

# CAN THE SUBJECT CREATE HIS WORLD?

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1st part

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## Perception in the System of Psychology

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In talking to younger psychologists, one finds that many of them seem to believe that perception is something at the surface of the mind, a kind of borderline problem, and that preoccupation with it is obsolete. They look with disdain at every psychological problem that does not at least deal with personality, motivation, or social intercourse. But when discussing problems in which simple facts of stimulus and reaction play a role, as for example in behavior therapy, they prove that they would have done well to occupy themselves a little more with the fundamentals of perception. It is hard to get them clear on the differences between a stimulus in the physiological sense, such as impingement on receptor cells, and a valence or *Aufforderungscharakter* in the sense of Kurt LEWIN, or an IRM in the sense of ethology. Obviously they have never been confronted with facts that can only be understood by carefully distinguishing between an impact on a sense organ and a characteristic of a percept that has come into existence through such impacts, and which therefore cannot again act on a sense organ of the same organism but only on the perceiving subject. Subjects correspond somehow to organisms, but are percepts themselves existing within the same phenomenal world as the objects to whose valences or IRMs they react. Psychologists of the younger generation tend to forget that, taken strictly, all social interaction is primarily interaction between percepts, interaction which only by cybernetic mechanisms is transferred to the participating organisms and copied by them, so that the interaction of the organisms is but a mediating correlate of what happens in the phenomenal worlds of the interacting subjects. And if this is the case, the theory of perception plays a fundamental role for every other field of psychology (cf. METZGER, 1965, 1968, 1969; GRAEFE, 1961).

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## Objects and Percepts

Phenomenal worlds are not exact reflections of the physical world. What is lacking in them, if compared with it, can be seen in any physics textbook. But on the other hand they have quite a number of essential characteristics that cannot be found in the physical world: the secondary and tertiary qualities of percepts and situations and the valences and tensions existing between them have no counterpart in the corresponding physical facts. But still they represent the physical facts so reliably, and their deviations from them correspond so highly, that different subjects in spite of their different standpoints can consider their respective phenomenal worlds as identical, that is, as, for all practical purposes, one and the same objective reality.

How do these phenomenal worlds come about? The question has at least partially been answered by psychophysics, if this term is taken in a somewhat loose sense. The decisive point is that there is

no direct communication between physical objects and percepts corresponding to them, but that between them there is a more or less long and complicated chain of causation whose critical link is the stimulation of receptors, that is, the initial penetration of the organism. This point is decisive. For the only basis of a phenomenal world is the totality of stimulations of millions and millions of receptor cells in their ever-changing distribution, as called forth by the changes in the objects themselves and by changes in the relations between objects and organisms as caused by the subject itself, whether impulsively or intentionally.

Percepts are never structurally identical with the varying configurations on the receptor level. Percepts are units or wholes coherent in themselves and segregated from each other; stimuli are not. Percepts are tri-dimensional and move in a tri-dimensional space; underlying stimuli are distributed over two-dimensional surfaces of the body, such as retinae or the skin of the fingertips. Percepts have (approximately) constant attributes such as size, shape, surface color, and so on, just as their physical counterparts do, while the underlying stimulus configurations vary continuously. For these reasons percepts are in decisive characteristics more like objects than like the stimuli intercalated between objects and percepts. Thus some thinkers (such as Max SCHELER) have been inclined to assume a direct, extrasensory connection between the two ends of the chain. Another attempt at accounting for the astonishing correspondence between the two ends of the causal chain between object and percept that must be

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noted here is J.J. GIBSON's; if I do not misunderstand him he holds that this chain is circular in the sense that it finally returns to its starting point (GIBSON, 1966). The formulations of these authors raise many new and unsolved problems. Therefore the conventional conception is preferable according to which there is neither direct connection nor identity between object and percept. This leaves the basic theoretical question of how and by what factors varying stimulus configurations are transformed into stable percepts.

### A World Created by Mental Acts

The oldest source in which it is held that the ego creates its own world by an act of will is J. G. FICHTE's *Introduction to Philosophy* (*Einleitungsvorlesungen in die Wissenschaftslehre*, 1797), in which he tries to interpret KANTian epistemology. But his arguments are so highly speculative and so far from empirical evidence that in this connection he shall only be mentioned.

Twenty years later, in 1818, Arthur SCHOPENHAUER dealt with a concrete problem of perception. His problem is how it happens that objects are seen where they are, instead of at the place of the physiological processes in the retina or in the cortex. According to his hypothesis, the subject follows the light rays back to the point on the surface of an object from which they diverge to the foveae of the two eyes, and, recognizing the angle between them, is able to reconstruct its place. With this, he in a way anticipates the theory of judgement or inference brought forward by HELMHOLTZ in about 1860.

The starting point of HELMHOLTZ's theory is that invariably the nervous stimulations (we should say excitations) are directly perceived, but never the objects themselves. (Or in a more general and less hypothetical formulation: the immediate *basis* of object perception is invariably the sum of stimulations of receptor cells but never the objects themselves.) HELMHOLTZ continues his argument as follows: "But there are mental activities that enable us to form an idea as to the possible causes of the observed actions on the senses. In their result, these activities are equivalent to a conclusion or inference from analogy"; this is the well-known theory of

unconscious inference. (From this follows his explanation of visual illusions as "erroneous interpretations" [*Urteilstäuschungen*].) HELMHOLTZ does not deny that there are certain differences between the hypothesized analogical inference made by the subject and his observable free acts of conscious

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inference: the former are instantaneous; they are unconscious, and - as Wolfgang KÖHLER (1913) adds - concerned with unconscious material; they are irresistible, that is, cannot be corrected by better knowledge. There is one more fundamental difference that was not yet known to HELMHOLTZ and KÖHLER: conscious inferential thinking becomes the more difficult the higher the complexity of the problem situation grows. However, with the phenomena that HELMHOLTZ intended to explain by unconscious inference, this relation is exactly reversed: the more complex the situation, the more irresistible and unambiguous the effect (METZGER, 1934).

Actually there are many more problems left open. Everybody knows what "an idea to a possible cause" is, and that an idea such as a pure thought or a mental image is quite different from a true percept, that is from a thing of our environment that can be seen and manipulated. And the question arises how this special kind of idea is related to the palpable things in our surroundings through processes originating in the retina and skin receptors. Another problem is the unavoidable inference that the subject must sit in the middle of the organism and from there observe all the stimulations around him, forming ideas as to their possible causes, ideas which by a rather miraculous additional act are "projected" or "externalized" beyond the surface of the organism into its nearer or farther surroundings.

KÖHLER (1913) points to the fact that no unconscious inferences are assumed by HELMHOLTZ if a plausible objective explanation for a phenomenon exists, as in the case of color mixture. Actually, HELMHOLTZ's theory applies to all those phenomena which cannot be understood without the assumption of *lateral interaction* of simultaneous nervous processes (*Querfunktionen*, as WERTHEIMER called it in 1912). Lateral interaction was not yet believed to be possible in the nervous system at HELMHOLTZ's time. Unconscious reasoning as well as unconscious sensations were constructs that could be dispensed with as soon as this possibility had been acknowledged.

Nevertheless, HELMHOLTZ's theory is still alive. More than forty years after KÖHLER's criticism it has been revived by TAUSCH (1954), KRISTOF (1961), and GREGORY (1962), but was refuted again by ZANFORLIN (1967), FISHER (1968), and METZGER et.al. (1970). One more instance of a relapse into HELMHOLTZian speculations can be found in an article on decision

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theory by SWETS et al. (1964). We owe to these authors not only the wellknown concept of sensitivity, but also the concept of choice of criterion in threshold observations, which means a valuable step forward in this field. But their decision theory makes sense only in the peculiar situation of threshold exposure, when the subject, presented with the task of detecting something hardly perceptible, is forced to make decisions observable by himself and by the experimenter. But the authors go further and try to apply their new-found principle to perception in general, with paradoxical consequences. Their generalization would imply that, for example, (1) while looking at a human face, a crowd in the street, a landscape, or a bunch of flowers, thousands of decisions would be necessary at one and the same moment, and that (2) all these decisions would never be noticed - in contrast to the *observable* deciding activity in threshold experiments.

But the whole waste of unconscious activities need not be assumed, because if the perceiver contents himself with clearly supraliminal differences, as is the case in all naive everyday vision in

which no searching attitude is maintained, there is nothing to decide.

The most recent publication in which HELMHOLTZ's theory expressly adopted is "Die Psychophysiologischen Grundlagen des Wahrnehmens" ("The physiological foundations of perceiving") by Egon KÜPPERS, a German psychiatrist (1971). But the abundance of fictitious mental activities introduced by him goes far beyond HELMHOLTZ.

There are still other types of mental-act-theories of perception. In his *Sinnespsychologische Untersuchungen* (*Sensory Psychological Investigations*) of 1917 (which, by the way, are full of interesting and reliable observations), Julius PIKLER offers a theory of binocular depth perception according to which the subject is able to observe separately the two retinal images of the right and left eyes, to interpret them as geometrical projections of solid bodies, to compare them and from their deviations to draw conclusions as to the distance and shape of the object represented by them.

The "Komplextheorie", first brought forward by MÜLLER (1903, 1923) and later with slight alterations by PETERMANN (1929, 1931), deserves special mention, along with the "Produktionstheorie" of MEINONG and BENUSSI (1904). These are theories of unit formation and unit segregation in perception that agree in the assumption of a special mental activity on the part of the subject. He organizes the perceptive field out of the crowd of unconnected elementary sensations by "producing" real - as opposed

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to merely imagined - relations between them or by directing collective or unifying attention to them.

These theories have the advantage of being based on activities of the subject that under certain conditions can actually be observed. Everybody knows what attention is, and can discriminate between an attentive and an inattentive state of mind. Beyond this, everybody knows the difference between seeing, for example, four points either as the corners of a square or as the ends of a cross, and can experience how by a change of attitude one of these apprehensions of the configuration can be changed into the other. (By the way, these two are not the only alternatives!) In the theories of production or collective attention this observable unifying mental activity is generalized to all cases of unit formation, and where it - as in the vast majority of cases - cannot be observed, it is thought to work unconsciously. BÜHLER (1913) and KÖHLER (1926) have pointed to the numerous facts that contradict such assumptions. The range of deliberate unification proved to be surprisingly narrow; unit formation in innumerable cases does not follow intentional, and to that extent observable, unifying or segregating efforts, and so many objective "cues" controlling attention behavior must be introduced by these authors right from the outset (MÜLLER, 1903), that finally the concept of attention is reduced to an *x* that occasions the subject to build very definite units, an *x* that can be omitted without any loss if the "cues" of these theories are considered as *factors* acting immediately upon the perceptive field.

To sum up, none of the known theories of "creating" one's own world *by mental acts* has proved to be adequate to facts.

### A World Created by Overt Action

Theories according to which the phenomenal world originates in overt action by the subject have two philosophical roots, one epistemological, one ideological.

As to the first, it is the notion that "the soul" or mind is nonspatial, as was held by DESCARTES, and that attention can be but punctual, for in a nonspatial mind no two things can be present simultaneously. Wholes can therefore be built up only through the following three steps: (1) by scanning, that is, by apprehending one element after another; (2) by keeping all those elements in mind simultaneously (at present we would say in short-term-memory); and (3) by finally unifying or synthesizing them into a whole, as KANT points out in the introduction of the first edition of his

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"*Kritik der reinen Vernunft*" (*Critique of Pure Reason*). This notion was handed down through LOTZE (1842, 1856) to WUNDT (1908) and finally to McDougall, PIAGET (cf. AEBLI, 1963), and to Soviet psychology.

WUNDT specified it into the assumption that perception of shape, not only tactile perception but also visual, comes about by tracing contours with the sense organ - with the fingertips or with the fovea. About fifty years later PIAGET renewed this assumption, this time not for the percept but for the concept; which structurally makes no difference. The concept of a thing, touched or seen, is, according to PIAGET, the total of movements by which it was explored.

Still, in 1971, this assumption is repeated as an established truth (see KÜPPERS). But as early as 1902, G.M. STRATTON had definitely disproved it by recording eye movements and showing that eye movements by which a subject tries to follow a simple outline, are anything but copies of that outline, and vary trial to trial in an unpredictable way. STRATTON's experiment was repeated in Münster a few years ago with different configurations and instructions but the same result. This could have been derived immediately from our knowledge of voluntary eye movements - which obviously has not so far been integrated into our theory of visual organization. Without exception, voluntary eye movements are jumps that cannot be controlled in detail by the subject. During these jumps, as a consequence of the blurring effect of quick displacements of contours over the retinae, *nothing can be seen*. In other words, reception of visual structures is possible only for the eye at rest, and that means simultaneously. This is why a whole landscape can be recognized during a lightning flash in the night, though it lasts no longer than one-tenth of a second ; that is, much less than the reaction time of the oculomotor system, so that it is dark again before the slightest movement of the eyes can be set going.

In haptics the situation is somewhat different. Because of the tiny area of the touching fingertips and the greater velocity of local adaptation, there is practically no recognition of structures without gross movements. But only by chance are these tracing movements. Recognition of structure is possible without tracing, as BÜRKLEN (1917) has shown and my own unpublished observations have confirmed.

The ideological root of creation-theories in perception can best be seen in a statement of PETERMANN when he criticizes Gestalt psychologists, saying that for them the perceiving subjects is "nothing but" a passive "battlefield of stimuli," to which one could reply, "Why should it be

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otherwise?" When WEIZSÄCKER (in 1940) propounds his "Gestaltkreis" theory, general anthropological considerations play a much greater role than the presentation of empirical data. There is a remarkable correspondence between WEIZSÄCKER's views and those of American transactionalists who also try to recenter perception research on what is done by the perceiver, and in this connection more than once emphasize that "each one of us ... creates for himself the world in which he has his life's experiences" (ITTELSON, 1960, p. 19). But this is not meant as

seriously as it sounds. It is preceded by the remark that "if everyone perceived entirely differently from everyone else, it is difficult to imagine how any agreement or social activity could be possible" (p. 16). The fact that agreement is possible is accounted for not only by common interests and purposes but also by neighboring and to that extent overlapping positions including a similar orientation in space and time - which, in order for different perceivers to assimilate their worlds to one another, must not be created but found (cf. E.J. GIBSON, 1966). But the last part of the sentence is not the author's but the reader's remark. The convergence toward familiar ways of perception research goes on when the concept of equivalent configurations of "externality-impingement" is introduced and experimental work on visual "depth cues" is reported in detail. These cues play a role exactly analogous to the unity cues in MÜLLER's and PETERMANN's theories of collective attention here controlling visual depth to such a degree that there is not much freedom for creativity left, except in the case where cues have contradictory effects. The role attributed to past experience in the origin of cues is about the same as in other American perception research. Finally the creativity of the perceiver comes down to the fact that "the experienced consequences of every action provide a check on the perceptual prediction on which the action was based," just as in the process of scientific inquiry (p. 35), which would not make any sense if the perceiver's world were his free creation. By these arguments "transaction" is reduced to the concept of an *interplay* between acting and observing objective consequences of action in which it makes no more sense to ask: which came first, the chicken or the egg. That there are stimulating new perspectives, as well as the remnants of nineteenth-century introspectionism, in transactionalist psychology is shown by the role that is attributed to the mystical activity of "externalization," which was shown to be an unnecessary construct by KÖHLER as early as 1929.

The last and most important ideologically determined branch of perception  
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research to be mentioned here is of the Soviets. The emphasis laid by them on the role of overt activity of the perceiver is unmistakably derived from the central position that "labor" plays in their whole philosophy of life (cf. SOKOLOV, 1966; ZINCHENKO, 1966). Hence their preference for intentional operations such as searching, analyzing, matching, arranging, counting, copying, building up out of given material, operations that furnish more thorough, more detailed or more exact information on objects that have been perceived already or are being perceived during this additional scrutiny.

### **The True Meaning of Action in Perception**

If instead of philosophizing we try to make a list of bodily activities, conscious and unconscious, that occur during perception, we get the following collection (which is perhaps not quite complete): Receptors are exposed to stimulation by certain objects (as by looking about, grasping, bending to a keyhole or climbing an a fence in order to peep, also by turning over the leaves of a book); the area accessible to receptors is enlarged (as by wandering about in a large building or in the streets of a city, or by groping in the dark, also by traveling); sense organs or objects are moved so that stimulus configurations shift to the most sensitive part of the receptor (as in fixation reaction of the eye or by bringing objects to the fingertips or to the tip of the tongue); receptivity of the sense organ is optimized (as for example in the eye by accommodation, convergence, retinal adaption, modifying width of pupil, and so on); the head is moved unintentionally so that by motion parallax the near and the distant can be distinguished (TSCHERMAK, 1939; KLIX, 1962); the same effect can be reached by passive transportation (GIBSON, 1950); the head turns and tilts unintentionally so that the source of a sound can be localized not only to the left or right side but also above or below and to the front - or back - of the

perceiver (WALLACH, 1939); local adaption slows down and perceived structures are prevented from fading (for example, by the minute unconscious oscillatory movements of the eyes [DITCHBURN, et al., 1952] or the intentional gross rubbing of the fingers in haptics, as in Braille reading [BÜRKLEN, 1917]; qualities of the material are abstracted (as roughness by rubbing, hardness by pressing or biting, elasticity by bending and so on); details of a perceived structure are intentionally explored by wandering eyes or systematic scanning, verbal, tactual, and visual, sometimes, but not necessarily including tracing; outer conditions of perception

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are improved (as in moving a watch toward the ear, stopping one's breath, shutting the windows that open on a noisy street, taking eye glasses on or off (or wiping them), turning on a light, going toward windows, blinking, sniffing, leaving and re-entering a room in order to recognize a smell, licking a finger and lifting it up in order to feel a faint air draft, shaking a hollow object or lifting it in order to find out whether it contains something, and so on, rolling an egg in order to find out whether it is raw or boiled, lighting a match and holding it to a piece of fabric in order to know whether it is wool, and so on); objects are subjected to planned operations in order to know them more exactly (as matching, arranging, counting, copying, building them up out of given material and so forth); one's own limbs are moved in order to observe them (as in the child preparing for voluntary movement by building up visual-kinesthetic coordination, or in an adult restoring it after experimental disturbance [HELD, 1966; SMITH and SMITH, 1966]; music is accompanied with rhythmic movements; music or words are recited, written characters are reproduced in order to know them better.

There is no sharp borderline between "natural" and more or less impulsive testing activities, on the one hand, and planned and systematic testing methods as developed in natural sciences, on the other.

All these activities have one trait in common: none of them "produce" or "create" anything. their very purpose is to make things react in various ways and thus lay open their nature and, at the same time, to optimize the receptivity of sense organs in order to draw from them as much information as possible.

### **The Influence of Emotion and Motivation**

The above statements about the nature of the subjects's activities in perception are not invalidated by pointing to the modifications of the perceptive field by "subjective" factors such as emotion and motivation. It is true, the conception of a causal chain leading from the object through the sense organs and the afferent nerves to the psychophysical niveau and thus calling forth the world of percepts is a simplification. Percepts are not mere effects of stimulation in an empty field. Rather they are reactions of the organism to the impingements coming through the senses and, to that extent, depend on the nature and momentary state of the organism, as well as on the nature of stimulation. Considering this, we must not be surprised about the modifications of our phenomenal perceptual world in

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consequence of changing motivational states: the recentering, the standing out of objects relevant to these states, the acquisition of varying valences by these objects, and so on. But all this has nothing to do with our problem, for the following reasons.

(1) These changes are not due to an activity of the subject, be it impulsive or intentional. They follow immediately from a modification of the nervous system itself.

(2) These changes are not instances of creativity. They come about by an increased (or diminished) sensitivity to specific *objective* facts by which the efficacy of their influence on the subject is enhanced (or lessened). In the moment when, instead of this increase of sensitivity, creative processes in the strict sense of the word take place, perception becomes prejudiced, distorted, illusionary, and in higher degrees hallucinatory and paranoid, that is, it is no longer cognition in the sense of reproduction of reality but a kind of daydream occasioned by the present stimulation and therefore no longer fit for information and mutual understanding.

### **Conclusion: The Less Creation, the More Information**

Perception is not a way of adding new facts to the world - this is the task of art and invention - but to find what there is before perceiving begins, but which has not yet been found by the present perceiver. In everyday perception the possibility of changing the observed object by the very act of observation need not bother us, though it plays a role in psychotherapeutic situations. There the endeavor to find out what is the matter with the patient may initiate real changes in him, so that after "observation," in some cases, he is no longer the same person as before. Apart from this particular case, in a perceiver creativity can only consist in inventing better and better methods of putting questions to phenomena and of making them answer these questions. But finally everything depends on listening to the answers. A judge who is talking all the time instead of having the witness speak does not get the information he needs.

To state the decisive point explicitly once more: the phenomenal or perceived world is one of the most ingenious inventions of organisms. These cannot directly orient themselves in their wider physical surroundings. But they acquire this possibility by a detour. They develop a kind of enclave within themselves, in which through the sensory apparatus a copy of the surroundings as well as a copy of the organism itself is built up. Between these copies - the phenomenal world and the phenomenal

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ego - the interaction exists that is lacking between the organism and its physical surroundings. By connecting the subject with the executive by cybernetic means, the organism becomes able to act and react adequately also in and to its wider physical surroundings. But if this is the case, the appliance will function most satisfactorily only if the processes representing the surroundings are controlled from outside as exclusively as possible, that means, if interference from the side of the subject is minimized. From this it can be understood what it means to be passive when perceiving, and even to be a "battle-field of stimuli." This kind of passivity, which to some of us, as it seems, is beneath human dignity, is the presupposition of prosperous action, particularly of group interaction and of successfully improving the world when we find that is should be better.

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### **References**

AEBLI, H. Psychologische Didaktik. Stuttgart: Klett, 1963.

BENUSSI, V. Zur Psychologie des Gestalterfassens. In A. MEINONG (ed.) Untersuchungen zur Gegenstandstheorie und Psychologie. Leipzig: J.A. Barth, 1904.

BRETANO, F.C. Psychologie vom empirischen Standpunkte. Leipzig: Duncker and Humboldt, 1874.

BÜHLER, K. Die Gestaltwahrnehmungen; experimentelle Untersuchungen zur psychologischen und ästhetischen Analyse der Raum- und Zeitanschauung. Stuttgart: W. Spemann, 1913.

BÜRKLEN, K. Das Tastlesen der Blinden-Punktschrift. *Zeitschrift für Angewandte Psychologie*, 1917, 16, 1-66.

DESCARTES; R. Meditationen mit sämtlichen Einwänden und Erwiderungen. Leipzig: 1915.

DITCHBURN, R. W., and GINSBORG, B.L. Vision with a stabilized retinal image. *Nature*, 1952, 170, 36-37

DUNCKER, K. Zur Psychologie des produktiven Denkens. Berlin: Springer, 1935.

FICHTE, J.G. Einleitungsvorlesungen in die Wissenschaftslehre, die transzendentale Logik und die Tatsachen des Bewusstseins. Leipzig: 1797.

FISHER, G.H, The framework for perceptual localization. Unpublished Ph.D. dissertation, University of Newcastle upon Tyne, 1968.

GIBSON, E.J. Perceptual development and the reduction of uncertainty. In A.V. ZAPOROZHETS and E.J. GIBSON (eds.) Symposium: Perception and Action. Proceedings 18th International Congress of Psychology, Moscow, 1966, 7-17.

GIBSON, J.J. The perception of the Visual World. Boston: Houghton-Mifflin, 1950.

- The Senses Considered as Perceptual Systems. Boston: Houghton-Mifflin, 1966.

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GREGORY, R.L. Distortion of visual space as inappropriate constancy scaling. *Nature*, 1963, 199, 678-680.

- Comments on the inappropriate constancy scaling theory of the illusions and its implications. *Quarterly Journal of Experimental Psychology*, 1967, 19, 219-223.

HELD, R. Plasticity in sensorimotor coordination. In A. V. ZAPOROZHETS and E.J. GIBSON (eds.) Symposium: Perception and Action. Proceedings 18th International Congress of Psychology, Moscow, 1966, 7-17.

HELMHOLTZ, H. von: Treatise on Physiological Optics. J.P. SOTHALL, trans. and ed. New York: Dover, 1962.

HERING, E. Grundzüge der Lehre vom Lichtsinn. Berlin: Springer, 1861-1862; and in GRAEFE and SAEMISCH (eds.), *Handbuch der gesamten Augenheilkunde*. Vol III. Berlin: Springer 1920.

- Der Raumsinn und die Bewegungen des Auges. In L. HERMANN (ed.), *Handbuch der Physiologie*. Vol. III. 1st part, p. 343 ff. Leipzig: Vogel, 1879.

HOCHBERG, J. What is learning in perceptual development? In A.V. ZAPOROZHETS and J.J. GIBSON (eds.), Symposium: Perception and Action. Proceedings 18th International Congress of Psychology, Moscow, 1966, 18-26.

HOLST, E. v., and MITTELSTAEDT, H. Das Reafferenzprinzip. *Die Naturwissenschaften*, 1950, 37, 464-476.

ITTELSON, W.H. Visual Space perception. New York: Springer, 1960.

KATONA, G. Organizing and Memorizing: Studies in the Psychology of Learning and Teaching. New York: Columbia University Press, 1940.

KOFFKA, K. Principles of Gestalt Psychology. New York: Harcourt, Brace, 1935.

KÖHLER, W. Über unbemerkte Empfindungen und Urteilstäuschungen: *Zeitschrift für Psychologie*, 1913, 66, 51-80.  
- Zur Komplextheorie. *Psychologische Forschung*, 1930, 13, 293-364.

KOPFERMANN, H. Psychologische Untersuchungen über die Wirkung zweidimensionaler Darstellungen körperlicher Gebilde. *Psychologische Forschung*, 1930, 13, 293-364.

KLIX, F. Elementaranalysen zur Psychophysik der Raumwahrnehmung. Berlin: VEB Deutscher Verlag der Wissenschaften, 1962.

KRISTOF, W. Über die Einordnung geometrisch-optischer Täuschungen in die Gesetzmäßigkeiten der visuellen Wahrnehmung; Teil 1. *Archiv für die gesamte Psychologie*, 1961, 113, 1-48, 127-150.

KÜPPERS, E. Die Psychophysiologischen Grundlagen des Wahrnehmens. *Archiv für Psychiatrie und Nervenkrankheiten*,

1971, 214, 301-318.

LOTZE, R.H. Medicinische Psychologie; oder Physiologie der Seele. Leipzig: Weidmann'sche Buchhandlung, 1852.  
- Mikrokosmus. Ideen zur Naturgeschichte und Geschichte der Menschheit. Leipzig: S. Hirzel, 1872-1876.

McDOUGALL, W. Energies of Men: A Study of the Fundamentals of Dynamic Psychology. London: Methuen, 1932.

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METZGER, W. Tiefenerscheinungen in optischen Bewegungsfeldern. *Psychologische Forschung*, 1935, 20, 195-260.  
- Zur anschaulichen Repräsentation von Rotationsvorgängen und ihrer Deutung durch Gestaltskreislehre und  
*Gestalttheorie. Zeitschrift für Sinnesphysiologie*, 1940, 68, 261-279.  
- Psychologie; die Entwicklung ihrer Grundannahmen seit der Einführung des Experiments. Darmstadt: Steinkopf,  
1968.  
- Das Wahrnehmungsfeld als zentrales Steuerungsorgan. *Ceskoslovenská Psychologie*, 1969, 8, 417-431.  
- Consciousness, judgment and action. In E.C. CARTERETTE and M.P. FRIEDMAN (eds.), *Handbook of perception*. New:  
Academie Press, 1972.

METZGER, W., VUKOVICH-VOTH, O., and KOCH, I. Über optisch-haptische Masstäuschungen an dreidimensionalen  
Gegenständen. *Psychologische Beiträge*, 1970, 12, 329-366.

MÜLLER, G.E. Die Gesichtspunkte und die Tatsachen der psychophysischen Methodik. In L. ASHER and K. SPIRO (eds.)  
*Ergebnisse der Physiologie*. Jahrg. II, 1903, 2, 267-519.  
- Komplextheorie und Gestalttheorie. Göttingen: Vandenhoeck and Ruprecht, 1923.

PETERMANN, B. Die Wertheimer-Koffka-Köhlersche Gestalttheorie und das Gestaltproblem. Leipzig: Barth, 1929.  
- Das Gestaltproblem in der Psychologie im Licht analytischer Besinnung. Leipzig, Barth, 1931.

PIKLER, J. Sinnespsychologische Untersuchungen. Leipzig: Barth, 1917.

PRITCHARD, R.M., HERON, W., and HEBB, D.O. Visual perception approached by the method of stabilized images.  
*Canadian Journal of Psychology*, 1960, 14, 67-77.

SCHOPENHAUER, A. Die Welt als Wille und Vorstellung. Leipzig: Brockhaus, 1818.

SMITH, O.W., and SMITH, P.C. Response-produced visual stimuli vs. non-RPVS for distance judgment in natural and  
unnatural units by children and adults. In A.V. ZAPOROZHETS and J-J. GIBSON (eds.), *Symposium: Perception and  
Action. Proceedings 18th International Congress of Psychology*, Moscow, 1966, 101-109.

SOKOLOV, J.N. Die reflektorischen Grundlagen der Wahrnehmung. In H. HIEBSCH (ed.), *Ergebnisse der sowjetischen  
Psychologie*. Berlin: Akademie-Verlag, 1967.

STRATTON, G.M. Eye movements and the aesthetics of visual form. *Philosophische Studien*, 1902, 20, 20, 336-359.

SWETS, J.A., TANNER, W.P., and BIRDSHALL, T.G. Decision processes in perception. In J. A. SWETS (ed.) *Signal  
Detection and Recognition by Human Observers*. New York: Wiley, 1964.

TAUSCH, R. Optische Täuschungen als artifizielle Effekte der Gestaltungsprozesse von Größen- und Formenkonstanz  
in der natürlichen Raumwahrnehmung. *Psychologische Forschung*, 1954, 24, 299-348.

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- Nichtbewusste (sogenannte unbewusste) Vorgänge bei der optischen Größenwahrnehmung von Gegenständen.  
*Psychologische Forschung*, 1955, 25, 28-64.

TSCHERMAK-SEYSENEGG, A. Über Parallaktoskopie. *Pflüger's Archiv für die gesamte Psychologie*, 1939, 241, 455-469.

WALLACH, H. On sound localization. *Acoustical Society of America*, 1939, 10, 270-274.

WEIZSÄCKER, V. v. Der Gestalt-Kreis - Theorie der Einheit von Wahrnehmen und Bewegen. Leipzig: Georg Thieme  
Verlag, 1940.

WERTHEIMER, M. Experimentelle Studien über das Sehen von Bewegung. *Zeitschrift für Psychologie*, 1912, 61, 161-265.

- Untersuchungen zur Lehre von der Gestalt. *Psychologische Forschung*, 1923, 4, 301-350.

WUNDT, W. Grundzüge der physiologischen Psychologie (6th ed.). Vols. I and II. Leipzig: W. Engelmann, 1908.

ZAHN, C. Sind die Augenbewegungen ein Indikator für gestaltliches Sehen? Münster: VD-Arbeit bei G. HAUBENSAK, 1968-1969.

ZANFORLIN, M. Some observations on Gregory's theory of perceptual illusions. *Quarterly Journal of Experimental Psychology*, 1967, 19, 193-197.

ZAPOROZHETS, A.V., and GIBSON, J.J. (eds.). Symposium: Perception and Action. Proceedings 18th International Congress of Psychology. Moscow, 1966.

ZINCHENKO, V. P. Perceptions as actions. In A.V. ZAPOROZHETS and J.J. GIBSON (eds.), Symposium: Perception and Action. Proceedings 18th International Congress of Psychology, Moscow, 1966, 64-73.