James J. Gibson

(See also Chapter 1 web page on ecological theory.)

Early Alignment with the Classical Tradition

Gibson (1904–1979) began his career as a follower of the classical tradition in perceptual theory (Lombardo, 1987). Initially a Berkeleian, Gibson believed that visual perception of spatial relations, i.e., distance, was mediated by tactual-muscular phenomena. Perception was considered a mediated process and, thus, was consistent with an indirect realist perspective. This alignment with beliefs in mediated processes was apparent in Gibson's work during World War II on depth perception. In order to identify people who might be good pilots Gibson subjected people to tests associated with the accepted theory of depth perception (Gibson, 1979/1986). Based upon the Helmholtzian tradition of cues for inferring depth, Gibson tested people in linear perspective, light and shade, apparent size, relative motion, accommodation, convergence and binocular disparity, i.e., monocular and binocular cues to depth. Such tests did not predict flying ability. The accepted theory of depth perception did not work and, as he explored the issue further, he came to realize that the whole theory was false. During the 1950s Gibson would undergo a transformation in his thinking such that by the 1960s he was forging ahead with a new perspective on vision that was decidedly a direct realist position.

Gibson (1950) published a text that focused on visual perception based upon phenomenological descriptions of the perceptual experience of the to-be-perceived environment (Lombardo, 1987). During this period he took phenomenology to be consistent with indirect perception but doubts were beginning to arise. It was a period during which Gibson was becoming impressed with the degree to which perception was veridical or corresponds with objective facts. It was really remarkable, from the standpoint of making inferences about the world, that people could drive automobiles and avoid crashing into each other or that pilots could land planes so effectively. It seemed incredible that perception, phenomenologically, was not of the environment. This incredulousness was echoed by M. Eysenck (1993) when he suggested, "if perception really involves educated guesses about the meaning of 'scraps of data', then it is surprising that perception is usually rather accurate" (p. 37). Besides the veridicality of perception, Gibson could not help being impressed with the high consensus that existed between subjective reports of experimental participants. It was becoming hard to believe that cerebral organization (Gestalt) or the influence of prior experience (unconscious inference) could account for such agreement. Something, he felt, was seriously amiss in psychological theorizing about perception. Rather than the world being perceived as a result of mediating mechanisms, i.e., an indirect realism based upon mental representations, people seemed to be responding to the real world as the object of their perceptions. Perception appeared to involve a direct access to the objective world beyond the senses.

Questionable Stimuli

The position of the constructionists was bolstered by findings that showed that perception could be fooled, that people are susceptible to illusions. That perception could be illusory brought all perception into question. Such talk of ambiguity and constructions-of-reality were beside the point to Gibson (1979/1986) because it was based upon artificial stimulation and unnatural distortions in perceptual stimuli, distortions that seldom occur under natural conditions. Line drawings (e.g., the Ponzo illusion or the Műller-Lyer) or unstable visual stimuli (perceptual ambiguity) like those generated by the "Necker cube" are not consistent with the information provided by normal viewing conditions. On top of that, in some experimental demonstrations stimuli were presented for exceptionally brief periods of time by way of a tachistoscope. Such experimental stimuli did not impress Gibson. The use of the tachistoscope was a calamity because it did not allow the perceptual system to operate normally. Such distortions as the tachistoscope may produce may reveal something of sense physiology but they did not inform as to how the world was perceived. Presentations are too quick for normal processing and are thus not only impoverished, they interfere with normal perceptual processes like scanning (sweeping over the visual field and extracting information) and examination (Gibson, 1966). Gibson argued further that illusions based upon two-dimensional line drawings might tell of vision under unusual conditions but vision evolved for functioning in a three-dimensional world and these illusions did not apply there.

Neisser (1976) was also sensitive to the problem of ignoring the normal perceptual environment. While effort had been focused on hypothetical models, insufficient attention had been paid to the environment that perception had evolved in and been adapted to. The stimulus displays that are used in research are nearly non-existent under natural viewing conditions. Brief presentations (portions of a second) lack the temporal coherence of current, antecedent, and subsequent occurrences, and they further lack their spatial linkages with the rest of the environment. On top of that, the subjects of the research are isolated from their normal life conditions and they are not in a position to either initiate or cease the experimental trials. To Neisser, that is, to say the least, problematic:

> Although the data obtained under such conditions can serve as the basis of much ingenious theorizing, the resulting theories may mislead us. Experimental arrangements that eliminate the continuities of the ordinary environment may provide insights into certain processing mechanisms, but the relevance of these insights to normal perceptual activity is far from clear. (Neisser, 1976, p. 36)

The adoption of such methods, in Neisser's estimation, was the natural product of the "internal processing theory of perception" or what we have been calling the constructionist approach.

Direct Perception

As an alternative, Gibson proposed that if, at an organism's receptors, there exist invariants in the flux of energy that corresponds with permanent environmental properties, and if they are the true basis of perception rather than sensory data, we have a reason for believing in

realism. Gibson argued that, if it were true, no operation was in need of being postulated to be that which acts upon sense data, or of any in the nervous system that worked upon nerve signals. So, if the theory of perception is based upon the pickup of information, sensory impressions are merely incidental symptoms and are not involved or implied in perception. (Such a suggestion may be an account of why Titchener's trained introspectionists found it impossible to break their percepts down into the elementary sensations that composed them, perceiving things, objects—the so-called *stimulus error*.) In asserting that environmental perception is direct, Gibson (1979/1986) meant that retinal images or pictures were not acting as mediating mechanisms, nor were neural pictures. To say that perception is direct meant that one is engaged in the acquisition of information from the array of ambient light.

Sense data may not enter into perception when dealing with perceptual systems as they provide an awareness of objects but not necessarily the receptors stimulated. There is a shift from notions of passive stimulation of receptors to acts of perceiving, e.g., looking, touching, hearing, that goes beyond passive receptors to active search for information to be obtained.

The New Approach to Research

Gibson's direct realism transforms how research in perception is to be conducted by shifting the starting point from the receptors to objects in the environment that can be perceived. A processing model that starts with the static retinal image is ill equipped to account for the exploratory perception of shapes, acoustic events, or visual events (Neisser, 1985). In Neisser's assessment, this shift involved three steps in the study of perception. The first step, as was just noted, involved describing the sorts of things that can be perceived rather than inventing mechanisms (such as unconscious inferences). Gibson's list of perceivables included objects, surfaces, events, body position, movement, and what action could be performed, i.e., what the environment would allow for (what Gibson called *affordances*). The emphasis was shifted from the perceiver to the perceivable environment.

The second step, after specifying what could be perceived, was to analyze the information structures by which perceivable things can be specified and make perception possible. In visual perception the critical information structures exist in the light itself. The structure of things in the world is represented in the structure of the light reflected from those worldly things; it is those things that are the source of whatever information is to be picked up. Things are specified by this objectively existing information. Furthermore, the structure is picked up directly by the perceptual system without any need for intermediate steps. As a result, such intermediate steps as information processing mechanisms may be rendered unnecessary. "If we do not have a good account of the information that perceivers are actually using, our hypothetical models of their 'information processing' are almost sure to be wrong. If we *do* have such an account, however, such models may turn out to be almost unnecessary" (Neisser, 1987, p. 11).

The final step in Gibson's approach was to look at the process of perceiving, how information is obtained and what is actually perceived. One has to take into consideration the perceiving system and the activities engaged in the pursuit of information. Perceivers come last in the process of examination because it was necessary to understand what information was available before one would be in a position to understand how it is used. This is where perceptual systems and the sampling of the optical array enter in. Let me reiterate that the perceptual system evolved for this very function and is adapted to what can be picked up as information.

Gibson's approach, beginning with things that can be perceived and the information structures as they exist in the objective environment, does not suffer from the hopeless subjectivity that those who begin with the receptors end up with. By starting with what can be perceived, Gibson never loses access to the objective environment and the things that are perceivable. While this captures Gibson's revised program the account is incomplete.

What Neisser (above) has left out of his presentation of Gibson's theory, and something that renders the exposition incomplete, is the other half of the Gibson's enterprise—the development of perception. Gibson made it quite clear that this was an important aspect of the overall theory. "The whole inquiry has been shared for years with Eleanor Gibson, my wife. In 1963, however, we divided the problems between us, and she has concentrated on perceptual learning and development while I concentrated on the senses" (Gibson, 1966, p. viii).

Perceptual Development

Gibson and Gibson (1955) presented the foundation for what would become their theory of perceptual development. In this paper they distinguished two general theories of perceptual learning: *enrichment theory* and *differentiation theory*. Enrichment theory was associated with the constructionist approach and differentiation theory was associated with the Gibson's ecological theory of information pickup.

The theories that fall under the constructionist banner take the position take that sensations are impoverished or barren and have to be supplemented or enriched by the brain, as a result of accumulated experience. This is *enrichment theory* and Helmholtz's *unconscious inference theory* is a clear example. Accumulated experience exists in traces of the past and takes up residence somehow in our current perceptions. These theories accept a distinction between sensation and perception and assume that perceptual development involves an increasing influence by the interpreting or organizing processes. As a result of such organizing or interpreting processes, the meager sensations that environmental stimulation provide are enriched or embellished. As a result, there is a progressive decrease in the correspondence of the perception with the stimulation.

According to *differentiation theory* perceptual learning, as involving increased differentiation, is a wholly different proposition. It is held that perceptual development involves changes in percepts over time by increased elaboration of the features and qualities of variation as provided by information via stimulation. From the start, percepts are of the world and not sensation and, through learning, more and more of the properties of things, as presented in the structured information, are appreciated and the objects of the world become ever more distinctive. Whenever such learning is successful the phenomenal properties, i.e., the subjective experience, and the phenomenal objects have a greater correspondence with the physical properties of the environment and its objects.

Unlike the proposition of enrichment theory that percepts deviate ever more from the primary sensory stimulation, differentiation theory holds that there is an ever-increasing correspondence between stimulation and phenomenal experience or percept. One learns to respond to those aspects of physical stimulation that had not as yet been understood or responded to.

> What *is* novel is to suggest that perceptual development is always a matter of the correspondence between stimulation and perception—that it is strictly governed by the relationships of the perceiver to his environment. The rule would be that, as the number of distinct percepts a man can have increases, so also the number of different physical objects to which they are specific increases. (Gibson and Gibson, 1955, pp. 34–35)

To support this, in the absence (at that point) of experimental evidence, Gibson and Gibson offered the example of two wine tasters—an amateur and an expert. Both drink the same wine samples: sherry, champagne, red, and white. To the amateur there are four percepts that correspond to the four wine types. The expert, however, unlike the amateur, can distinguish various qualities in each type of wine. This results in a variety of percepts due to an increased skill at differentiating the characteristics that wines possess (variations in flavor, bouquet, and appearance are some of the qualities that may be differentiated). While Gibson and Gibson did not emphasize this, it should be noted that each person, novice or expert, tastes the same wine and has the same stimulation of receptors and the same sensations (assuming no major differences in their sensory system for taste). While the stimulus information available is the same for each they can be distinguished by their abilities to extract from the information available to them. Perceptual development is thus a process of making greater sense of what is, and always has been, available at the level of the receptors.

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