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Field of View

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Two concepts of field of view are spelled out, the ordinary concept defined by the dictionary and the technical concept devised by Gibson and put to work in his ecological account of visual perceiving. The dictionary's concept refers to an area of the environment taken from a particular viewpoint; from this viewpoint, there are some objects visible throughout the geographical area constituting the corresponding field of view. The technical concept refers to the total large solid angle of light that projects to an animal's point of observation and is registrable by its ocular system. Consisting of photic energy, a Gibsonian field of view is neither a kind of experience nor a part of the ecological environment, although a field of view instantiates stimulus information specifying properties of the environment or animal and makes visual experience possible. Being a portion of the light by which we see the environment and ourselves, a field of view may not be itself a possible object of experience — if Gibson's account of visual perceiving is on the right track. Our visual system picks up features of the light that makes up our successive fields of view, but we thereby have visual perceptual awareness of what these photic features are nomically specific to, not of the features themselves. A concept of stream of view may be preferable to a concept of field of view, for a perceiver is typically moving, rather than occupying a point of observation.

In *The Ecological Approach to Visual Perception* (1979/1986, p. 114), James J. Gibson warns readers not to confuse his concept of the "visual field," which figured prominently in *The Perception of the Visual World* (Gibson, 1950, Chapter 3), with his concept of the "field of view." The latter concept belongs to ecological optics and evidently has important functions to perform within Gibson's (1979/1986) current account of visual perceiving; whereas it becomes clear, as this final book of his proceeds, that Gibson is in the midst of a process of revision that would eliminate from his theory all references to the "visual field," under that or any other name.

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In his immediately preceding book, Gibson (1966) described the "visual field" partially as follows:

> [It] seems [(a)] to be experienced when one concentrates on what it feels like to see, [(b)] to be displaced when one turns the eye or head, [(c)] to rotate when one lies on his side, and [(d)] to have a sort of window-like boundary betweeen inner content and outer nothingness, or indeterminacy. (p. 253)

Thus, after having considered the visual field to be a kind of visual experience with intrinsic properties that are apprehensible from the first-person perspective, Gibson (1979/1986, p. 286) now asserts *that we can have, in fact, no firsthand consciousness of the visual field.* Also, he evidently has found no other role for his concept of the visual field to play in an advanced account of the perceptual functioning of the visual system. As Austen Clark (1996) comments: "By 1979 the 1950 'visual field' is not seen, not needed, and not missed" (p. 494).

Gibson provides no explanation for how he was led into this phenomenological error, nor why he remained there for so long. And he leaves us to wonder what it was that finally caused him to begin to make the respective improvement in his theory. Elsewhere in the same book, Gibson (1979/1986) rightly states, "A person can face backward while riding in a vehicle, or walk backward for that matter, and observe how the array flows inward, instead of outward as it does when one faces forward" (p. 122). But if there is no visual field in Gibson's sense, what is this array that we are held to experience and Gibson is asking us to take notice of? After all, no portion of the environment flows inward or outward as we move — "one experiences a rigid world and a flowing array" (p. 123) — and Gibson (1979/1986) devotes nearly two pages to questioning whether we can have visual experience of the light by which we see: "the light that is *in* the air, or that *fills* the air" (p. 55).

The concept of the visual field had purported reference to what one experiences upon adopting an attitude of introspection that radically affects, as one continues to look at the same part of the environment, what is taking place visually in one's stream of consciousness. Judging himself to have been mistaken about the content of this kind of experience — which, no doubt, he has often consulted — Gibson (1979/1986) now seeks to replace the concept of the visual field with a new concept, referring instead to what he calls the "seen-now-from-here." The concept of the "seen-now-from-here" is a more ecological concept, referring as it does to certain particular arrays of surfaces of objects or of other environmental entities, including one's own body.

Just as Gibson (1950) proposed concerning the visual field, these "here-and-now surfaces," as Gibson (1979/1986, p. 196) also calls them, serve among the intentional objects of experience. That is, they are items of which

we can and do have visual experience. For that, however, these surfaces are no less proper parts of the environment. Which the visual field was claimed not to be: Gibson stating that the visual field is "strictly an introspective or analytic phenomenon" (1950, p. 27), and "comes from a vague kind of detection of the retinal mosaic" (1966, p. 256). But Gibson (1979/1986) now states, "The stimulation of the receptors in the retina cannot be seen, paradoxical as this may sound" (p. 55).

Although Gibson issues no warning in this case, the "seen-now-from-here," like the visual field, should not be confused with the "field of view." Given Gibson's definition, the "field of view" is made up entirely of photic energy, as will be explained in subsequent sections of the present article. In contrast, any environmental surface — whether or not it happens to be a part of the current "seen-now-from-here" — is *that portion of a substance which is exposed to the medium (air or water), absorbs and reflects light, and typically gives structure to the light that it reflects:* "The ambient light at any point in the medium is *structured* by the light reflected from surfaces so that [the texture, reflectance, and layout of the surfaces] are specified" (Gibson, 1979/1986, p. 307; cf. Reed, 1996a, p. 59). As will be seen, a particular field of view is a certain kind of "sample" of the total light arriving at a particular place in a medium.

Nevertheless, when one speaks or reads of the "field of view," because of ordinary usage it is easy to think not of light, but of the "seen-now-from-here." Thus, as will be seen in the closing section of the present article, when Gibson (1979/1986) tries to illustrate a particular "field of view" — with a drawing of a man seated in a living room and looking straight ahead with one eye open — Gibson provides, instead, a picture of the "here-and-now surfaces" that are facing the depicted man at his point of observation.

On Gibson's new view, when one shifts one's attention from the environment to the activity itself of one's visual perceiving, one becomes aware not of the visual field, as Gibson (e.g., 1950, 1963/1982) previously held, but of the "seen-now-from-here." As he did in discussions of the visual field, Gibson (1979/1986) implies *that two distinct kinds of activities of the visual system occur at different times, and that one can switch back and forth between them by a change in attitude*. Thus, he states, "The awareness of the here-and-now surfaces might be called *viewing* the room as distinguished from *seeing* the room" (p. 196). By adopting an introspective attitude, one can engage in the reflective visual activity of "viewing" the room; one thereby switches out of the more straightforward activity of simply seeing the room. The idea of two kinds of visual activity has been present in Gibson all along (Natsoulas, 1989). Compare the latter quotation with Gibson's (1963/1982) statement of earlier days: "There are two kinds of seeing, I argue, one resulting in the experience of the visual field and the other in the experience of the visual world" (p. 352).

Has Gibson now got it right? The theoretical change from the visual field to the "seen-now-from-here" places Gibson on a better footing with respect to what actually takes place perceptually. But, not unusually, much work needs yet to be done. For one thing, Gibson does not adequately construe what one apprehends when one adopts, as he says, an "attitude of introspection" with respect to one's activity of visual perceiving and distinguishes the "seen-now-from-here" from other portions of the environment. Gibson fails to address how the perceiver discriminates the "here-and-now surfaces" from other environmental surfaces that are, according to Gibson's theoretical understanding, also being visually experienced at the same time.

The title of one of Gibson's (1979/1986) sections states, "What is seen at this moment from this position does not comprise what is seen" (p. 195). Without diverging into a discussion of "all that is seen," let me say that, for Gibson, the "seen-now-from-here" is made up of *all the surfaces and parts of surfaces that are at the moment projecting (i.e., reflecting or radiating) light to the observer's point of observation.* These environmental surfaces are what Gibson also calls the "here-and-now surfaces." But how can an observer, when he or she is engaged in "viewing" the environment, tell that the here-and-now surfaces are, as they in fact are, projecting light to his or her point of observation? Of course, this may not be how, according to Gibson, the observer distinguishes the here-and-now surfaces. But then, in what other way are they picked out from all the rest?

The following answer, which may come to mind, is less than satisfactory:

> I know that I am seeing what I am seeing by seeing it. The here-and-now surfaces are not only projecting light to the observers's present point of observation; also, they are the only surfaces that the observer is literally seeing, as we commonly use the latter word. That is, they are picked out as the seen-now-from-here surfaces simply by being the surfaces that the observer literally sees.

This answer is inadequate because, as part of the activity of viewing, there must take place more than just seeing what one is literally seeing when one is engaged in ordinary, nonreflective, straightforward visual perceiving of the environment. When one engages in the activity of "viewing" the environment and body, the here-and-now surfaces are supposed to be distinguished. That is, they are supposed to be *apprehended as distinct from other surfaces which are also being visually perceived.*

To discuss all the relevant issues in a single article would require excessive condensation. A separate article will consider the theoretical shift from the visual field to the seen-now-from-here that is in progress within Gibson's (1979/1986) last account. In the present article, my focus is on the "field of view," rather than on the visual field or on its successor in Gibson's theory.

My purposes here are:
(a) to distinguish Gibson's technical concept of the "field of view" from how one would tend to think of a field of view prior to studying Gibson's thought concerning visual perception;
(b) to ensure that the "field of view" does not get confused with the visual field — as Gibson (1979/1986, e.g., p. 207) himself sometimes runs them together — nor with one or another set of environmental objects or surfaces, including those that constitute the seen-now-from-here; and
(c) to begin to develop an understanding of the functions that the "field of view" is supposed to perform in the process of visual perceiving.

Although not in the present article, I want eventually to address whether Gibson's concept of the "field of view" is another good candidate for theoretical replacement. As I proceed here, the following theses, among others, concerning the "field of view" in Gibson's sense, will receive emphasis:

1. The "field of view" is not itself any kind of experience, as the visual field was said to be.

2. The "field of view" may not ever be, as a whole or in any of its parts, an object of visual experience, as the seen-now-from-here is, and as the visual field was previously considered to be.

3. The "field of view" is not, and does not consist partly of, anything which reflects (or radiates) light into the eyes, as the here-and-now environmental surfaces certainly do.

The Common Meaning

I begin by juxtaposing Gibson's (1979/1986) technical concept of the "field of view," as defined and discussed in his last book, with how *The New Shorter Oxford English Dictionary* (1993; henceforth: "the dictionary") explicitly defines the common term *field of view*. I proceed from the familiar to the technical while keeping these two different concepts in mind throughout. It does not help thought or communication to allow oneself to drift back and forth between the common meaning and the technical concept, as though they were one and the same.

As an ordinary term, *field of view* is, of course, very well-known. The dictionary familiarly states that when we commonly use *field of view*, we intend to refer to "the space or range within which objects are visible from a particular viewpoint, or through an optical instrument, the eye, etc., in a given position" (p. 943). A field of view is a certain spatial extent, a particular area of the physical world, taken with reference to those objects within that area which are visible from a certain viewpoint. The dictionary implies that any field of view is a part of the environment or of the sky or of both. For the rest

of the present article, it does no harm to suppress reference to those fields of view that are in part or whole constituted of sky. With this understanding, I can say *that a particular field of view is equivalent to a continuous*[1] *portion of the environment at locations throughout which objects are visible from the corresponding viewpoint*. Let me spell out several features of the common meaning in turn.

1. In order for a part of the environment to qualify as someone's present field of view, not every object situated within that part of the environment needs to be visible from the corresponding viewpoint. Some of the objects that lie within the boundary of a field of view may be, in relation to that viewpoint, hidden, or too small, or too far away to be visible (cf. Martin, 1992, p. 199). But there must be something or other that is visible from the corresponding viewpoint at locations throughout the environmental area constituting a field of view. And, whereas objects situated within a field of view can be seen from the corresponding viewpoint, any object that remains entirely outside this area cannot be seen so long as one continues to observe from exactly the same viewpoint.

2. The size of one's field of view is simply the size of the geographical area throughout which there are some objects visible from the particular viewpoint that one occupies. We naturally ask how much of a scene is visible, or how large someone's field of view is from a particular viewpoint. An environmental surface may reduce the size of one's field of view if it lies between one's viewpoint and what would otherwise be one's field of view. As we say, it may "block" one's field of view partially or entirely. Such a surface is not considered to be part of one's field of view, although it is, of course, visible from one's viewpoint.[2] Similarly, coming close to a facing surface such as a wall without aperture is also said to narrow one's field of view, because a smaller segment of the environment is visible than when one is standing at a greater distance from the wall. When one looks through a small window, one's field of view is likely to be small, at least relative to one's field of view when one sticks one's head out the same window. One then has a relatively large field

[1]This is not strictly correct because a psychologist may well be using the common concept of field of view when he or she says, for example, that the field of view of a blindsighted person has "holes" in it, corresponding to the damage that the person has suffered in his or her occipital cortex (Weiskrantz, 1993; Natsoulas, 1997). Cf. Clark (1996, pp. 483–484) on those portions of a field of view that correspond to bleached and therefore temporarily inoperative photoreceptors.

[2]Gibson (1979/1986, p. 230) states that, as one approaches head-on, an obstacle will hide more and more of the "vista," whereas an opening will reveal more and more of it. For Gibson, a vista would seem to be similar to but not exactly the same as a field of view in the dictionary's sense (cf. Reed, 1996a, p. 98). Gibson (1976/1982) provides the following definition: "Illuminated surfaces at a place in the environment are projected to a point of observation in the medium. The projections constitute what I call an ambient optic array. The surfaces constitute what I call a vista" (p. 415).

of view unless a building or something else is in the way, restricting how much of the environment can be seen from one's present viewpoint. The size of a window through which one looks from a certain distance does not by itself determine the size of one's field of view.

3. We may think of a field of view in the dictionary's sense analogously to an area lying within an otherwise totally dark environment. This analogous area is receiving illumination from the only beam of light shining at the moment. Suppose, too, that none of this light manages to reach any other place in the environment except as the beam is caused to shine in a diffferent direction. In the latter case, a different area of the environment, which may overlap with the first, becomes the current "field of view," reflecting light into the perceiver's eyes. However, there is also an important disanalogy between a uniquely illuminated area of the environment and an area that constitutes an actual field of view. The objects in the analogous illuminated area would be visible from many viewpoints, whereas the dictionary defines *field of view* in terms of a particular viewpoint.

4. The dictionary adverts to a point or place from which objects in the environment are visible that lie within a perceiver's field of view of the moment. Indeed, with its mention of a "particular" viewpoint and a "given" position, the dictionary would seem to imply *that a field of view involves a fixed point of observation*. Thus, one's field of view would be considered to undergo continuous replacement as one is visually perceiving the environment through which one is locomoting or being transported. One's field of view from moment to moment would remain the same only insofar as, again and again during one's travels, one comes to occupy the same point of observation. Each different point of observation means a different field of view, as I understand the dictionary's concept. But, in the absence of any pause in the movement through the environment, no fixed point of observation is occupied by the perceiver. Consequently, from the perspective of the dictionary's concept of the field of view, it would seem *that an observer who is continuously moving through the environment does not strictly have a field of view*. A field of view is a physical extent taken with reference to a particular viewpoint. The dictionary defines the word *viewpoint*, which it uses in its definition of *field of view*, as having reference to "a point or position from which a view or prospect is seen; an observation point" (p. 3578). Unless a perceiver assumes one or another particular observation point, he or she has no field of view at the moment.

5. Of course, environmental objects are visible to a continuously travelling observer as well. Often, more such objects are visible than when he or she chooses to remain at a particular observation point. Perhaps, we can say that, although this observer, when continuously locomoting or being transported, does not have a viewpoint in the dictionary's sense, he or she does have a

"viewpath" along which objects are visible. So too, although a continuously moving observer does not have a field of view, he or she does have what we may want to call a "stream of view." A particular stream of view would consist of *everything belonging to the environment or body that is visible from a particular viewpath travelled by a particular observer for a particular duration.* Even someone whose only movement in relation to the environment consists in turning his or or her head back and forth has a stream of view from a certain viewpath.

6. Another legitimate use of *field of view* exercises a concept that has reference to a number of fields of view in the ordinary sense under discussion. It is perfectly good English to speak of a single field of view when one actually means *a combination of fields of view over a narrow range of points of observation.*[3] Here I have in mind, for example, someone who, without a change in bodily position, continues looking at the environment while turning or tilting his or her head to a succession of points of observation. We might rightly speak in this case of the whole field of view of the individual's head from his or her bodily position in the environment, meaning the combined fields of view corresponding to all of the points of observation that the individual can occupy merely by moving his or her head. However, if one turns around, one changes one's viewpoint sufficiently to acquire a different field of view in the combinative sense and, needless to say, in the dictionary's unitary sense as well, which requires no more than any change in viewpoint.

7. Before coming to Gibson's concept, a further point needs to be made regarding the ordinary meaning of *field of view.* I have construed this meaning as having reference to an area of the environment. The objects that the dictionary speaks of in its definition I take to be situated physically within a portion of the environment that is a field of view. Note that these objects are of the kind that one might look at as well through an optical instrument. All of them are seen by means of light and the operations of a visual system. Their location is, so to speak, on the other side of the eyes. An interpretation of the ordinary field-of-view concept would be mistaken if it located the objects visible from a viewpoint inside a field of view of a different kind, a field of view that belongs to the activity of seeing itself, specifically, to the component of the latter which is visual experience. The field of view is not a feature of the phenomenology of visual experience (cf. Martin, 1992, pp. 198–199). This does not say, of course, that the environmental area that is a field of view cannot be itself an object of visual perceptual awareness. A field

[3]Gibson's (1976/1982) concept of a vista (see footnote 2 above) gets subsequently modified (see Gibson, 1979/1986, p. 198). Now a vista is to be conceptually taken with reference to "an extended region" of observation, rather than a single point of observation.

of view, in the dictionary's sense, includes the here-and-now surfaces specified by Gibson, which are, of course, eminently perceivable by means of one's visual system.

Contrast to Gibson

Even before I spell out Gibson's concept of the field of view, I can begin to draw a contrast with the dictionary's concept. Gibson (1979/1986) speaks often of a moving or travelling point of observation or, equivalently, of a path of observation. And he explains that such a path

> does not have to be treated as an infinite set of adjacent points at an infinite set of successive instants; it can be thought of as a unitary movement, an excursion, a trip, or a voyage . . . . One can perceive an object at no fixed point of observation. (p. 197)

Gibson speaks of the field of view, contrary to the dictionary definition, as "sweeping" with each turn of the head and as "wheeling" with each tilt of the head. In Gibson's technical sense, the moving observer does not lack a field of view while he or she is moving. The field of view of a moving observer is supposed to move along with many of the observer's movements. A field of view is therefore not, according to Gibson's concept, an area of the environment.

However, Gibson also describes the field of view of an observer who is simply turning his or her head as a "sliding" sample of the total light projected (reflected or radiated) directly to a path of observation from all of the environmental surfaces surrounding it. The notion of a "sliding" sample is not consistent with the notion of a field of view that moves with the observer. Instead, as the observer travels, the visual system "picks up" a succession of samples of the light projected to various points along his or her path of observation. Each such sample is a field of view taken with reference to a different point of observation.

The Technical Concept

The perception theorist Gibson may seem to be picking out the same referent as the dictionary, but, as we have already seen, his notion of what the field of view consists of differs from what the dictionary's definition expresses. A divergence of concepts may well have been expected, for Gibson's radical perception theory is not the kind of theory that has influenced the commonsense meaning of the term. For that matter, many discussions of perception, visual and otherwise, within psychology also do not draw upon Gibson's theory.

However, one can also detect in Gibson's writings an occasional use of *field of view* in the exercise of something like the older, dictionary concept. For example, when discussing an animal's receiving afferent stimulation from its own movements, Gibson (1968/1982) states that there will be a visual such input "if the movement of the foot, paw, or hand is in the field of view" (p. 189), and "Many of the higher animals have limbs that are visible, that is, enter the visual field of the head" (p. 189).

So too, the Gibsonian Thomas J. Lombardo (1987) states that parts of the body appear in the field of view. Lombardo goes beyond Gibson in this respect. Not only does Lombardo add that both perceiver and surrounding environment are within the perceiver's field of view, but he erroneously paraphrases Gibson's definition of the field of view as "the angular section of the environment within sight" (p. 349). Thus, Lombardo's understanding of Gibson's concept of field of view is much closer to the dictionary's concept than it is to Gibson's technical concept. However, I do not say that Lombardo, in his book on the development of Gibson's thought, is applying the ordinary concept of field of view. For Lombardo evidently finds it unproblematical also to state, as he does immediately, that an individual's field of view "sweeps" and "wheels" with movements of his or her head.

Gibson's Definition

In a section titled "The Specifying of the Self by the Field of View," Gibson (1979/1986) explains what a field of view is, and states that fields of view should not be confused with visual fields. The section begins with a paragraph which serves Gibson as his definition of the concept of field of view (see Subject Index):

> The *field of view* of an animal, as I will use the term, is the solid angle of the ambient light that can be registered by its ocular system. The field of view, unlike the ambient array, is bounded; it is a sort of *sample* of the whole sphere. The angular scope of the field of view depends on the placement of the eyes in the head, some animals having lateral eyes and a nearly panoramic field of view and others have frontal eyes and a roughly hemispherical field of view (Walls, 1942, Ch. 10). Horses belong to the first group and humans to the second. In both ocular systems, the separate fields of view of the two eyes overlap in front, but the amount of overlap is very much greater in humans than it is in animals with semipanoramic vision. By the field of view, I mean the combined fields of view of the two eyes. (p. 111)[4]

[4]Under the name *the field of view of a head*, Gibson (1966) defined the same concept similarly in his previous book:

> This can be defined as the light intercepted by the ocular system of any animal without a complete panoramic field. For man it is roughly a hemisphere, since the orbits have migrated to the front of the head and the entering light is limited by the eyebrows above and the nose and cheeks below. It spans about 180° horizontally and 150° vertically. When the head is turned on any axis, the oval field sweeps across the available ambient array, uncovering its structure at the leading boundary and covering it at the trailing boundary. (pp. 257–258)

Thus, for Gibson, a particular field of view, of a particular individual animal at a particular time, consists of *all of the light that is arriving at the point of observation which the animal is now occupying and can be registered by its ocular system.* An occupied point of observation is a position in the medium at which an animal's eye is situated and from which the animal can make observations. An animal who possesses two eyes normally has two points of observation although, for most purposes, we can speak of the animal's point of observation in the singular, without having to mention each time that there are actually two such points per animal.

Notwithstanding that the proximal source of the photic energy constituting a Gibsonian field of view is a certain array of environmental surfaces, namely, those that are projecting light to the particular point of observation, a Gibsonian field of view is not a spatial extent or an area of the environment. A field of view is not something seen but, as it were, something by which one sees. However, Gibson's definition of his concept of the field of view is in terms of the registering of light by the animal's ocular system, rather than in terms of observations that the animal makes of its environment. Thus, it would seem, *an animal's having a field of view here and now does not depend on its actually making any observations.* This is a further divergence from the commonsense meaning.

Even when no objects are visible from the animal's point of observation, as in a dense fog or mist of light, the animal may have a field of view at that time as well. It has a field of view for as long as there is light arriving at the point of observation it occupies and as long as this light is being registered by the animal's ocular system. Even when the animal is able to observe nothing in its environment, the receptors in the animal's retina may be effectively stimulated, its ocular system may register the stimulational presence of the light, and the animal may discriminate "brightness" and "darkness" experientially as it opens and shuts its eyes (Gibson, 1979/1986, p. 53).

What the Field of View Does and Does Not "Contain"

Of course, Gibson tells us much more about the field of view than the dictionary does. His concept of the field of view is introduced in a chapter describing the stimulus information available in an illuminated medium that makes visual self-perception possible. Therefore, one would expect him to bring into his discussion, as he does, the partial constitution of a field of view by light which is being projected to the point of observation from surfaces of the body. What Gibson has to say in this connection bears upon how he understands the relation between the environment and the field of view, because he treats of the reflecting bodily surfaces very much as he would those that belong to environmental objects.

1. Stimulus-informational features. In the section beginning with the above definition, one of Gibson's main points is that a field of view possesses features that informationally correspond to certain properties of the perceiver. The definition of *field of view* in the dictionary alludes to no such features. These features are described by Gibson as constituting optical information regarding the observer himself or herself as opposed to the environment (Gibson, 1979/1986, p. 111). Although these features belong to the light arriving at the animal's point of observation, although they are photic pattern properties and have their existence outside the visual system, the system is designed to "pick up" these features among others. The visual system resonates to these features of the stimulation, its processes becoming like the features picked up in the sense of their containing the same information about the perceiver. Also, the visual system functions beyond the level of "pickup" (see Natsoulas, 1993). It puts the picked-up stimulus information to use within the visual perceptual process, with the consequence that there takes place visual awareness of the properties of the perceiver to which the stimulus information corresponds. Important to note that the same applies to perceiving properties of the environment, which also are "specified" within a field of view.

2. Nonphotic constituents? Although Gibson defines his concept of the field of view in terms of a certain solid optical angle — rather than, as the dictionary does, in terms of an area of the environment, which contains objects — he goes on to speak, as I quote below, of certain constituent items that, in fact, are not made up of light. Despite their not consisting of light, Gibson characterizes them as "appearing" within or "protruding" into a field of view. How can anything which does not consist of photic energy be a part of a field of view, in Gibson's sense of the latter? For that is what he must mean by their appearing or protruding therein, given his concept of field of view as he explicitly defines it.

It is not at all startling to hear someone say that a particular field of view "contains" certain environmental or bodily objects or that these objects are parts of a field of view. Such a speaker would be recognized as exercising a different concept of field of view than Gibson's concept. This other concept would be one that resembles the dictionary's concept of field of view, whose definition I quoted early in the preceding main section. The statement would be meant to say that those objects, said to be "contained" in, or to make up a part of, a certain field of view, are the objects now visible to the perceiver at his or her present point of observation.

For example, Clark's (1996) recent discussion of three kinds of "visual field" draws on Gibson's theorizing and, at one point, citing Gibson (1979/1986, p. 286), Clark states, "'The surfaces of the world that are viewed now from here' [are] portions of the field of view" (p. 494). This statement is

true if those surfaces are claimed to be what Clark means by (portions of) the field of view, but not what Gibson means by the same words. Clark's concept of field of view simply refers to the sum of things seen by a particular individual at a particular time. Clark (1996) describes this totality as "a large three-dimensional physical phenomenon. It might be several miles deep. Its size and shape are determined at time *t* by the physical position of the head and eyes" (p. 479). As I mentioned in the above section on the common meaning, the size of the field of view also depends on whether there is present, obstructing part of the light that would be projected to the respective viewpoint, a surface that reduces the size of the geographical area throughout which there are some visible objects from that viewpoint.

In the following quotation from Gibson (1979/1986), the reader will notice that the nonphotic items that are said to enter the field of view are all parts of the perceiver. However, Gibson would make statements of the same kind about other parts of the world whose projected light also goes to make up a field of view.[5]

> There are other remarkable features of the field of view besides its oval boundaries. Still other occluding edges appear within it, those of the nose, the body, the limbs, and the extremities, some of which can be seen in the drawing.[6] The edges of the eye socket, the eyebrows, the nose and cheek bones are only the nearest; the edges of the arms, legs, hands, and feet are more distant, but they still occlude the surfaces of the "outer" environment. The hands and feet behave more like the occluding edges of an object than like the occluding edges of a window; they are actually protrusions into the field of view from below. They are therefore attached objects in the present terminology, but they are attached to the observer, not to the ground, and they are elastic. When the semiobjects move, there is deletion of optical structure at the leading edge and accretion at the trailing edge, just as with objects in the world. (p. 114)

Among other things, Gibson is stating above that bodily and environmental objects determine, through the particular patterns of light that they project to a perceiver's point of observation, the internal, cross-sectional optical structure of the solid angle of photic energy which is the perceiver's field of view.

Neither bodily or environmental objects make an appearance in a field of view, nor can either kind of object protrude into a field of view, as Gibson defines the concept. Indeed, Gibson's (1979/1986, e.g., pp. 44–45) general theoretical orientation is such that he would want to emphasize his distinction between what we see and the light by which we see it. Part I of Gibson's

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[5]For example, Gibson (1979/1986, p. 118) states that the sky will enter the field of view when one looks up and the ground will enter the field of view when one looks down.

[6]See the section below in the text titled "Depicting a Field of View."

book is about what there is, of the environment and body, to be visually perceived; Part II is about the stimulus information contained in the light that makes visually perceiving the environment and body possible; and Part III is about the "psychosomatic" activity of visual perceiving in which an animal engages.[7] There is no overlap between these three categories of items according to Gibson's theory. Thus, Gibson (1966) does not confuse an environmental object with a part of the field of view when he speaks, for example, of "a small part of [a field of view], such as that corresponding to a book page" (p. 258). A book page is never a part of a field of view; considerations pertaining to the nature and character of a book page would naturally belong to Part I of Gibson's last book.

3. *Occluding edges?* If a field of view is conceived of, along dictionary lines, as a certain area of the environment, then it makes sense to speak of objects that it contains or that protrude into it. But if all fields of view consist of photic energy, then *environmental and bodily objects can have at most external causal relations to any field of view.* Even in such a case as Gibson draws attention to in the above passage, where an object is preventing light projected by other objects or surfaces from reaching the perceiver's point of observation, even then the occluding object does not itself "enter" the respective field of view, but simply reflects light to the point of observation. In the field of view, an occluding object's own projected light substitutes, as it were, for the light of the surfaces behind it, whose projected light the object is occluding.

A case that the ecological psychologist Gibson does not mention, no doubt because it is a quite artificial one, is the case of a perceiver who is wearing a contact lens half of which is totally opaque and the other half transparent. This device would prevent about half the light that would normally reach the retina from doing so. However, the occluding half would not reflect light into the eye, as does the occluding object considered in the preceding paragraph. The effect of such a contact lens is to reduce the angular size of that eye's field of view. This kind of occluding object too would serve as a condition that determines properties of the field of view, rather than being something that appears in, protrudes into, or is contained by a field of view.

With a drawing after Ernst Mach, Gibson (1979/1986, p. 113) makes an attempt to illustrate the field of view of a man's left eye. This is the drawing mentioned in the passage quoted in the subsection of the present article titled *"Nonphotic constituents?"* In the passage, Gibson states that, among the features of the field of view are not only its oval boundaries, but also the

[7]See Gibson (1979/1986): "Perceiving is a psychosomatic act, not of the mind or of the body but of the living observer" (p. 240).

boundaries or edges of occluding objects attached to the body, such as the man's extremities, nose, and limbs, which can be seen in Gibson's drawing.

I argued above that a field of view cannot possess such objects among its intrinsic features. Therefore, someone may point out to me that, in the quoted passage, it is the occluding edges of such objects that Gibson describes as "appearing within" a field of view. What is an occluding edge? Might the occluding edges of an environmental or bodily object belong to a field of view although the object itself must be considered to be not a possible feature of a field of view?

No less than any other edge, an occluding edge is, as Gibson defines, the "junction of two surfaces that make a convex dihedral angle." It is "occluding" with respect to a particular point of observation. An occluding edge is *the edge between a surface that projects light to that point of observation and a surface that does not project light to that point of observation*. The two surfaces may belong to the same object or to different objects. No further explication of Gibson's concept of the occluding edge is needed here. Clearly, an occluding edge does not "appear within" a Gibsonian field of view, it is not a feature of a Gibsonian field of view, but rather it belongs to the environment. It belongs to that part of the environment which is determining the pattern of light that is projected to the respective point of observation.

4. *Outer boundaries*. The field of view is said to possess outer boundaries that give it an oval shape. These boundaries are said to resemble occluding edges, which "hide the environment behind them, as those of a window do" (Gibson, 1979/1986, p. 112). However, Gibson could not mean that the field of view literally hides something. The outer boundaries of a field of view are *simply the limit of the solid angle of light that the eye can register without a change in occupied point of observation*. Those parts of the environment that are not now projecting light to that particular point of observation may be spoken of as "hidden" with respect to that point of observation, but all that "hidden" would mean is that they are not among the surfaces projecting light to that point of observation. Some of these surfaces lie just behind surfaces that are projecting light to that point of observation; they would project light to that point of observation if those occluding surfaces were to get moved or to go out of existence. But there are many other environmental surfaces that would necessarily require a change in the perceiver's point of observation in order for them to "fall within" the perceiver's field of view.

Gibson states that, in the case of the field of view, what "hides the background" is the "the head of the observer." In speaking of the edge of a field of view, it is the observer's head that Gibson actually has in mind. About half of the surrounding environment is "revealed" to a pair of human eyes, whereas the rest of the environment is "concealed by the head." Except for being obstructed by the head, light from other environmental directions could be

focussed on the surface of the retina. We know this from the fact that we can see parts of our cheeks, nose, and eyebrows; light coming from behind them is prevented from reaching the retina. Gibson characterizes such concealment as "temporary," yet it is always the case with respect to some large portion of the environment.

At the various, different points of observation which one occupies over time, one's field of view is the same only in its dimensions, which depend on the retinal surfaces and how the eyes are positioned in the head. In the sense of its having constant dimensions, it makes sense to speak of one's field of view as remaining the same as one moves, whichever succession of photic arrays make up one's field of view. As we have seen, the same cannot be said regarding a field of view in the dictionary's meaning of the phrase; the latter's size depends on the spatial extent of a geographical area that is visible from the particular viewpoint. Shutting an eye does immediately result in a smaller Gibsonian field of view, as well as a smaller ordinary field of view. But there is nothing that one can do with one's head or body (aside from covering an eye or inserting therein a special contact lens) that will alter one's present Gibsonian field of view to one that is smaller or larger. In contrast, many bodily movements will have the effect of a smaller field of view in the dictionary's sense (cf. Clark, 1996).

Fields of View in Motion?

When one shifts from one point of observation to another point of observation, one's field of view gets replaced by another field of view. The same environmental and bodily surfaces may be projecting the light that partially constitutes a succession of different fields of view belonging to the same perceiver. But it would be somewhat misleading to say that, therefore, these fields of view "overlap" with each other; the reason being that no pair of fields of view belonging to this succession even partially consists of the same light. The body of light which arrives at one point of observation directly from an array of environmental surfaces is not, in any part, the body of light which directly comes from the same surfaces to a different observation point. In contrast, using the dictionary's concept of field of view, it is sometimes correct to say that two fields of view overlap: whenever some of the same surfaces or parts of surfaces are visible from the two corresponding viewpoints.

As mentioned, it is compatible with the dictionary's concept of field of view to say that, while moving through the environment without pause, one does not strictly have a field of view. Of course, light is being reflected into one's eyes all along one's path of observation. This light can be described in terms of a certain constant size of solid visual angle, but every movement

along the path of observation results in a complete change of what light it is that makes up this solid angle.

Gibson speaks of the "stationary" field of view of a mobile eye with the head fixed (however, see Bingham, 1993), and contrasts it with the "shifting" field of view that takes place as the head turns while the eye remains fixed on something in the environment. Just as soon as one moves, there occurs a replacement of the field of view by a different field of view. However, it is misleading to speak of a field of view that "shifts" or even "changes," as though one's motion has a retroactive effect on the body of light constituting one's field of view at the point of observation just vacated. Rather, moving from one to another point of observation, one's photoreceptors become exposed to a different field of view. Fields of view replace each other but do not shift. Nor do they themselves change individually, except when there is a change in the light that is being projected to the respective point of observation or in the ability of the ocular system to register this light.

I mentioned earlier that perhaps a concept of the stream of view is preferable in place of the field of view of a moving observer. This new concept would be analogous to Gibson's notion of a path of observation in place of a point of observation. An animal typically perceives while it is in motion rather than from a succession of points of observation. A point of observation cannot shift or move; it is "a position in the medium that can be occupied by an animal" (Gibson, 1979/1986, p. 308). An animal normally keeps moving from point of observation to point of observation, but no point of observation shifts along with an animal's movement. Gibson rightly emphasizes that different individuals can successively occupy the same point of observation. The notion of a path of observation should therefore be preferred over the notion of a moving point of observation — as should perhaps, for the same reason, the concept of a stream of view over the concept of a field of view. From the Gibsonian perspective, a stream of view would be defined as consisting of *all of the light that the environment projects to one's path of observation, all of the light that gets reflected or radiated into one's eyes as one is travelling that path of observation.* The concept of a path of observation is preferable because we may never actually perceive from a stationary position, or a fixed point of observation.

When one turns one's head, some parts of the environment that were not projecting light to one's point of observation will now do so, and other parts that were projecting light to one's point of observation will cease to project light to it. Having placed one's head in a different position in relation to the environment, one's eyes occupy a new point of observation and one consequently has a different field of view. While one is turning one's head to the right or left, that is, before one stops turning it at, say, the extreme right or

left, one does not have a field of view, but one may be said to be traversing a path of observation. The movements of the head or of the perceiver through the environment constitute unique paths of observation, they are always different each time, and create unique streams of view from the totality of light available in the medium along the path of observation.

As mentioned earlier, Gibson (1979/1986) describes a field of view as capable of movement as the head moves. He refers to "the *sweeping* of the field of view over the array during head turns and the *wheeling* of the field over the array during head tilts" (p. 118). Since the concept of the field of view is defined as having reference to a solid angle of light, it is not immediately clear what is being proposed as these movements of the field of view. Nor would the latter be any more clear if one construed the field of view, consistently with the dictionary's definition, to be that area of the environment which contains throughout some objects visible from the perceiver's point of observation. For it is also the case, of course, that this geographical area does not move with a change in the point of observation; rather, another area of the environment replaces that area as the present field of view, while overlapping with it more or less.

Gibson conceives of the head's movements of turning and tilting as producing a systematic accretion of elements of optical texture at the leading edge of the field of view and a systematic deletion of elements of optical texture at the trailing edge of the field of view. Better to say, perhaps, that if one is turning one's head to the left (right), the left (right) side of each of the succession of replacement fields of view includes elements of optical structure that are new, and the right (left) side of each of them is lacking elements present in the immediately preceding field of view.

An Object of Experience?

Gibson (1979/1986) sometimes writes as though features of a field of view are themselves visually experienced, for example:

> The awareness of "out there" and of "here" are complementary. The occluding boundary of the visual field constitutes "here." The content and details of the field of view are "out there," and the smaller the detail the farther away it is. (p. 207)

I believe such statements of Gibson's are explainable in terms of conceptual slippage, rather than by attributing theoretical inconsistency to him. When Gibson appears to be implying that we can experience photic properties of the field of view, I suggest that what he actually means is that something in particular which "lies within" a field of view is visually apprehended; that is,

Gibson is reverting temporarily to something like the common meaning of *field of view*.

For example, Gibson (1979/1986) states that the boundary of an animal's field of view "specifies" the animal's body, but he also states that this boundary has a "meaning," implying that the animal has some kind of experience of this boundary. The actual boundary that Gibson has in mind here consists of that part of the animal's head that is visible to the animal. Gibson goes on to say that the blind region (which normally is also of about 180°) adjacent to any human field of view is "not actually a blind region, of course; it is the head" (p. 205). That is, one sees "oneself in the middle of the environment" (p. 205), rather than seeing light and the absence of light. However, Gibson cannot resist also saying that "the blind area means the same to the horse as it does to the human being" (p. 205), as though this statement means more than that the horse sees itself by virtue of the stimulus information at the boundary of its field of view. Neither the boundary of the field of view or the blind area beyond it are to be understood as something that can be itself perceived; they are not part of the ecological environment, nor of the self.

At another point, Gibson states the following concerning the field of view, seeming to imply — in the context, which is about the difference between the visual-field kind of experience and the visual-world kind of experience — that the field of view is the object of a kind of experience, like the experience one gets from looking at a picture reflecting a similar pattern of light as makes up the field of view.

> The field of view of the two eyes is a sort of mixed cross-section of the overlapping solid angles registered by the eyes. The field of one eye would correspond to a plane picture cutting the solid angle for that eye. It would correspond in the sense that a faithful picture could be substituted for the angular sample so as to yield almost the same phenomenal experience. (p. 207)

Which phenomenal experience does Gibson mean? Which experience would be almost like the one with the substituted picture? Is seeing a scene by means of just one eye experientially like seeing a picture of the same scene? I believe there is conceptual slippage here too. This slippage makes it seem as though Gibson is suggesting that the field of view, not the world and body, is experienced when one sees with just one eye; therefore, a very similar field of view produced by a picture would produce a similar experience. But, in the Gibsonian view, what we visually experience, with one eye or two, is the environment and ourselves in it, not any part of the field of view, which consists of light.

Depicting a Field of View

Gibson's (1979/1986, p. 113) drawing intended to illustrate a field of view depicts certain parts of a man and his immediate environment: those surfaces projecting light to the point of observation occupied by his left eye. At the moment depicted, the eye's field of view consists of the pattern of light reflected by those particular surfaces into the eye. Gibson comments, "If the reader will put his or her left eye close to the page, one gets an approximation of the sample of the ambient light that the [man] could see with his head still and his right eye closed" (p. 112). But Gibson does not mean the reader can see the light reflected from the surface of the picture, nor even that the man sees the light reflected by the surfaces depicted. Gibson can only mean that the pattern of light reflected into the reader's eye from the surface of the picture is like the pattern of light projected to the man's point of observation. Thus, the approximation one gets by doing as Gibson instructs is *simply one's having an experience that approximates the visual experience of the depicted man under the depicted conditions*. Taking notice of the experience one has in looking at the drawing as Gibson instructs, one gathers what the visual experience is like under the perceptual conditions specified.

The preceding paragraph does not contain a paraphrase of what Gibson states about that figure or about three other figures which he uses in the same chapter to show fields of view at different points of observation. In this connection, Gibson does not refer, as I just have, to anyone's visual experience. It is supposed to be *fields of view* that are being pictorially represented in the chapter. However, any actual field of view is, at the same time, held by Gibson not to be visible, consisting as it does of the light by which a particular perceiver sees at a particular time from a certain point of observation. One sees by means of this light, and *right through it* just as though it is not actually there and making it possible for one to see. Well, then, what are the four drawings actually pictures of? In addition to seeing the pictures themselves, what else does one see when one looks at the pictures? Discussing the perception of pictures in general, Gibson (1979/1986) states, "We distinguish between the surface *of* the picture and the surfaces *in* the picture" (p. 282). What in fact does one see *in* these pictures, which are supposed to be pictures of four different fields of view?

Each of the drawings quite clearly depicts, with reference to a different point of observation occupied by the depicted man in each case, not a field of view, but an array of surfaces seen-now-from-here that belong to the man's environment or his body. According to Gibson's own analysis elsewhere in the book, upon adopting an introspective attitude, these are the surfaces that the man would experience and distinguish from other surfaces. As part of the subtitle for a set of three of these pictures, Gibson (1979/1986) includes this

statement, in explanation of what is being depicted: "The field of view is a *sliding sample of the ambient array*" (p. 118). This is correct, but what the three pictures depict is something else, namely, the respective surfaces seen-now-from-here — which, being parts of the environment and body, consist neither of light nor of experience. However closely one looks at these pictures, one does not see the light by which one sees them, nor does one "get an approximation," in the form of having a visual experience, of the light that would be arriving at the depicted man's point of observation. What one sees — in what Gibson considers the "indirect" way of seeing by means of pictures — is *a restricted array of environmental and bodily surfaces, those that happen to be projecting light to the point of observation that is occupied by the depicted man's left eye*.

The same kind of picture was used by Gibson (1950, 1963/1982, 1979/1986) in publications spanning twenty-nine years. On the first of these occasions, the figure was labeled "The monocular visual field of Ernst Mach." The second time it was called, "Momentary cross-section of the light entering a human eye." And the third time, the figure was given the name "The ego as seen with the left eye. The temporary field of view of the left orbit of an observer." Thus, what had earlier served as a picture of a visual field — that is, what one would consciously experience, having adopted an attitude of introspection, from a certain point of observation in a certain room — came to be understood as portraying a field of view instead. Gibson would now say the picture could not be a picture of a visual field because people do not experience visual fields, as he once thought.

Nor, as I have suggested, does the picture show a field of view. And I want further to suggest that this error of Gibson's may be a consequence of the unfinished project of theoretical revision that I mentioned in the Introduction. What the drawing portrays is what it has always portrayed notwithstanding Gibson's (1950) belief that it portrayed a certain object of introspective experience. Compatibly with the change in his theory, the drawing portrays the particular array of environmental and bodily surfaces that are at the depicted moment projecting light to the point of observation of the observer's left eye. According to Gibson's new account of "viewing," if the man in the picture were to adopt an attitude of introspection, he or she would become aware of this particular array of surfaces — the here-and-now surfaces — and distinguish them from other environmental surfaces, rather than become aware of a visual field, which is a mythical object of introspective experience.

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