is the question of *direct realism,* also known as *naïve realism,* as opposed to *indirect realism,* or *representationalism.* I note parenthetically that although Gibson (1966; 1979) called himself a naïve realist, this was only a provocation. The theory of direct perception is neither naïve nor realistic. As Michaels and Carello (1981, p. 90) clearly put it, "the test of the veridicality of perception concerns the mutual compatibility of the action of the actor/perceiver with the affordances of the situation." Here we are very far from the veridicality requested by genuine naïve realism.

More important is the picture of Gestalt psychology that Lehar offers to us. It is well known that in *Gestalttheorie* there was a strong Spinozian attitude. For example, Wertheimer (greatly impressed by Spinoza's *Ethica* from childhood on: see Luchins & Luchins 1982) remained in this orientation all his life. So we can speak in terms of an indifference or "indifferentism" about the problem of representation. In general, Gestaltist isomorphism has to be considered as a variant of psychophysical parallelism (see Boring 1942; 1950, mainly Ch. 13; for a recent survey of this issue, see Luchins & Luchins 1999). But the same could be said about almost all other Gestalt psychologists. Lehar quotes Köhler extensively. But Köhler never said that "the world we see around us . . . (is) . . . generated by neural processes in our brain" (target article, sect. 2, para. 1). Köhler, indeed, was in some instances a little ambiguous on this topic (e.g., Köhler 1969). But he was absolutely clear when he had to address the mind-body problem directly. He conceived the Gestalt position as a variant of parallelism (Köhler 1960, pp. 20–21), and said: "The thesis of isomorphism as introduced by the Gestalt psychologists *modifies* the parallelists' view by saying that the *structural* characteristics of brain processes and of related phenomenal events are likely to be the same" (emphasis added).

Lehar, quoting Köhler (1969), insists that the isomorphism required by Gestalt theory is not a strict *structural* isomorphism but merely a *functional* isomorphism. But Köhler always spoke of structural isomorphism. He was very clear in stating (Köhler 1940, Chs. 2 and 3) that the processes that run in our brain do not have any necessary correlate in our phenomenal experience. What is *structurally* identical is their interaction with what happens in bordering areas of the brain and the interaction that there is in the phenomenal field: Their dynamics and the dynamics of the phenomenal field.

The structural identity between the phenomenal world and physiological processes does not imply any causal relationship between the two levels. It means only that we are made up of one, and only one matter. The physical laws that rule matter lead to structurally identical outcomes when we consider the phenomenal level as well as the physiological one. In this sense, Gestalt psychology is neither representationalist nor antirepresentationalist; it is indeed indifferentist.

The main limit of Lehar's model derives, in my opinion, from this misunderstanding. His computational model, as I can assess it, works perfectly for a world that is organized in terms of soap bubbles (Koffka's metaphor [Koffka 1935], used too by Attneave 1982). A soap bubbles world is, in Gestalt terms, a world in which the forces of the perceptual field tend to dispose themselves to make an outcome that is maximally *good,* pregnant in the sense of *ausgezeichnet.* In Lehar's model, this happens at the phenomenological as well as the neurophysiological level. The fact is that – as I believe Kanizsa and I have demonstrated (Kanizsa & Luccio 1986; 1990) – a tendency of this kind does not exist in perception. These tendencies are instead well present in thinking, in memory, in all that Kanizsa (1979, Ch. 1) called "secondary processes," to distinguish them from primary processes of perception. But they are beyond the scope for which the concept of isomorphism is interesting – and relevant.

In recent years, a few other computational models have been presented to account for some typically Gestaltist phenomena, from information theory, to coding theory, to group algebra. However, Lehar is right when he says that they cannot account for both the phenomenal level and the neuropsychological level. I should stress that there is at least one exception: nonlinear dynamic systems, and, in particular, the synergetic approach. Apparently, we have not yet at our disposal a fully comprehensive theory; it should be interesting to test if the model proposed by Lehar could be integrated with other approaches.

The unified electrical field

William A. MacKay

Department of Physiology, University of Toronto, Toronto, ON M5S 1A8, Canada. **william.mackay@utoronto.ca**

Abstract: The electrophysiological perspective presents an electrical field that is continuous throughout the body, with an intense focus of dynamically structured patterns at the cephalic end. That there is indeed an isomorphic mapping between the detailed holistic patterns in this field and in perception (at some level) seems certain. Temporal binding, however, may be a greater challenge than spatial binding.

The independent processor model of individual neurons has given rise to the widespread impression, echoed by Lehar, that neurophysiology fails to deliver a unified basis for the holistic properties of perception. If there is any "illusion," it is not in the unity of perceptual awareness but in the portrayal of physical separation by techniques such as extracellular recording and fMRI. Overlooked is the axis of continuous activity stretching from the spinal cord to the cerebrum. The tonic activity in the brain stem activating systems (cholinergic, serotonergic, and noradrenergic), plus the histaminergic activating system of the hypothalamus, is responsible for our state of (un)consciousness (Pace-Schott & Hobson 2002). All sensory and motor activity feeds into this axis and influences the general distribution of activity. Also, the activating systems can directly trigger synchronization of activity within the cerebral cortex (Munk et al. 1996).

Furthermore, it is extremely doubtful that action potentials are of much significance in the direct link to perception. They are far too fleeting. It is the more sustained membrane potentials that are likely to correlate the best. Discrete neuronal activity in the brain, however isolated it may appear, is simply a local distortion in an unbroken continuum of electrical flux. All cells produce membrane potentials, even if static, such that an electrical field encompasses the entire body. The "panexperientialism" view would also suggest that perceptual awareness is linked to something like an electrical field. This is the only obvious property that is shared by both the atom and the organism, and it is increasingly elaborated as one ascends to the organism. One might postulate that the higher the degree of complexity in the electrical field, the higher the level of consciousness experienced. Using fMRI, it can be seen that the same cortical areas are active whether a stimulus is perceived or not. The difference in the case of perception is that the level of activation is greater (Moutoussis & Zeki 2002). This could mean either that more neurons are depolarized within the given area, or that the same synapses are active, but at a higher frequency, or both.

Neurons and their attendant glial cells manipulate membrane potentials like no other part of the body. This is their "game." Many attributes of neuronal electrical activity extend the range of information coding. No single one of them is the essence of conscious perception, but collectively they can raise (or lower) the level of consciousness. Spike synchrony is unquestionably relevant. For example, Riehle et al. (2000) have shown that unit pairs in the motor cortex synchronize activity to a very significant degree exactly at the moment of an expected signal. However, synchrony is not essential for "binding." In area MT, Thiele and Stoner (2003) recorded from pairs of units, one pair preferring the direction of motion of one visual grating, and the other preferring another grating direction. The units did not usually synchronize activity when the gratings were perceived as moving together in a

https://doi.org/10.1017/S0140525X03330092 Published online by Cambridge University Press

coherent plaid. Synchrony elicited by coherent plaids was the same as for noncoherent ones. Again, it is probably not spiking activity per se that is ultimately important, but the associated changes in membrane potential and possibly phenomena such as depolarization fields manifested in superficial layers of cortex (Roland 2002).

The various states of Lehar's Gestalt Bubble model can easily be construed as hypothetical neuronal feature detectors. One could not ask for a better set of discriminators of planar properties in depth, and I suspect that something very similar lurks somewhere in the association areas between V1 and the inferotemporal cortex. The transformation from a two-dimensional image on the retina to a three-dimensional percept would follow a process as outlined by Lehar when the stimulus is an everyday, familiar experience with established expectations. For any unfamiliar object, whether presented to the eye or hand, exploratory movement is requisite to clarify ambiguities. Here, Lehar is correct to emphasize the translation/rotation invariance of the perception, divorced from the motion of the explorer. The target is perceived as it relates to its environment external to the viewer. This is the essence of the great transformation from egocentric (parietal cortex) to allocentric representation (presumably in the hippocampus or prefrontal cortex). The constancy of the percept over time as another data sample is added with each exploratory movement is also rightly highlighted.

It is essential that perception integrate over time as well as space. Even within one sampling episode, different sensory attributes such as color and motion are processed at slightly different times, although they are perceived as a unity. Hence, Zeki and Bartels (1998) postulate the existence of multiple "microconsciousnesses" in the brain, which are asynchronous with one another. This raises the problem of how they are integrated. A simple possibility is that everything processed within a finite window is integrated, just as two colors flashed within less than 40 milliseconds are blended together. But it cannot be that simple, because haptic exploration of an object can continue for hundreds of milliseconds.

Figure-ground designation also involves time constraints. Neurons in the inferotemporal cortex that are selective for shape maintain that shape preference when light-dark contrast is reversed (negative image) but not when a figure-ground reversal is made. Just as the perception of shape depends on whether a visual region is assigned to an object or background, so the visual analysis of form depends on whether a region is perceived as figure or ground (Rubin 2001). One cannot relegate the problem of resolving border-ownership of edges to earlier stages in the visual stream. It occurs quickly, within 10–25 milliseconds of response onset and really requires feedback from higher cortical areas. Hence, it is an instantaneous, holistic decision of the entire visual system, presumably selecting the most probable choice.

Lehar's excellent model of perceptual processes gives neurophysiology some precise goals and direction. Hopefully, the outcome will be convincing evidence that every percept is associated with a unique distribution of neuronal activity. An immediate problem, however, is the elucidation of the mechanism for binding elements of a percept in time.

The soap bubble: Phenomenal state or perceptual system dynamics?

Slobodan Marković

Laboratory of Experimental Psychology, Faculty of Philosophy, University of Belgrade, Belgrade, 11000, Serbia and Montenegro. **smarkovi@f.bg.ac.yu**

Abstract: The Gestalt Bubble model describes a subjective phenomenal experience (what is seen) without taking into account the extraphenomenal constraints of perceptual experience (why it is seen as it is). If it intends to be an explanatory model, then it has to include either stimulus or neural constraints, or both.

While presenting the theoretical background of his approach, Lehar attempts to keep a critical equidistance toward both indirect and direct realism. However, instead of a radically new approach, he offers a combination of some constructivist and some Gibsonian premises. On the one hand, like many constructivists (e.g., Gregory 1971; Hochberg 1978; Marr 1982; Rock 1983), Lehar adopts a representational paradigm that defines perception as a subjective conscious description or as an internal virtual copy of the external world. On the other hand, inconsistent with the constructivists' perspective and more similar to the views of proponents of direct realism (e.g., Gibson 1979; Shaw & Bransford 1977; Shaw & Turvey 1981), Lehar does not postulate any mediating mechanisms that process the representations within a perceptual system.

Moreover, Lehar's exact position concerning the question of direct perception of distal objects is not quite clear. At one point he explicitly claims that "the internal perceptual representation encodes properties of distal objects rather than of a proximal stimulus" (sect. 9, last para.). At another point he states that "the direct realist view is incredible because it suggests that we can have the experience of objects out in the world directly, beyond the sensory surface, as if bypassing the chain of sensory processing" (sect. 2.1, para. 1). Why would the thesis that distal objects are mapping onto the phenomenological domain without neural intervention be incredible and mysterious, while the idea about the projection of internal representation onto the external perceptual world not be incredible and mysterious? How is it possible that perception is partially indirect (representational), and partially direct (distally oriented)?

In his criticism of neurophysiologic modeling, Lehar rejects not only the classical Neuron Doctrine, but also some recent holistic approaches (cf. Crick & Koch 1990; Eckhorn et al. 1988; Singer 1999). Hence, for Lehar, the greatest shortcoming of neural models is not atomism, but rather, the problem of neurophenomenal decoding. That is, how can a fully spatial (topographical) perceptual description be created from spatially less constrained (topological), or even completely abstract, symbolic, and nonspatial neural representation? I find that this epistemological question is a natural consequence of a hidden ontological dualism: How does one domain of reality (consciousness) know how to read and understand the codes coming from the other (neural) domain?

To paraphrase Koffka (1935), the ultimate task for perceptual science is to answer why things look as they do. In the case of Lehar's theory, this question might be formulated as the following: Why is the phenomenal volumetric space such as it is? Why is it nonlinear in a particular way? Implicitly, Lehar proposes that this is an intrinsic property of phenomenal space which is not in a causal relationship with any other domain of reality. My opinion is that without the precise specification of the extraphenomenological aspects of perception, such as the stimulus and neural domains, it is difficult to answer the question related to why the percept looks as it does. For instance, imagine the difficulty in explaining the path shape and velocity of the planet Earth's motion without taking into account the mass and motion of other cosmic objects (moon, sun, other planets, and so on). A description of the Earth's motion is not an explanation of its motion.

Even Gestalt psychologists, who widely utilized the phenomenological method, did not create pure phenomenological explanations of perception. For instance, Koffka (1935) used the soap bubble metaphor, not to describe some phenomenal bubblelike experience, but to point out some basic principles of perceptual (neural) system functioning. Attneave (1982) also used the metaphor "soap bubble system" to describe the economy of perceptual system behavior. Like the soap bubble, which tries to enclose the largest volume within the smallest surface, the perceptual system tends to reduce the global spending of energy (entropy, minimum tendency) while at the same time striving to increase its effective use (dynamics, maximum tendency) (cf. Köhler 1920/1938; 1927/1971; see also Hatfield & Epstein 1985; Marković & Gvozdenović 2001).

https://doi.org/10.1017/S0140525X03330092 Published online by Cambridge University Press