

MAX WERTHEIMER'S RESEARCH ON APHASIA AND BRAIN DISORDERS: A BRIEF ACCOUNT¹

Viktor Sarris and Michael Wertheimer

Max WERTHEIMER (1880–1943), widely considered the main founder of Gestalt psychology, was a visionary man throughout his life. His colleague and life-long friend, Wolfgang KÖHLER (1887–1967), once said that WERTHEIMER was a “*seer*”: he looked and “saw” (KÖHLER, 1944; cf. Mich. WERTHEIMER, 1980).

In contemporary psychology books, around the world, WERTHEIMER's major accomplishments are now treated as *landmarks* in the history of science due to his research contributions to the psychology of perception and thinking which formed the basis of his pioneering Gestalt-theoretical approach, strongly opposed to the traditional *association theory* held by Wilhelm WUNDT and his students as well as to the perspective of *behaviorism* suggested by John B. WATSON and defended by his followers until the middle of the last century.

1. Introduction

WERTHEIMER's important work is generally believed to have begun when he came to Frankfurt's Institute of Psychology, in the year 1910, in order to conduct his experiments on *motion perception* (i.e. “apparent” versus “real” motion). More specifically, one of the erroneous assumptions shared by many scholars in psychology today is that WERTHEIMER did, first, his perceptual research in Frankfurt (later also in Berlin) before he then left for the USA, in the thirties, in order to study there – for the first time – “thought” processes. What did WERTHEIMER really do; and what did he actually accomplish even before 1910?

Max Wertheimer in Frankfurt (1910-1914).- Prior to an answer to this question consider briefly Max WERTHEIMER's first Frankfurt years (1910-

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1914). According to an anecdote, which WERTHEIMER later liked to share with his students, the basic idea for his motion-perception studies occurred to him while riding in a train, in the vicinity of Frankfurt. He interrupted his trip in Frankfurt to study the apparent-motion effect, first in his hotel room by means of a toy tachistoscope before he went to Frankfurt's Psychology Institute in order to investigate this basic perceptual phenomenon more systematically (quoted after SARRIS, 1997a, p. 273; cf. Mich. WERTHEIMER, 1980):

"I noticed certain (illusory) movements of the toy ... One turns the inner disk and sees moving film through the openings on the outer disc. ... I made a few of them and then called the laboratory in Frankfurt. ... They sent me Dr. Köhler, who was still a lecturer (assistant) at that time. ... Later we also gained the support of Kurt Koffka."

At the well-equipped laboratory of Frankfurt's institute he employed Friedrich SCHUMANN's wellknown *wheel-tachistoscope* to study experimental variations of the "phi" phenomenon (his main research topic for his 1912 "habilitation" thesis). – WERTHEIMER, in this soon-to-become famous investigation, studied apparent motion not only in subjects with normal vision, like his friends Wolfgang KÖHLER and Kurt KOFFKA (1886-1941), but also in neurological patients suffering from severe impairments of the occipital lobes in the brain; this latter fact, hardly known today, is most important here (cf. STEMBERGER, 2000; CROCHETIERE, VICKER, PARKER, KING, & Mich. WERTHEIMER, 2001):

"I mention that a (neuro-) *pathological case* suffering from the impairment of the occipital lobes, at both sides, speaks for a central location of the perception of (seen) motion. Specifically, Dr. Pötzl has reported: '... if one directs a strong light source slowly and quickly (towards the female patient), she does not appear to perceive a (continuous) movement of the object but only several (isolated) lights.' In May of 1911, I contacted Dr. P., the author, and had the opportunity to test the patient using real (as well as apparent) motion. (WERTHEIMER, 1912b, p. 246; quoted from SARRIS, 1997a, p. 273).

For a better understanding of the important theoretical implications of this pathological case, one must take into consideration WERTHEIMER's goal to try to explain basic psychological facts by means of central neurobiological processes in the b r a i n. According to WERTHEIMER, the perceptual organization, i.e. *Gestalt*-binding, in this patient's vision did not work due to the neuroanatomical damage in the occipital lobes ("motion blindness": see O. PÖTZL, 1928; cf. ZIHL, VON CRAMON, & MAI, 1983; ZEKI 1993, chap. 10). In other words, WERTHEIMER's motion-blind case illustrated a disintegration of *perceptual* and *cerebral* coherence (both *motion* and *form* agnosia should be considered as failures of the brain's integrative mechanisms).

Since historians of psychology have treated the evolution of WERTHEIMER's Gestalt theory after 1912 quite extensively (cf. ASH, 1995), it suffices to mention here the related brain-pathological research of Otto PÖTZL as well as Adhémar GELB and Kurt GOLDSTEIN; these influential works demonstrate the relevance of WERTHEIMER's Gestalt-theoretical motion-perception approach not only in psychology but also in the realm of neurobiological disorders (cf. SARRIS, 1997a, Tab. 1, p. 274).

2. Wertheimer's Research on Aphasia (1905-1909)

In the following we deal mostly with the answer to the question above, i.e. the period of research conducted between 1905 and 1909, before Max WERTHEIMER's arrival in Frankfurt in 1910. Note that WERTHEIMER presented in the same year in which his habilitation thesis was published (1912b) a congress report on his so-called "*Experimental-psychological analysis of some brain-pathological symptoms*" at the "*Vth Kongreß für experimentelle Psychologie*" (1912a). This congress report contains a *summary* of WERTHEIMER's experimental-clinical diagnostic work accomplished during the years before. Until today there exists only a brief published abstract of this report. WERTHEIMER's 1912 summary report refers to a so-called pure "alexia" case – a special type of aphasia; and although he announced a full paper in preparation (to be published soon in the *Zeitschrift für Psychologie*), this article never appeared, for unknown reasons. Fragments of related WERTHEIMER notes are located in the *Max Wertheimer Archives* housed in the Public Library, NYC, and have been translated into English by Michael WERTHEIMER (cf. KING & Mich. WERTHEIMER, 2001).

Wertheimer's Aphasia Research. - Max WERTHEIMER, after his doctoral research at Würzburg's University, wandered to different places during the ensuing years to conduct research in Berlin, Prague, and Vienna on topics like *music perception, thinking, and aphasia*. During these years he gained special experience in anthropological, neurological-psychiatric, and neurophysiological fields. For example, in Berlin he worked with the psychologist and ethnomusicologist Erich VON HORNBOSTEL and others; in Prague with the physiologist Johannes GAD and the neuropsychiatrist Anton PICK, in Vienna with the physiologist Sigmund EXNER and the neurologists Otto PÖTZL and Julius WAGNER VON JAUREGG. In 1907, he joined the neurological-psychiatric clinics in Vienna and did extensive work on the *psychopathology of language*. During these years, WERTHEIMER spent much time with patients who had sustained a brain lesion resulting in aphasia, i.e. the partial or total loss of the ability to understand and /or generate

meaningful words and sentences: "He developed hundreds of detailed protocols and tests of the linguistic, psychological and neurological condition(s) of his aphasic patients." (KING & Mich. WERTHEIMER, 2001).

Wertheimer's psychodiagnostic materials. – WERTHEIMER constructed new diagnostic materials that were individually designed to fit the specific symptoms of a particular patient. His procedures involved the same general strategy that he had already developed for his dissertation studies in Würzburg under KÜLPE's supervision; namely, he adapted the available methods in order to try to diagnose a given patient's psychopathological language deficits. In this he used materials which resembled various *figures* that were employed in his later *Gestalt* work. For example, some of his fragmentary notes refer to so-called "hidden" (embedded) figures, i.e. materials that Kurt GOTTSCHALDT, many years later, was to employ in his experimental studies in the 1920s. Also, he created panels of stimuli of *words* and *numbers*, with the intent of testing a patient's ability to respond accurately to the test symbols used, one by one.

One of the more thorough protocols is the following description of a male aphasic patient, quoted after KING & Mich. WERTHEIMER (2001):

No. 1

The presenting symptom complex was typical of so-called pure alexia: inability to read; impossible to recognize words (even own name!), with simultaneous relatively intact (at least much better) recognition of individual letters. ... He can not generally read words that consist of letters which he was able to recognize ...; what is lacking is not only the verbal image: he doesn't have the faintest idea of the meaning of the presented word; speech, spontaneous writing, understanding of speech intact; intelligence intact; orientation and recognition of persons intact.

No. 2

Right lateral hemianopsia; otherwise, ocular findings good; no peripheral disturbance.

A case of stroke; steady course.

Trouble with walking; headaches; occasional vertigo.

General status somewhat vacillating: better, poorer days (often in connection with sleep, evacuation, etc.).

If a word is presented to pat. for him to read, he clearly makes an effort to read it, but it is completely impossible for him; he sits working at it a long time (5 minutes and 10 — more) ... without succeeding.

No. 3

... He recognizes the relevant letters much more easily; often quite promptly; sometimes with difficulty and occasional misidentification.

What is missing for him is clearly not only the spoken image; he has no idea whatever of the meaning of the presented word.

The situation appears quite clear:

He can see well (as demonstrated, e.g., by the positive results of the ophthalm. investg.); only in reading is a crass disturbance demonstrable.

No. 4

Since only reading is disturbed and since reading is distinguished from other optical recognition by the (learned) association between optical and acoust.-mot. speech images it is a case of a disturbance of the associative pathways between the optical and the acoust.mot. centers.

WERTHEIMER, in addition to these linguistic tests, thought that something more general was involved in "alexia" (this special form of aphasia); he wondered if, and to which extent, experimental studies with the *tachistoscope* might help to gain more insight into the nature of this cognitive pathology. – In passing it should be noted that *tachistoscopic* investigations of reading abilities and disabilities were rather common during those years.

Specifically, WERTHEIMER raised the following questions:

No. 5

Might it be possible to penetrate further into the nature and operation of this particular disturbance with the help of ad hoc experimental procedures, designed expressly for this purpose? How does the process occur? What is it in the process of reading that is really disturbed? What can specific experimental qualitative analysis reveal about the presenting deficiencies? The process of reading certainly involves a variety of specific skills; where are these difficulties? What does the particular quality of the impossibilities, of the errors, indicate?

In his extensive studies WERTHEIMER also generated techniques to test for a patient's "...ability to develop *visual images*."- He used for instance the following instruction for the patient:

No. 6

„Imagine a large printed letter F, a capital letter; now add, at the bottom end of the long vertical stroke, a third horizontal line like the one at the top; what letter do you have then? M; no, an E; I had thought of the M as turned to the right “Imagine a Roman numeral 5; now stand it on its head, and add a small horizontal stroke in the middle.”

Promptly: “that is an A.”

Max WERTHEIMER paid close attention to his research patients; and for at least one of them he developed eighty-seven (!) different diagnostic tests. Drafts of his theoretical discussion of the outcomes focused, for example, on the possible association of *optical* with *acoustical* items, thus looking for the intermodal-biopsychological associations involved. He concluded that his ideas were consistent with the literature (e.g., see KING, & Mich. WERTHEIMER, in preparation, especially on the 1907 paper published by Giulio BONVICINI and Otto PÖTZL, “*On pure word blindness*”). As indicated by the protocols of his studies with aphasic patients, WERTHEIMER continued this kind of work for several years, at least until March 1912. – (In passing it should be noted that he delivered papers on this topic as late as 1913 and 1920.)

3. Comments on Wertheimer’s Aphasia Research

WERTHEIMER’s clinical research findings were mostly *qualitative* in nature; furthermore, his extensive research on aphasia never came fully to *fruition*. This is remarkable; especially in view of the published work by many other prominent scientists who later gave major credit to WERTHEIMER’s *Gestalt*-oriented view. Consider, for example, the following appraisals by Otto PÖTZL (1928), Kurt GOLDSTEIN (1948), and Alexander LURIA (1966).

Otto Pötzl, 1928: PÖTZL, in his influential handbook-volume, gives credit to WERTHEIMER’s *Gestalt*-thinking in at least two places:

- *Case Barbara L.* on motion-blindness (B.L). – Here PÖTZL provides an extensive description and support of WERTHEIMER’s 1912 clinical study on motion-blindness; in it, the brain-physiological *Gestalt* interpretation of WERTHEIMER’s case is fully acknowledged (1928, pp. 61-76).
- *Case Spitz*, on aphasia (“alexia”). – PÖTZL, in a chapter on *pure word-blindness* (“*Das klinische Bild der reinen Wortblindheit*”; pp. 80-85), gives further credit to some collaborative research work done with WERTHEIMER in the years 1910 through 1911, thus underlining the significance of a *Gestalt*-theoretic approach to a better understanding of “alexia”.

Kurt Goldstein, 1948: GOLDSTEIN, twenty years after Pötzl, also stresses the theoretical relevance of a *Gestalt*-theoretical approach to the neurobiology of “aphasia” and related language disorders, but does it more critically than PÖTZL. – Consider the following two quotations:

- *Positive account:* “There is a relation of acoustic speech-Gestalten to other acoustic Gestalten, as noises or music. ... Whether all acoustic Gestalten are

disturbed or only some depends on the degree of differentiation of the sphere.

Usually speech sound Gestalten are more disturbed than ... noise Gestalten. further studies are necessary ..." (GOLDSTEIN, 1948, p. 89.): ... "The process of recognition of letters can be disturbed in different degrees. The patient may be unable to see – in spite of intact visual acuity – the simplest form in general (so-called gestalt-blindness), and thus also the form of the letters ... It seems that in some cases visual imagery is totally lost ... The [psychodiagnostic] decision [to be made] is difficult, due to the imperfection of our methods of investigation." (GOLDSTEIN, 1948, p. 120).

-Negative account: GOLDSTEIN ponders why the Gestalt-oriented researchers did not find more evidence on the subject in question: "It is especially surprising that *Gestalt psychology* contributed so little to research on aphasia. ... (After all,) it repulsed [Wilhelm WUNDT's] association psychology. ... 'There are contents', wrote M. WERTHEIMER, 'in which what is happening in the whole cannot be deduced from the characteristics of the separate pieces, but conversely what happens to parts is determined by the laws of inner structure of its whole.' The general point of view of Gestalt psychology has fertilized brain pathology in general, but this theory has scarcely influenced the process ... of aphasia [research]. I know only some short remarks of WERTHEIMER and POETZL."

Alexander R. Luria, 1966: LURIA's account of a Gestalt approach to *aphasiology* is more positive, but even shorter than GOLDSTEIN's 1948 treatment. – For example, LURIA underlines the relevance of WERTHEIMER'S "*movement Gestalten*" to a proper interpretation not only of perceptual but also of semantic phenomena; namely:

- "... syntheses of perceptual elements into a simultaneous whole constitute a fundamental (pre-) condition for the still more complex *intellectual processes* (emphasis: A.L.). ... The grasping of any system of relationships, whether the grammatical system of language or a system of arithmetical concepts, is impossible without (the) arrangement of the elements into a simultaneously surveyable scheme. ... Their disturbance may lead to disintegration of the corresponding logico-grammatical relationships ..." (LURIA, 1966, pp. 76f).

(See also LURIA's treatment of his so-called "*kinetic melodies*" as an example of *serial* perceptual-cognitive organization.)

4. Some Afterthoughts and Some Tentative Conclusions

Why is it that Max WERTHEIMER neither continued his aphasia research nor published his findings himself? Different answers to this question have

been suggested. Consider first the following answer provided by the historian of psychology Mitchell G. ASH (1982):

“Although leading neurologists and physiologists were evidently willing to let Wertheimer do research in their institutions (as a guest researcher) ..., he lacked the medical degree he would have needed to establish himself in such a setting; and it is not immediately clear whether he would have been able to obtain an academic position in philosophy with work on such problems.” (ASH, 1982, p. 254; quoted from KING & Mich. WERTHEIMER, 2001, p.19).

In addition or as an alternative to ASH’s hypothesis might be the assumption that WERTHEIMER, at least during his early scientific career, wanted to establish a much firmer *neurobiological* basis for his Gestalt theoretical position. Some support for this latter assumption is provided in a passage about WERTHEIMER’s own claims made in 1937 in his *New School Seminars on Perception*:

“I ... had turned to optical phenomena *instead of real life* (emphasis: V.S.) because it [life] was more difficult and vague. ... I sought to develop tools ... in which I could get a clear decision. ... It [i.e.: the experimental laboratory approach] was chosen because we could get the best scientific technique [at Frankfurt’s psychology institute]. ... I conducted the experiments [on apparent vs. real motion perception] ...” (WERTHEIMER’s *New School Lectures*, 1937; edited by A. LUCHINS: see LUCHINS & LUCHINS, 1982, p. 163; cf. also Sarris, 1995, pp. 18f.).

Compare LUCHINS’ *indirect* quotation, with Max WERTHEIMER’s own prophetic assertion already made in a central part of his 1912 paper:

“In my opinion physiological theorizing interacts with experimental research [in psychology] in a double way: On the one hand, it should combine the single research findings and the major principles in a unified form and make them deducible; on the other hand, ... a [physiological] theory should *promote* the research process by stimulating concrete hypotheses to be tested *experimentally* ... thus leading to deeper understanding of phenomenal laws.” (Wertheimer, 1912b, p. 247; translated into English by Sarris, 1989, p. 59; emphasis by V.S.)

Since WERTHEIMER and his contemporaries, in the first decade of the twentieth century, could not rely on refined physiological research tools (EEG technology and neuroimage-methods were developed much later), the experimental study of *perception* seemed to be a much safer (“firmer”) enterprise than the investigation of language or thinking. Eventually, in the long run, the study of higher-order perceptual processes might perhaps have led to findings of interest also for the researcher in language and thought processes. In this connection, one should keep in mind that the Gestalt theorists were typically looking for processes which were common to both perception and thinking (cf. the examples provided in WERTHEIMER’s final work, *Productive Thinking*, 1945; see also Irvin ROCK, 1983, who

made the following claim: "... *It is entirely possible that we may learn about the operations of thinking by studying perception.*", quoted in SARRIS, 1995, p. 1).

Throughout his academic life, in Europe as well as in the USA, Max WERTHEIMER performed original studies in diverse fields of psychology. But his best-known work in cognitive psychology became his seminal book, *Productive Thinking*, posthumously published in 1945 in the USA (cf. SARRIS 1996, 1997b, 1999).

Conclusions .- Our main conclusions from WERTHEIMER's findings are the following ones:

(1) Max WERTHEIMER's studies on problems in *aphasia* are not well known today, partly because his work done in the first decade of the 20th century was never published (there exist only fragmentary notes housed in the *Public Library in New York City*).

(2) Nevertheless, WERTHEIMER's findings from his aphasia work had some important implications for Gestalt theory; they were also cited by later renowned neuropsychiatrists such as PÖTZL (1928), GOLDSTEIN (1948), and LURIA (1966).

(3) As to the question why WERTHEIMER discontinued his *aphasiology* research (1905 – 1909) we suggest the following answer. Possibly WERTHEIMER, in his search for a more *neurophysiologically* oriented basis for Gestalt theory, believed that the study of language disorders should be postponed in favor of the then-more-promising *experimental* investigation of motion perception. – (For a modern account of cognitive neuroscience see ZEKI, 1993, chap.10; GAZZANIGA, 2000.)

“What was it that made Max Wertheimer unique ...? It was not simply that he was a great scientist, indeed one of the greatest. ... He was, intellectually, a great man, a valuation he would have rejected while alive, but which we who knew him recognized from our first encounter.”

Alvin JOHNSON, 1943

President of *The University in Exile*

New School for Social Research, New York

(Quoted from SARRIS, 1997a,b)

Zusammenfassung

Max WERTHEIMERs Arbeiten über die Aphasie sind bis heute nahezu unbekannt geblieben, da sie nicht in Form von üblichen Zeitschriftenaufsätzen publiziert wurden. Das gilt unbeschadet der Tatsache, daß seine Aphasie-Untersuchungen wichtige Implikationen für die Gestalttheorie enthalten. Zur Frage, warum WERTHEIMER seine einschlägige Forschung nicht fortsetzte, wird die Erklärung erwogen, daß diese zugunsten der damals eher vielversprechend erscheinenden experimentellen Analyse der Bewegungswahrnehmung zurückgestellt wurde.

Summary

Max WERTHEIMER's studies on aphasia are hardly known today, since they were not published in ordinary scientific journals. This holds true in spite of the fact that his respective investigations contain important implications for Gestalt theory. The question why WERTHEIMER discontinued his aphasia research is tentatively answered here by the suggestion that WERTHEIMER postponed it in favour of the then-more-promising *experimental* research on motion perception.

References

- ASH, M.G. (1982): *The emergence of Gestalt theory. Experimental psychology in Germany 1890-1967*. Unpublished doctoral dissertation at the Department of History, Harvard University. Cambridge, MA.
- ASH, M.G. (1995): *Gestalt psychology in German culture 1890-1967*. Holism and the quest for objectivity. Cambridge, Mass.: Cambridge University Press.
- CROCHETIÈRE, K., VICKER, N., PARKER, J., KING, D.B. & Mich. WERTHEIMER (2001): Gestalt theory and psychopathology. Some early applications of Gestalt theory to clinical psychology and psychopathology. *Gestalt Theory* 23, 144-154.
- GAZZANIGA, M.S. (Ed.) (2000): *The new cognitive neurosciences*. (2nd ed.) Cambridge, Mass.: MIT Press.
- GOLDSTEIN, K. (1948): *Language and language disturbances*. New York: Grune & Stratton.
- KING, D.B. & Mich. WERTHEIMER (2001, in preparation): *Max Wertheimer*. A biography.
- KÖHLER, W. (1944): Max Wertheimer, 1880 – 1943. *Psychological Review* 51, 143-146.
- LUCHINS, A.S. & E.H. LUCHINS (1982): An introduction to the origins of Wertheimer's Gestalt psychology. *Gestalt Theory* 4, 145-171.
- LURIA, A.R. (1966): *Human brain and psychological processes*. New York: Harper & Row.
- PÖTZL, O. (1928): *Die Aphasielehre vom Standpunkte der klinischen Psychiatrie*. Bd. 1: Die optisch-agnostischen Störungen. Leipzig: Deuticke.
- ROCK, I. (1983): *The logic of perception*. Cambridge, MA: MIT Press.
- SARRIS, V. (1989): Max Wertheimer on seen motion. Theory and evidence. In V. SARRIS (Ed.): Max Wertheimer Memorial Issue. *Psychological Research* 51, 58-68.
- SARRIS, V. (1995): *Max Wertheimer in Frankfurt*. Beginn und Aufbaukrise der Gestaltpsychologie. Lengerich: Pabst.
- SARRIS, V. (1996): Max Wertheimer in New York. Zum 50. Jahrestag von "Productive Thinking (1945)". *Psychologische Rundschau* 47, 137 – 145.
- SARRIS, V. (1997a): Gestalt psychology at Frankfurt University. In W.G. BRINGMANN, H.E. LÜCK, R. MILLER & C.E. EARLY (Eds.): *A pictorial history of psychology*, 273-276. Chicago: Quintessence Publ.
- SARRIS, V. (1997b): Reflexionen über den Gestaltpsychologen Max Wertheimer und sein Werk: Vergessenes und wieder Erinnerungtes. In M. HASSLER & J. WERTHEIMER (Hrsg.): *Der Exodus aus Nazideutschland und die Folgen*, 177-190. Tübingen: Attempto-Verlag.
- SARRIS, V. (1999): Der Gestaltpsychologe Max Wertheimer in Frankfurt und New York. *Psychologische Beiträge* 41, 57-73. Reprinted in G. BÖHME (Hrsg.) (2000): *Die Frankfurter Gelehrtenrepublik*. Idstein: Schulz-Kirchner Verlag.
- SARRIS, V. & Mich. WERTHEIMER (1987): Max Wertheimer (1880-1943) im Bilddokument – ein historiographischer Beitrag. *Psychologische Beiträge* 29, 469 – 493.

- STEMBERGER, G. (2000): Gestalttheoretische Beiträge zur Psychopathologie. *Gestalt Theory* 22, 27-47.
- WERTHEIMER, M. (1912a): Über das Denken der Naturvölker. 1. Zahlen und Zahlgebilde. *Zeitschrift für Psychologie* 60, 321-378.
- WERTHEIMER, M. (1912b): Experimentelle Studien über das Sehen von Bewegung. *Zeitschrift für Psychologie* 6, 161-265.
- WERTHEIMER, M. (1913): Über hirnpathologische Erscheinungen und ihre psychologische Analyse. *Münchener Medizinische Wochenschrift* 60, 2651 – 2652.
- WERTHEIMER, M. (with E.M. von HORNBOSTEL) (1920): Über die Wahrnehmung der Schallrichtung. *Sitzungsberichte der preußischen Akademie der Wissenschaften, Berlin* 20, 388-396.
- WERTHEIMER, M. (1934): On truth. *Social Research* 1, 135-146.
- WERTHEIMER, M. (1945): *Productive thinking*. New York: Harper & Row.
- WERTHEIMER, Mich. (1980): Max Wertheimer. Gestalt prophet. *Gestalt Theory* 2, 3-17.
- WERTHEIMER, Mich. & V. SARRIS (2000): Wertheimer. "Productive Thinking". In H.E. LÜCK, R. MILLER & G. SEWZ-VOSSHENRICH (Eds): *Die Klassiker der Psychologie*, 183-187. Stuttgart: Kohlhammer.
- ZEKI, S. (1993): *A vision of the brain*. Oxford: Blackwell Scientific Publ.
- ZIHL, J., CRAMON, D. von & N. MAI (1983): Selective disturbance of movement vision after bilateral brain damage. *Brain* 106, 313-340.

Addresses of the authors

Prof. Dr. Viktor Sarris,
Institute of Psychology, Frankfurt University
Mertonstr. 17, 60054 Frankfurt/M., Germany
E-mail: Sarris@psych.uni-frankfurt.de

Prof. Dr. Michael Wertheimer
University of Colorado, Department of Psychology
Muenzinger Psychology Building, Campus Box 345
Boulder, Colorado 80309
E-mail: Wert@psych.colorado.edu