It follows that there cannot be a natural science of perception. There is a science of perceptual report, a tradition that goes back to Fechner (1860/1966). But perceptual reports cannot be taken at their face value (here the Gestalt psychologists erred); rather, they must be evaluated by experiment. Lehar is aware of this (sect. 5.2), but asserts that perceptual experience is isomorphic to the neural substrate and thereby denies this distinction.

Lehar's stance is that "the world of conscious experience is accessible to scientific scrutiny after all, both internally through introspection and externally through neurophysiological recording" (sect. 2.3, para. 9). He envisages an isomorphism between perceptual experience as described by the observer and the observations of the natural scientist. Thouless's (1931a; 1931b) experiment on phenomenal regression to real size (Fig. 2) shows why such an isomorphism is not found in nature.

The observer's task is to select a disc set normal to the line of sight at distance *a* to match the *angular size* of the larger disc at distance *b*. Although people do choose a smaller disc from the alternatives at *a,* they systematically choose one too large to match (phenomenal regression to real size). Imagine that a neurophysiologist is making observations at the neural level of description relevant to understanding how and why this error of judgment occurs. If the observer's perceptions stand in the same relation to the neural substrate as the neurophysiological observations, then there has to be an internal "observer" looking at internal processes with the same objectivity as the neurophysiologist. The fact that Lehar has a mathematical model to replace the neurophysiological observations does not alter this requirement. This observer is represented by the "thinks bubble" in Figure 2. Philosophers will immediately identify this internal observer as Ryle's (1949) "ghost in the machine" (which is why the "thinks bubble" is decisively crossed out).

I next ask whether the hypothetical neurophysiologist can also observe the neural substrate of this "ghost." If so, the relationship of the ghost to the neural substrate is structurally different from that of the neurophysiologist; otherwise the "ghost" is pure mind-stuff. In fact, verbal descriptions of what is perceived are produced by the same system as that which does the perceiving, and the relationship of "observer" (if that term may still be used) to the neural substrate that is supposedly "observed" is essentially different from that of a third-party neurophysiologist. Several conclusions follow:

There need not be any useful isomorphism between neural process and perceptual experience.

Modelling perceptual experience is not an alternative to understanding the neural process.

There cannot be a natural science of perception, distinct from the study of perceptual report.

The idea of psychological relativity also impacts on consciousness (sect. 6). Because it is impossible to access any other person's subjective experience, it is not possible to observe any other person's consciousness. Even if the hypothetical neurophysiologist were to observe and record a substrate in the brain that subserved consciousness, there is no way in which the observations could be identified as such. However much one explores the brain, all that one finds is brain function. Phenomenal consciousness is simply the quality of subjective experience.

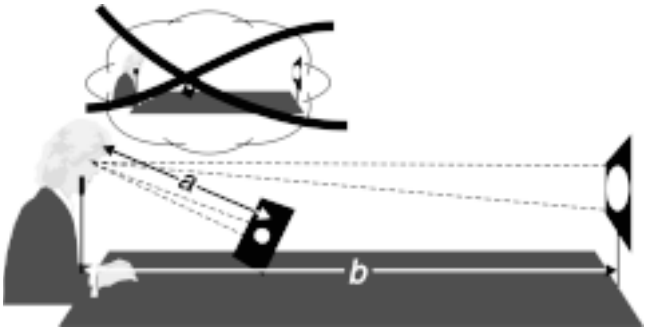

Figure 2 (Laming). Experimental set-up for the measurement of phenomenal regression to real size. (© 2004, Donald Laming. Adapted with permission from D. Laming, *Understanding human motivation,* Blackwell.)

Lehar's discourse has neglected some real empirical relations between perceptual report and experimental observation. I give two examples. Rubin (1921) drew attention to the "figure-ground" phenomenon, the assertion that the first stage in visual perception was the separation of a figure from its background. Elementary neurophysiological study has revealed that sensory neurons are differentially coupled to the physical input (Laming 1986), so that they are specifically sensitive to boundaries in the visual field while responding with only a noise discharge to uniform illumination. This appears to match the "figure-ground" phenomenon. Second, the Necker cube is ambiguous as a visual stimulus. The ambiguity is temporarily resolved by factors from within the perceiver (sect. 7.3). But there is no reason why those internal factors should be consistent, comparing one instance with another, so that the project of constructing a consistent geometry of subjective perceptual space is not achievable.

Double trouble for Gestalt Bubbles

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Abstract: The "Gestalt Bubble" model of Lehar is not supported by the evidence offered. The author invalidly concludes that spatial properties in experience entail an explicit volumetric spatial representation in the brain. The article also exaggerates the extent to which phenomenology reveals a completely three-dimensional scene in perception.

The real world is a place of many properties; so also is its presentation as a phenomenal world in the conscious brain. One way for a brain state to present in experience a worldly property *P* is to duplicate *P* itself. Like a painter striving for perfect mimesis, an embodied consciousness might use patches of red in the head to represent a red apple. Or, according to Lehar, a brain might use spatial properties to represent external spatial reality:

> The central message of Gestalt theory is that the primary function of perceptual processing is the generation of a miniature, virtual-reality replica of the external world inside our head, and that the world we see around us is not the real external world but is exactly that miniature internal replica. (target article, sect. 10)

Lehar's article makes the case for the internal replica, or "Gestalt Bubble," and then develops a model of how three-dimensional spatial modeling could occur in something like a neural medium. In this commentary, I suggest that the evidence in support of the Gestalt Bubble is in double trouble. It is both conceptually and phenomenologically flawed.

The coffee in the cup at my elbow is (to me) hot, brown, of a certain weight and size, and in a specific location. We cannot conclude, however, that the state of my brain that is my consciousness of the coffee replicates any of these properties itself. Yet this is an inference Lehar seems to make repeatedly in the target article. For example: "The fact that the world around us appears as a volumetric spatial structure is direct and concrete evidence for a spatial representation in the brain" (sect. 5.2).

This is a non sequitur, as can be seen by substituting "colored" for "spatial" in the passage. A slightly more elaborate argument is no less fallacious:

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> The volumetric structure of visual consciousness and perceptual invariance to rotation, translation, and scale offer direct and concrete evidence for an explicit volumetric spatial representation in the brain, which is at least functionally isomorphic with the corresponding spatial experience. (sect. 5.1)

Lehar is right that functional isomorphism between phenomenal experience and its implementation is required to avoid "nomological danglers," but once again, "explicit volumetric spatial representation" is in no way entailed – for "rotation, translation, and scale" substitute "hue, saturation, and brightness," and the fallacy will be apparent. Nor does Lehar's claim that phenomenal spatiality preserves the relational structure of spatial objects entail an internal replica, because (once again) a three-dimensional relational structure defines "color space" without in the least implying that the color solid appears somewhere in our brain. Functional isomorphism, meanwhile, is readily preserved between spatial objects/scenes and their representations without invoking replicas. For example, the World Wide Web is well stocked with virtual worlds that preserve functional isomorphism with spatial scenes, each of them encoded in some nonspatial computational idiom such as VRML.

In sum, the conceptual arguments in the target article do not support the author's main conclusion. Nonetheless, the brain does have properties, and some of its properties do determine the contents of conscious experience. Lehar's arguments do not establish that the brain must use space to represent space. Does phenomenality license any inferences at all about the neural medium? There are two ways to approach this question, beginning either with contingent generalities about perception or with its essential structures. The first approach begins with features of phenomenality (as revealed by perceptual psychology, including the Gestalt demonstrations of our perceptual capacities). The second analysis isolates essential or necessary structures of phenomenality. The second approach accords with classical phenomenology, as exemplified in the works of Husserl (e.g., Husserl 1974). In either case, the hope is that the analysis of phenomena will constrain the search for computational architectures sufficient to generate some or all of the features of phenomenality.

On neither approach is there compelling reason to posit the spatial virtual world proposed by Lehar. I do not doubt that I live in a spatial world, but my visual field – that is, what I see before me right now – conveys far less spatial information than Lehar's Gestalt Bubble encodes. At the focus of attention I am aware of surfaces, distance from my eyes, and edges, but outside of focal attention I experience only a very indefinite spatiality, which seems to me to be inconsistent with the continuously present three-dimensional models constructed in the Gestalt Bubble. The supposition that my experience specifies a full 360-degree diorama in my head arises from the "just-in-time" availability of spatial information with every attentional focus. The information is there when and where I need it, and experience presents an ordered sequence of focally attended presentations rather than a single wraparound replica of the spatial world. This seems to be phenomenologically "given" but it is also amply confirmed in psychological studies of "inattentional blindness" (Mack & Rock 1998) and "change blindness" (Simons 2000). (Sect. 8.8 briefly acknowledges the effect of successive gaze fixations in different directions, suggesting that parts of the replica fade while outside the visual field. This suggests either that the replica has an absolute spatial orientation and does not turn with the head or, if the replica does turn with the eyes, that only a small focal part of it has the spatial detail Lehar describes.)

This disagreement can be made more rigorous and more properly phenomenological. One essential property of the phenomenal world is expressed in our ability to distinguish properties by location. That is, I can be aware of a red circle and a green square at the same time without confusing the pairings of colors and shapes. Austen Clark refers to the problem posed by this pervasive perceptual ability as the "Many Properties" problem, and he argues that it can be solved only by coding places along with other perceptual properties (Clark 2000). So "red" and "circle" must be assigned a location, and "green" and "square," a second location. Experience, of course, solves the Many Properties problem easily, and arguably it is essential to the very concept of phenomenality that consciousness solve it. This argument so far provides support for Lehar's position but immediately raises the question: How many spatial dimensions are required? Lehar advocates three, Clark suggests two, but the argument necessitates just one, a linear dimension along which one point is tagged "red" and "circular," and another "green" and "square." The basic dimension, then, would be temporal, and experience would be an orderly ensemble of phenomenal leaps and bounds, a time line. Spatiality emerges from trajectories encoded in proprioception that orient each momentary percept to those before and after. This proposal conforms well with classical phenomenology (Husserl 1966; 1974), and in other work, I present evidence for its implementation in the brain (Lloyd 2002; 2003). This alternative cannot be defended here, but it does suggest that the Gestalt Bubble is not entailed by phenomenology.

It is important that theories of perception accommodate the Gestalt observations; Lehar brings forward an essential array of examples to consider, and exhibits the care and detail required to translate spatial perception into a computational model. But more evidence to support the model – from philosophy, phenomenology, psychology, and neuroscience – will be needed.

Isomorphism and representationalism

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Abstract: Lehar tries to build a computational theory that succeeds in offering the same computational model for both phenomenal experience and visual processing. However, the vision that Lehar has about isomorphism in *Gestalttheorie* as representational, is not adequate. The main limit of Lehar's model derives from this misunderstanding of the relation between phenomenal and physiological levels.

Gestalt psychology has been fundamentally misunderstood in the United States (though the field too has to bear some responsibility; see Kanizsa 1995). After World War II, it had a meager destiny, cultivated only marginally in Germany and America though more intensively in peripheral countries such as Italy and Japan. However, mainly in the last few decades, some concepts of Gestalt psychology have appeared frequently in psychological debate, such as *prägnanz,* isomorphism, minimum principle, and so forth. The continuing debate demonstrates the inability of cognitive psychology to accept some highly significant aspects of our way of picking up the reality that is around us. Lehar's paper does not confine itself to stressing the importance of some classic Gestaltist ideas taken in isolation, as other scholars in the past have done, in an attempt, never completely successful, to integrate part of the *Gestalttheorie* into cognitive psychology. Instead, Lehar tries to build a computational theory that succeeds in offering the same computational model to both phenomenal experience and visual processing.

This highly interesting attempt deserves some comment, however. In my opinion, Lehar's vision of *Gestalttheorie* is not fully adequate, and this has some consequences for his theorizing. The point on which I disagree almost completely with Lehar is the following: He claims that there is a central philosophical issue that underlies discussions of phenomenal experience, as seen, for example, in the distinction between the Gestaltist and the Gibsonian view of perception. Is the world we see around us the real world itself or merely an internal perceptual copy of that world generated by neural processes in our brain? In other words, this

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