZ, D. (1911/1935): *The world of color*. London: Kegan, Paul, Trench, & Trubner.
- KATZ, D. (1937/1971): *Animals and men. Studies in comparative psychology*. London: Longmans, Green.
- KLÜVER, H. (1933): *Behavior mechanisms in monkeys*. Chicago: The University of Chicago Press.
- KLÜVER, H. (1936): Re-examination of implement-using behavior in a cebus monkey after an interval of three years. *Acta Psychologica* 2, 347-397.
- KOHLER, O. (1937): Können Tauben 'zählen'? *Zeitschrift für Tierpsychologie* 1, 39-48.
- KÖHLER, W. (1918): *Aus der Anthropoidenstation auf Teneriffa. IV. Nachweis einfacher Strukturfunktionen beim Schimpansen und beim Haushuhn über eine neue Methode zur Untersuchung des bunten Farbensystems*. Berlin: Verlag der Königlichen Akademie der Wissenschaften.
- KÖHLER, W. (1973): *Mentality of apes*. London: Routledge & Kegan. (First edition published in English in 1925).

- KRESSLEY-MBA, R. (2000): *The history of animal psychology in Germany as an antecedent to German comparative psychology and ethology prior to 1940 with special emphasis on nonhuman primates*. Unpublished doctoral dissertation, Passau University, Passau, Germany.
- KRESSLEY-MBA, R., & JAEGER, S. (2003): Rediscovering a missing link. The sensory physiologist and comparative psychologist Mathilde Hertz (1891-1975). *History of Psychology* 6, 379-396.
- KRESSLEY-MBA, R. (2006): On the failed institutionalization of German comparative psychology prior to 1940. *History of Psychology* 9, 55-74.
- KRESSLEY, R. (In press): Mathilde Hertz. In the *New Dictionary of Scientific Biography*. Farmington Hills, MI: Thomson Gale.
- LORENZ, K. (1937): Biologische Fragestellung in der Tierpsychologie. *Zeitschrift für Tierpsychologie* 1, 24-32.
- LORENZ, K. (1959): Gestaltwahrnehmung als Quelle wissenschaftlicher Erkenntnis. *Zeitschrift für experimentelle und angewandte Psychologie* 6, 118-165.
- NAHM, F. D. K., & PRIBRAM, K. H. (2005): *Heinrich Klüver*. Retrieved September 8, 2005, from the National Academy of Sciences, Biographical Memoirs Web site: <http://fermat.nap.edu/html/biomems/hkluver.html>.
- NELLMANN, H., & TRENDELENBURG, W. (1926): Ein Beitrag zur Intelligenzprüfung niederer Affen. *Zeitschrift für vergleichende Physiologie* 4, 142-200.
- SARRIS, V. (1994): Contextual effects in animal psychophysics: Comparative perception. *Behavioral and Brain Sciences* 17, 763-764.
- SARRIS, V. (2004): Frame-of-reference models in psychophysics: A perceptual-cognitive approach. In C. Kaernbach, E. Schröger, & H. Müller (Eds.): *Perception beyond sensation* (69-88). Mahwah, NJ: Erlbaum.
- SCHILLER, C. H. (Ed.). (1957). *Instinctive behavior: The development of a modern concept*. NY: Hallmark Press.
- SIMONS, D. (1984): *Problemverständnis und Problemlöseverhalten bei Primaten*. Göttingen: Hogrefe.
- SOKAL, M. (1984): The Gestalt psychologists in behaviorist America. *The American Historical Review* 89, 1240-1263.
- WASHBURN, D. A., RUMBAUGH, D. M., & PUTNEY, R. T. (1994): Apparatus as milestones in the history of comparative psychology. *Behavior Research Methods, Instruments & Computers* 26, 231-235.
- WUKETITS, F. M. (1995): *Die Entdeckung des Verhaltens. Eine Geschichte der Verhaltensforschung*. Darmstadt: Wissenschaftliche Buchgesellschaft.
- ZOEKE, B., SARRIS, V. & HOFER, G. (1990): Comparative psychophysics. Some contextual effects in birds and humans. *International Journal of Comparative Psychology* 3, 151-163.

Address of the author:

Dr. Regina Kressley
J W Goethe - University Frankfurt am Main
Department of Developmental Psychology
Georg-Voigt-Strasse 8
D - 60325 Frankfurt am Main / Germany
Telephone: +49 (69) 798-28260
Fax: +49 (69) 798-28595
email: kressley-mba@psych.uni-frankfurt.de