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The nature of the visual field, a phenomenological analysis ☆

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ABSTRACT

The visual field is the spatial form of visual awareness, that is, immediate visual experience ignoring qualities and meanings. Such an entity only exists in the discursive representation, for the awareness as such is quality and meaning throughout. Thus the discursive, formal treatment is necessarily limited. We identify a number of important distinctions of a geometrical nature. This description is confronted with experimental phenomenology, that is the psychology of the Gestalt Schools, and with well known principles of artistic practice. We also trace the connections with biology, especially ethology, aesthetics, and the field of cognitive science based upon Cassirer's concept of symbolic forms.

1. Geometry of the visual field

In this paper we discuss the simultaneous structure of visual awareness, often referred to as the "visual field". It is an operationally defined "geometry" (not in the conventional, formal sense), explored through experimental phenomenology [1].

We know the visual field only through immediate visual awareness, it has no existence outside of that. Although a twofold extended manifold (topologically a "plane"), it is evidently *very much unlike* your trusty Euclidean plane [4,8]. It has the topology of the disk, with an ill defined boundary. It has finite, graded resolution. Moreover, there is evidence that at any single location a range of resolutions is "active". It manifests itself often differently from one glimpse to the next.

Although the visual field is familiar to everybody as part of immediate visual awareness, it is generally considered to have roots in the physiology of the "visual front end", composed of eye, retina, primary visual cortex, and (according to choice) up to a few dozen "visual areas".

Many scientists even go as far as to *identify* the visual field with the front-end. This is an unfortunate move. The relations between the "physical world" in front of the observer, the "optical structure", that is the radiance incident upon the cornea, the "brain activity", that are electrochemical processes in the skull of the observer, and the "visual awareness" that is part of the mind of the observer, are ill, if at all, understood. Causal relations are not possible between the ontologically distinct levels of physics and mind. Here one relies on "bridging hypotheses" of various kinds. An example is the "isomorphism" hypothesis used in early Gestalt psychology [21]. The modern conviction that somatotopy explains the visual field [18] is essentially a variation on that. It is embarrassing in its naïvité. Thus the topic of the "geometry" of the visual field is a challenging one. It stands in need of formal development.

In this paper we intentionally circumvent the hairiest problems by using an abstract overall model of the genesis of visual awareness. This allows us to straddle the wide ontological gap in a simple, formal manner.

It is important to understand that the visual field is a mysterious place. This may not be so evident in focal vision, but it becomes immediately evident in attempts to experience eccentric vision. Fixate a point in the scene in front of you, and concentrate your mind on a location away from the fixation point. But make sure not *to look* at that location! Try to describe the best you can what is your visual awareness. This will be *hard*, very hard. Words are only somewhat useful here, sketching your experience as a simple doodle is perhaps more appropriate. The things you are aware of will be very difficult to describe, no matter how, and have only a fleeting existence.

This experience is not particular to the eccentric visual field. It is not different in "vision proper". For *mystery is everywhere*, although most people never notice [41–46].

Here is an exercise that will prove this to you. Sit in front of a bookcase at such a distance that you are just unable to read the booktitles, whereas you are well aware of the lettering and so forth. Try to draw exactly what you see. This exercise is like Chinese torture, at least if you play it honestly. Yet this type of mystery is what your vision deals with on a regular basis. "Understanding vision" certainly implies that you can deal with what goes on here. At this particular stage in history

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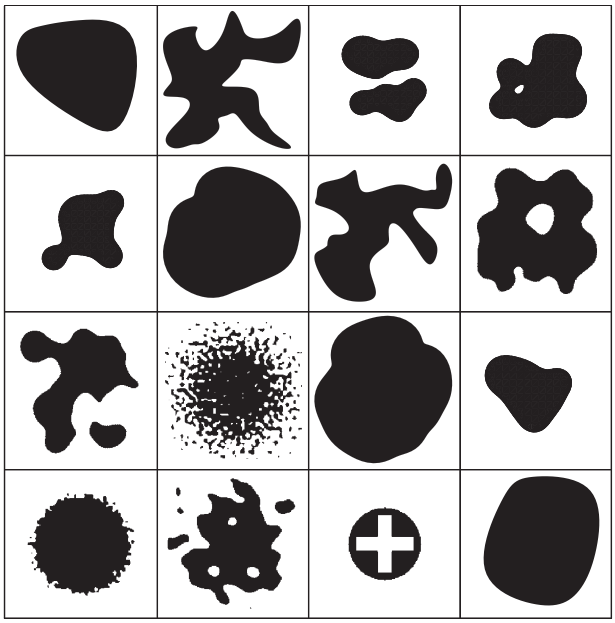

Fig. 1. Here are some "points". Of course, a "point" is a *point* only at a scale when its internal structure is ignored. The internal structure still gives the point an identity. The possibilities are infinite. Something is a "point" if your psychogenesis designates it that. A point may "explode" into structure when you scrutinize.

no one can, which is why it is—or at least, should be—an important frontier of science.

The simultaneous presence in your awareness evidently is of some "geometrical" nature. But it is a geometry that is hard to describe. Even being able to discuss the phenomenology should count as important progress. Here we give it a try, for better or worse. Any little headway—even just grasping the magnitude of the problem—is certain to be useful.

1.1. Geometrical configurations

"Configurations" are entities like triangles, circles, irregular "blobs", and so forth. "Geometrical configurations" are structures composed of points, and lines, that satisfy certain constraints. In this section we deal exclusively with such geometrical configurations.

1.1.1. Fiducial geometrical elements

The basic geometrical elements are uniform areas, and local marks (to be amplified below). A common uniform area in daily life is the blue sky. It is a single non-composite entity, that is to say, it is by no means composed of points, or pixels. In a digital photograph the blue sky is "made up" of blue pixels. In visual awareness there is no such notion.

In the simplest cases, which are rare, the local marks have no further structure, and may be considered "points". Geometrically, a point is fully characterized by its location. As Euclid has it "a point is that which has no parts". The fact that one ignores its internal structure makes it a point [4,19]. However, only the fact that there usually *is* an internal structure makes it possible to *identify* the point. A bit like our university town Leuven on a map of the world. It gives the point its individuality (see Fig. 1). As said above, there are no points in the blue sky, this is because that would violate [26] Identity of Indiscernibles. Other than internal geometrical structure, a point might have qualities, *e.g.*, color. We are not concerned with qualities here. A point is thus created by "placing" it. It is an intentional entity.

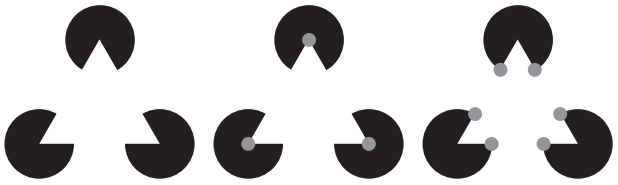

Fig. 2. At left the famous Kanizsa triangle [20]. It shows a depth layering that will be discussed later in the paper. Here it is of interest that the gray points in the figure at center are "intentionally placed", whereas the points indicated in the righthand figure do not exist in this manner.

To place a point is an intentional act of psychogenesis.[1] Psychogenesis starts as a mere "hallucination", and gains existential power when it completes "reality checks" in the visual front end [3]. The "placing" is relative to other matter in the visual field, which also has "evidence" of some kind in the visual front end (see Fig. 2). Visual awareness is a purely mental affair, whereas the "evidence" in the visual front end is based upon patterns of electrochemical activity, the world as you—or rather some brain scientist—might find inside your skull. Brain activity is physical structure, in principle not different from footprints in the sand of a beach. The "meaning" of such patterns is again due to psychogenesis. One is dealing with a circular process here. Psychogenesis "accounts for" front end activity by adjusting its hallucinations in a suitable manner. This explains why it increases your biological fitness.

Psychogenesis is a systolic process, that delivers updates at a rate of about a dozen a second [3]. Thus it just keeps up with the volatile, continuously overwritten, contents of the front end buffers. The updates are in legato style, thus it is not possible to identify individual "frames" as in a video clip. Thus time is continuous, although the "moments", as recorded by an external observer, have finite duration. We will succinctly speak of "beats", no moment implying a discrete structure.

The beats of psychogenesis occur phenomenologically as glimpses of immediate visual awareness. Awareness "just happens" to you, there is nothing you can do about it. Actually, it would be better to drop the "to you", because immediate awareness does not involve a notion of "self", although we would not press this point.

A "point" of the visual field is thus a formal, intentional entity. It may or may not re-occur at the next beat of the psychogenetic process. If it does, it is still a novel creation, it does not "endure". The continued being of a point is due to its recreation from beat to beat. The psychogenetic process tries to account for the front end activity best as it can. Its "reality checks" are bound to yield slightly different results from beat to beat, even if the scene is fixed. This is modeled by treating a point as a *stochastic* element.

We use an isotropic normal distribution, and draw a fresh location at every beat. The center of the distribution may be regarded as the goal of the intentional act, whereas the sample may be regarded as the result after the "reality check". This is how the physical world, through the physiology of the front end, appears to modulate awareness, an empty notion, because psychogenesis "modulates" itself.

Over some time span one meets with various instances of the point that statistically define a "fuzzy" [57] point-like entity. We sometimes speak of "fuzzy points", and by that will refer to the distribution of successive instantiations of a single fiducial point. (See Fig. 3.)

Such a system has the advantage that psychogenesis may ignore optical structure, and that it may hallucinate structure for which no front-end structure is present at all, a frequent occasion in daily life. On the whole, vision is bound to promote the agent's fitness—in the

[1] Notice that we use "psychogenesis" in preference to the more conventional term "microgenesis". This usage should hardly be objectionable, since alternative uses of psychogenesis play no role here.