Article

The Multidimensional Spectrum of Imagination: Images, Dreams, Hallucinations, and Active, Imaginative Perception

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Abstract: A theory of the structure and cognitive function of the human imagination that attempts to do justice to traditional intuitions about its psychological centrality is developed, largely through a detailed critique of the theory propounded by Colin McGinn. Like McGinn, I eschew the highly deflationary views of imagination, common amongst analytical philosophers, that treat it either as a conceptually incoherent notion, or as psychologically trivial. However, McGinn fails to develop his alternative account satisfactorily because (following Reid, Wittgenstein and Sartre) he draws an excessively sharp, qualitative distinction between imagination and perception, and because of his flawed, empirically ungrounded conception of hallucination. His arguments in defense of these views are rebutted in detail, and the traditional, passive, Cartesian view of visual perception, upon which several of them implicitly rely, is criticized in the light of findings from recent cognitive science and neuroscience. It is also argued that the apparent intuitiveness of the passive view of visual perception is a result of mere historical contingency. An understanding of perception (informed by modern visual science) as an inherently active process enables us to unify our accounts of perception, mental imagery, dreaming, hallucination, creativity, and other aspects of imagination within a single coherent theoretical framework.

Keywords: imagination; mental imagery; mental image; perception; eye movements; active vision; enactive perception; seeing as; dreams; hallucination

1. A Potent and Protean Concept

Imagination is a concept far more frequently invoked than it is analyzed, even by philosophers. Brann, in her magisterial *The World of the Imagination* ([1], p. 3) calls it the "missing mystery" of philosophy: it plays a pivotal role in the epistemologies of many, diverse philosophers—from Aristotle to Hume, from Kant to Bachelard and Popper, as well as in contemporary philosophical movements such as *simulation theory*—but this role is rarely highlighted, and still more rarely satisfactorily explained.

In the wider culture too, "imagination" is a word of power. Indeed, McFarland ([2], pp. xi ff.) suggests that in recent times it has taken over many of the functions once served by "soul". We seem to be forever being told that all good things (from anti-terrorist preparedness to Disney movies) come from the imagination, and that cultural apocalypse looms if we continue to allow our educational system (or video games, or the internet, or over-scheduling, or whatever) to stunt the imaginations of the coming generation (e.g., [3]). No less a cultural icon than Einstein is often said to have asserted that "imagination is more important than knowledge". On the other hand, parents and teachers warn children not to let their imaginations run away with them, and if people sincerely claim to have had experiences that we find incredible (such as having been abducted by aliens), we dismiss the experiences as mere figments of their imagination. It was because of usages such as this, presumably, that Pascal called imagination "that mistress of error and falsehood", an "arrogant faculty, the enemy of reason" [4]. Deep cultural ambivalence about imagination has a long history [1,5]; no wonder the Renaissance philosopher Gianfrancesco Pico della Mirandola was driven to the conclusion that "not only all the good, universally, but also all the bad, can be derived from the imagination" [6].[1]

2. Deflation or Inflation?

Although the word "imagination" is heard frequently enough; both in scholarly and lay discourse; its meaning; once we pay attention to it; is often far from clear. It seems to be an indispensable psychological concept (it has certainly survived in our folk-psychological vocabulary for a very long time); but it has an air of the unscientific; even the occult; about it that often renders it suspect to those who pride themselves on their rationality. Daston [7] has gone so far as to write of a history of "fear and loathing of the imagination" in scientific circles. On the rare occasions that contemporary scientists have ventured to grapple with this treacherous concept; they have almost invariably wound up focusing on just one; or a very few; idiosyncratically chosen aspects of its seemingly protean; multifaceted nature [8].

Analytical philosophers often see themselves as being in the business of clarifying concepts, so one might think that they would see a real opportunity to do something useful here. In fact, however, some of the "fear and loathing" of the scientists seems to have rubbed off on them, and few have paid it much serious attention. The limited attention it has received, has come more from aestheticians rather than philosophers of mind or epistemologists, and even the aestheticians are typically not enthusiastic: Where Walton [9] speaks of imagination as "placeholder for a notion yet to be clarified" (having given up on a brief attempt at the relevant clarification), Matravers [10] goes so far as to suggest that, even in

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[1] Gianfrancesco, whose *De Imaginatione* was written, in Latin, in about 1500 A.D., should not be confused with his uncle, also a philosopher, Giovanni Pico della Mirandola.

aesthetics, we should give up on it altogether. Inasmuch as there is any consensus view of imagination in analytical philosophy circles, it is deeply deflationary (but see Crowther [11] for an interesting recent exception). Some think of "imagination" as a polysemous word, nothing but a label we apply indiscriminately to a motley collection of mental capacities that are united by little more than the fact that they are poorly understood (e.g., [12–17]). For others, the word is just an explanatorily empty way of referring to our ability to conceive of what is conceivable (e.g., [18–23]). Although one or other of these views is very often taken for granted (and the second has begun to spread, unexamined, into cognitive science [22]), careful, sustained arguments in support of either of them are few and far between. Arguments for the polysemy view tend to amount to little more than the listing of a bunch of apparently diverse usages of the verb "to imagine" and, as it were, throwing up the hands in despair; the view that imagination is the faculty of conceiving of the conceivable (*i.e.*, of things that are conceptually possible) is occasionally defended with a few sentences, or else simply asserted. To the best of my knowledge, White [19], is be the only philosopher to have published a systematic defense of deflationism. He firmly rejects the polysemy view, but makes a sustained case for the idea that "imagination" has no conceptual connection whatsoever with mental imagery, and always and everywhere just means the capacity to conceive of conceptual possibilities. Admittedly, this does seem to encompass the *extension* of the wide variety of usages of "imagination" (and related words, such as "imagine" and "imaginative") quite well. However, like *featherless biped* offered as a definition of "human being", it leaves one feeling that the essence of the concept has been missed, and thereby insinuates the radically deflationist view that imagination has no essence at all, that it does not really exist. I have rebutted White's arguments, which mostly rest upon his intuitions about correct English usage, in some detail elsewhere [24] (as, from a rather different perspective, has Kind [25]), so I will not further address them here.

   More than likely, much of the motivation behind deflationism, and behind much of the scientific wariness of imagination too, lies in a delayed reaction against the rhetorical excesses of the Romantic Movement. In their own reaction against the "Age of Reason", Romantic thinkers seized upon what had long been considered a necessary but relatively humble (not to say untrustworthy) faculty of the human mind, and, notoriously, virtually deified it. Formerly seen as ancillary and (when functioning properly) subordinate to reason, imagination became the "substance" to which reason is but the "shadow" (Shelley); not only "absolute power / And clearest insight, amplitude of mind / And Reason in her most exalted mood" (Wordsworth), but "the Divine Vision and Fruition / In which Man liveth eternally" (Blake), and "the living power and prime agent of all human perception,...a repetition in the finite mind of the eternal act of creation in the infinite I AM" (Coleridge).[2] As this once humble faculty was valorized out of all recognition, it also changed from being something that was merely unexplained, into something that *should not be* explained, something ineffable and sacramentally mysterious. Some two centuries later, this Romantic conception of imagination (or its degenerate descendants) continues to have enormous popular influence. However, the once thrilling hyperboles of

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2   The Shelley is from his *A Defense of Poetry* ([26], originally written in 1821 and first published in 1840), the
     Wordsworth is from *The Prelude* ([27], book 14, 1845–6 version, lines 167–70; 1850 version, lines 189–92), the Blake
     is from his *Milton* ([28], §32, lines 19–20) (written c.1804–1808), and the Coleridge, complete with capitalization, is
     from chapter 13, "On the Imagination, or Esemplastic Power", of his *Biographia Literaria* [29].

Romanticism have become stale clichés, and, while some still avidly cling to them, others, with more meticulous sensibilities recoil, and are induced to regard the very concept of imagination as suspect. In my view, both those extreme responses are to be avoided.

3. McGinn on the Discontinuity of Imagination and Perception

Colin McGinn's account of imagination, in his 2004 book *Mindsight* [30],[3] stands out from most other recent discussions of the topic in that it succumbs neither to Romantic obscurantism, nor to its inverse, scientistic deflationism (although it does not directly confront either tradition). This is surprising in a way, because McGinn is well known for his "mysterianism" about consciousness. Although he believes that consciousness arises from the brain, he holds that how this can be so is likely to remain forever beyond the reach of our understanding [31,32]. Imagination and consciousness are closely intertwined concepts [33], and mysterian attitudes towards imagination have long been with us. It was not only Romantic poets who regarded it as ineffable. Even Hume, that most down to earth of philosophers, called the imagination a "magical faculty", ([34], I.1.vii), and Kant, in similar vein, described it as depending upon "an art concealed in the depths of the human soul, whose real modes of activity nature is hardly likely ever to allow us to discover" ([35], A141–B181). However, there is no sign of mysterianism in *Mindsight*. McGinn clearly hopes for, and is seeking a basis for, a rational and scientific understanding of imagination. I do not think he succeeds: I shall argue below that he makes a number of significant false steps. However, he does open up opportunities for useful discussion. In what follows, I will attempt to build upon McGinn's work, and to correct his more serious mistakes (and the related mistakes of others), in order to move forward his project of developing an understanding of the imagination that neither sanctifies nor trivializes it.

Unlike most analytical deflationists, but in common with virtually all pre-twentieth-century thinkers, including the Romantics [1,19,36], McGinn sees mental imagery as central to the concept of imagination, and much of his book is in fact concerned with imagery. In his crucial first chapter, he focuses on the differences between mental images and percepts. Many writers about imagery have held some version of what we may call the "continuum theory". That is, they have regarded images and percepts as being varieties of the same species, differing in degree rather than in kind, and lying at opposite ends of a continuous spectrum with many varieties of imaginatively informed perception, such as *seeing as*, hallucination, and perceptual errors of various sorts, filling in the continuum between them. Some have defended this idea explicitly (e.g., [24,37,38]); more often it is accepted implicitly, without real argument.

Indeed, the contemporary cognitive science of mental imagery is very largely predicated upon the truth of the continuum theory. Setting aside minor variants, there are currently *three* [39–44] hotly contending candidate scientific theories of mental imagery. According to *quasi-pictorial* theory, both visual percepts and visual mental images are picture-like: two-dimensional patterns of excitation in a "visual buffer" in the brain [45–48]. According to *description* (or "propositional") theory, both percepts and images are descriptions of visual scenes [49–55], couched in the brain's inner "language of thought" (*mentalese*) [56]. According to *enactive* theory (a.k.a. motor theory, perceptual cycle

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3 Henceforth, unless otherwise indicated, references to McGinn's views will be alluding to this work.

theory, role taking theory, *etc.*), the process of perception constitutively involves action [40,57–69]. Perceptual experience (experience of perceivables), on this view, arises from specific sequences of exploratory perceptual actions, *perceptual routines* [67,70–74], through which the identity of specific types of perceivables in the environment is determined; the corresponding mental image is experienced through the (partial, abortive, and largely covert) enactment of the perceptual routine through which the identity of its object (*i.e.*, the thing imagined) would be recognized if actually present. Thus mental images are (or supervene upon) enactments of sequences of exploratory perceptual acts [40–44,75–82].[4]

Although these three types of theory are in deep contention with one another in many respects, at both empirical and philosophical levels, all of them regard mental images as fundamentally akin to percepts. Their differences are rooted in deeper differences over the nature of perception, mental representation, and conscious experience [40,43,44]. Thus they all depend upon the continuum theory. (*Quasi-pictorial theory* is currently the most widely known and accepted of these theories, but it is worth noting that McGinn ([30], chapter 5) joins critics such as myself ([40,43], [44], §4.4 supplement), Slezak [83], and Pylyshyn [49–54] in explicitly arguing against it. He does not, however, endorse any alternative.) I do not know whether a theory of the nature and mechanisms of imagery that does *not* assume the continuum theory is really a coherent possibility; at any rate, no-one seems ever to have devised one.

McGinn, however, follows philosophers such as Reid ([84], §II.5), Sartre [85], and Wittgenstein ([86], §§625ff.) who reject the continuum theory, and draw a fundamental conceptual (and phenomenological) distinction between images and percepts (and, thus, imagination and perception). Although he defends this view in considerably more detail than his predecessors ever did, and although his defense is lucid, insightful, and superficially persuasive, I believe that it fails, and, in fact, that we positively *need* the continuum theory if we not to fall back into mysterianism. It is not clear that we can even get a grip on the concept of mental imagery without recognizing its fundamental kinship with perceptual experience ([43]; [44], §1), and, as we have just seen, without it we have no inkling of a scientific account of imagery. McGinn's arguments, however, are valuable, because a detailed exploration of how they fail will deepen our understanding of the real relationship between perception and imagination.

He initially approaches the issue via Hume's well known version of the continuum theory. Hume ([34], §I.1.i) held that percepts and images (*impressions* and *ideas*, in his terminology)[5] differ, and may be distinguished one from the other, only in their degree of "vivacity" (by which he is

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[4]   Sima and Freksa [81] distinguish between their own view and what *they* call "enactive theory". However, they appear to be using that expression to refer specifically to the imagery theory that I proposed in 1999 [40] (actually under the name "perceptual activity theory"), and which they criticize for not being formulated in computational terms. (Blain, however, has since shown that it can be modeled computationally [79].) As I intend the expression "enactive theory" here, however, it does not refer specifically to my own view, but to a broad class of theoretical positions (including mine) that, although they may differ in various ways, are alike in that they all reject the identification of mental imagery with inner pictures or descriptions, and, instead, see it as arising from the offline functioning of active, exploratory mechanisms of perception and attention. On that basis, I think it is justifiable and appropriate to classify the Sima and Freksa [81] theory as a form of enactive theory. Certainly they explicitly reject both quasi-pictorial and description theories.

[5]   Yolton [87] argues against the generally accepted view that Hume understands his *ideas* to be mental images. His position, however, is vulnerable both on conceptual and textual grounds ([44], §3.3.3).

generally taken to have meant something like *vividness*). They differ in the "force and liveliness" with which they strike the mind. Like many commentators before him (e.g., [84], II.5, VI.24; [36,38]), McGinn has no difficulty in showing that this view (on any plausible interpretation of "vivacity") is seriously inadequate. After all (as Hume himself admits), it is perfectly possible, and not even particularly uncommon, for people to experience percepts that are far from being vivid, forceful or lively (think, for example, of a distant cry, barely heard over a nearby hubbub). Likewise, imaginative experiences can occasionally be very vivid, forceful and lively without, thereby, tempting us to mistake them for percepts. Even if we do occasionally make that mistake, furthermore, it remains a mistake. Our imaginings do not *become* percepts just because they are forceful and lively enough to fool us; but Hume's account seems to entail that they should.[6]

Having effectively demolished Hume's version of continuum theory (and thereby, he seems to think, all possible versions), McGinn goes on to list nine (not necessarily independent) respects in which, he thinks, imagery and perception really do differ:

(1). **Will:** We can freely choose to imagine pretty much anything we want, at any time, but we can perceive only what is actually now before us ([30], pp. 12ff.);

(2). **Observation:** Perception can bring us new information about our current environment, but imagination cannot ([30], pp. 17ff.);

(3). **Visual field:** Our eyes can only take in things within a physiologically fixed angular field of view, and the things we see must always appear at some particular location in this visual field. Imagination, by contrast, suffers from no such limitations ([30], pp. 22ff.);

(4). **Saturation:** McGinn is aware that the hoary argument that mental images can be indeterminate in a way that percepts cannot is unsound.[7] However, he defends the related view that perceptual experiences are always "saturated" (*i.e.*, some quality is always manifested at every point in the visual field), whereas images are typically unsaturated or

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6   It has been put to me, by a referee, that Hume did not hold that all *ideas* are necessarily less vivacious than all *impressions*, only that any particular *idea* will be less vivacious than the *impression* from which it derived. I do not think that this consideration will rescue Hume's version of continuum theory from vacuity, however. In Hume's system, no *idea* can ever be compared in point of vivacity to the *impression* from which it derived, because, by the time it has become an *idea*, the *impression qua impression* no longer exists. We can only ever compare current *impressions* to current *ideas* derived from past *impressions*. If it is then admitted that sometimes a current *impression* may be less vivacious than certain current *ideas*, then vivacity is rendered useless as a criterion for distinguishing these two classes of mental content (yet Hume seems to offer us no other). In any case, this is all rather beside the point. My concern is not to criticize (or defend) Hume, but to defend continuum theory. If McGinn's objection to Hume's version of continuum theory is unsound, then so much the better for continuum theory. If the objection is sound (as I and others [36,38,84] are inclined to believe) well then, I am going to argue that there is nevertheless a version of continuum theory that remains plausible and defensible.

7   A closely related argument, that I think has been made more often (and has also been repeatedly refuted), is that mental images cannot be inner pictures, because the former can be indeterminate in ways that the latter cannot. Both these arguments fail for similar reasons. See [44] (§4.4.1, and particularly note 31) for a brief account of the argument as applied to the notion of inner pictures, of why it fails, and for a brief bibliography both of attempts to press the argument, and of refutations of it.

"gappy": an object, such as a face, may be visualized without every detail, every shade of color at every point, being specified ([30], pp. 25f.);

(5) **Attention:** "I can pay attention to what I am seeing or I can fail to pay attention to it; but I do not have this choice in the case of images: here I must pay attention in order to be imaging at all…[I]mages necessarily involve attentive intentionality…[O]ne has to attend to the *object* of the image in order for the image to exist" ([30], pp. 26ff.);

(6) **Absence:** If we say that we perceive something, this implies that the something is really there in the world, present to our senses. By contrast, if we say that we imagine something, this implies that it is *not* there, *not* present to our senses ([30], pp. 29f.);

(7) **Recognition:** One knows the identity of the object of one's imagining simply in virtue of the fact that one has chosen to imagine that thing. No further act of recognition is needed in order to identify it. By contrast, perceiving what something is *does* require an act of recognition, because the identity of the object is determined not by the will, but by how the world is ([30], pp. 30f.);

(8) **Thought:** Although you can perfectly well be seeing X and, simultaneously be thinking of Y, you cannot be imagining X and simultaneously be thinking of Y. ([30], p. 32);

(9) **Occlusion:** Unlike real things, imaginary things do not block or occlude the visual scene. If there is a tree in front of us, we will not be able to see whatever might be hiding behind it, but if we imagine a tree in front of us, however vivid it may be it will not hide anything that is really there ([30], pp. 32ff).

I think most of what McGinn says about imagery here, and some of what he says about perception, is true. Imagery and perception do differ in most of these ways. I shall argue, however, that, like Hume's "vivacity", these differences are all best construed as differences of degree (or consequences of underlying differences of degree). Thus, the failure of Hume's simplistic, one-dimensional, "vivacity" based version of the continuum theory is no ground for rejecting the theory out of hand.

Nevertheless, McGinn's analysis does suggest that there are several distinct ways in which imagery and perception differ, and although not all these ways are necessarily independent of one another, this still implies that our continuum, or spectrum, is likely to be a multidimensional one. (And with that acknowledged, there will no harm in throwing vividness or vivacity back into the mix, as one of these dimensions, so long as we are not tempted, like Hume, to privilege it over the others.) As McGinn himself points out, there is a whole range of types of experience (he classifies most of them as forms of "imaginative seeing") that are like perception in some ways and like imagery in others. If any particular such experience happens to fall well towards the perception end of the spectrum on a majority of these dimensions of difference, and only towards the imagery end, or towards the middle, on a lesser number, we might be inclined to classify it as a somewhat atypical case of perception. If the reverse is true we might be inclined to think of it a slightly aberrant example of imagination. Other more mixed cases may call for other terms: illusion, hallucination, pseudohallucination, phantasm, daydream, figment, fancy, visual ambiguity, misrecognition, pareidolia, hypnagogic image, *etc.* Both ordinary and technical language provide a rich, but unsystematic, vocabulary for talking about such things. One of the attractions of the multidimensional spectrum view is that it might provide the basis for a more systematic way of organizing our understanding of them. We might hope ultimately to be

able to map the various types of imaginative and perceptual phenomena as regions within a unified multi-dimensional phase space.[8] Before that project can begin, however, it must be shown that what McGinn and others think are absolute differences in kind, qualitative differences, are all (or are all reducible to) quantitative differences of degree.

4. Reestablishing Continuity: (i) Will

Because of the ways in which the issues are interrelated, in what follows I will not deal with McGinn's points of difference strictly in the order in which he introduces them (*i.e.*, as listed above). Instead, each time I touch on one of these points, I will mention it in **bold type**, using the name it has been given in the bolded headings of the list in our previous section (which correspond quite closely to McGinn's own section headings).

Nevertheless, we may conveniently begin at the beginning, by considering **will**. On the one hand, this may be the criterion most likely to resonate with other philosophers, because far more influential philosophers than McGinn, notably Sartre ([85], p. 18) and Wittgenstein ([86], §§627, 633), have made similar points before. On the other hand, it is not difficult to make a *prima facie* case that it marks a difference of degree rather than kind. Although it is true that we do typically have considerable voluntary control over our imagery, this is by no means absolute, and varies in degree from case to case: we may want to imagine some familiar person's face, but be quite unable to call it to mind, and, even when we can form an image of something, it is often very difficult either to visualize much detail, or to maintain the image in consciousness for more than a fleeting moment. By the same token, most people have had the experience of some apparently random image popping unbidden into consciousness, or of being unable to dismiss some annoying or disturbing image (perhaps of some gruesome or disgusting sight) from their mind [88]. This does not just apply to visual images, either: most of us know what it is get a song or a snatch of music stuck, infuriatingly, in our head, a phenomenon that has come to be known as an "earworm" [89].

Hallucinations might also very plausibly be taken to be examples of mental images that have thoroughly escaped the control of the will, and, as we will see later on, they have been so taken by many of the clinicians and scientists who have studied them. (This does not accord with McGinn's conception of hallucination, but, as we shall also see, that conception is untenable.)

Perception, in turn, is not so far beyond voluntary control as McGinn wants to imply. Although the content of visual experience is, at any one time, certainly strongly constrained by what is within range of the eyes, we nevertheless have a considerable degree of voluntary control over what we actually see. Something may be there in front of you, but, if you don't want to see it, it is easy enough to shut your eyes, or turn them away; or if you *do* want to see what is not *quite* in front of you, it usually takes no great effort to turn your eyes or move your body toward it.

Ichikawa [90] has recently attempted to defend McGinn's view about **will** from objections of this sort. He concedes that we cannot always control our imagery as well as we would like. However, he insists (rightly, I think), that, whether we succeed or no, we can always *try* to control our imagery, try

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[8] As we shall see in what follows, it may be that just three dimensions will be enough. If so, such a map should be relatively easy to visualize and to grasp intuitively. Anything beyond very rough quantification along the dimensions may prove difficult, however.

to form a particular image, or to banish one from consciousness. By contrast, he thinks, it does not even make sense to *try* to exert an equivalent sort of control over perception: "The instruction", "stop having the auditory experience of my voice", or "start having the visual experience as of a red square" is a confused one" ([90], p. 107).

Those instructions, however, do not, in fact, leave me confused. It seems to me that not only could I try to follow them, but very often I could quite easily succeed. If I want to stop experiencing someone's voice, can I not stick my fingers in my ears and hum, or perhaps leave the room? As for seeing a red square, I believe I have a square, red box around here somewhere that used to hold floppy discs...Let me just take a moment to find it...and hold it up to look at...There! Done!

Of course, these performances will not satisfy Ichikawa. He has already (albeit offhandedly) dismissed the suggestion that we can voluntarily change what we see by redirecting our attention elsewhere by saying that this only amounts to "indirect" control over our perceptual experience ([90], p. 107). Presumably this is meant to contrast with the direct (though imperfect) control we apparently have over our imagery, and, if merely shifting attention is sufficient for indirectness, presumably he would think that performances like leaving the room or finding and holding up a red box are profoundly indirect ways of affecting one's perceptual experience.

What, however, is the basis for this direct/indirect distinction? Ichikawa does not say, but so far as I can see, the only plausible surmise is that (for him—and perhaps implicitly for McGinn, Sartre, and Wittgenstein too) direct control of our experience is that which can be accomplished through purely mental acts, whereas when such control involves actual bodily movements (even small ones, like turning the eyes in their sockets, or lowering the lids) then it is merely indirect.

There are at least two sorts of good reasons to reject this distinction (or, rather, to reject the idea that it is a difference in kind rather than of degree). First of all, unless we are to embrace metaphysical mind-body dualism (I doubt that Ichikawa wants to do that, and I know McGinn doesn't), it is not at all clear that any sharp and principled distinction can be drawn between mental acts and bodily acts. On the one hand, both, being acts, bear intentionality, so that will not serve to distinguish between them. On the other hand, from a materialistic point of view, why should we draw a sharp, ontologically significant distinction between those movements of ions and molecules through and around membranes that constitute neural activity in the brain, and the very similar electrochemical processes that constitute both signals in the peripheral motor nerves and the events within the muscle fibers that cause them to contract? Perhaps bodily acts (if we take them to consist of the relevant muscle contractions *plus* the central and peripheral neural activity that brings them about) typically use up more energy than purely mental acts, but that is a quantitative and not a qualitative difference.

Quite apart from this, however, Ichikawa seems to be assuming that changing what you see always depends upon actual bodily movement (such as turning the eyes or the head), whereas changing what you imagine never does. He is mistaken on both counts.

First of all, we can, to a degree, shift the direction of our visual attention without moving our bodies (or our eyes) in any relevant way [91]. There is reason to believe that such "fixation shifts", as they are called, are enough to make an object appear or disappear from visual consciousness [92]; certainly they can have profound effects on what it is that we think we are seeing [93].

Even more significantly, however, there is now a considerable amount of evidence, from a range of experiments, to show that unconscious eye movements are directly involved in mental imagery. A

variety of experiments have revealed that when people form a visual mental image they spontaneously tend to move their eyes in a spatiotemporal pattern that parallels the distinctive eye-movement pattern that they would have used in actually viewing the object or scene being imagined [94–104]. If they deliberately try to refrain from making such movements, their imagery is degraded [97,103]. Thus (in many, and perhaps most, cases), if someone wants to change what they are visually imagining, they will have to change the way they are moving their eyes. Indeed, although Ichikawa talks of banishing a mental image as if it were an effortless, purely mental act, in fact, it is often not easy at all. Notoriously, the injunction "Do not think of a white bear" is almost impossible to deliberately obey, and the "thinking of" will, more often than not, include visualizing [105,106]. Even worse are the "intrusive images", often of unpleasant, disturbing scenes, that people sometimes get stuck in their heads. They are a significant aspect of many psychological disorders, but also occur quite commonly in mentally healthy people [88,107]. Merely willing these to go away is almost never effective. In fact, probably the best way to free the mind from the grip of an unwanted image is to perform the voluntary *physical* act of consciously moving one's eyes about [108–116]. These voluntary eye movements disrupt the spontaneous but unconscious eye movement pattern that sustains the image.[9]

All in all, then, Ichikawa's sharp, qualitative distinction between direct and indirect control over one's own experience cannot be sustained, and thus he and McGinn fail in their attempt to establish that the criterion of susceptibility to the **will** marks a *qualitative* difference between imagery and perception. I am not denying that it may usually be noticeably easier to control what we imagine than to control what we see, or even that, sometimes, we might use our sense of how, and to what degree, we are controlling an experience to ascertain whether it is real or imaginary (as Hume apparently thought we might use degrees of "vivacity"), but this is not the sharp difference in kind that McGinn (and Ichikawa, and Sartre, and perhaps Wittgenstein) wants.

5. Of Passive Perception, Visual Impressions, Retinal Images, and Eye Movements

The points I have made about changing your perceptual experience through bodily movement, through turning your eyes in a different direction, banal though they may seem, touch, I think, on what may be the real foundation for the belief that imagination is fundamentally different from perception. Those who hold this view—certainly those whose defense of it we are considering here: Sartre, McGinn, Ichikawa—hold not only that imagination is inherently active, that imagining is something we *do* (which I entirely accept), but also that perception, and visual perception in particular, is, in its fundamental essence, *passive*, something we suffer.

Sartre, indeed, makes this point quite explicit ([85], chapter 1, §5), and Ichikawa ([90], p. 107) quotes the relevant passage approvingly, so we may take it that he agrees. McGinn is less direct, but, once one is on the alert to the issue, his passive view of perception is obvious enough, perhaps most clearly when he discusses how he thinks imagination and perception can be differentiated in terms of their relationships with **attention** and **thought** (matters to which we shall return). In effect, all these authors rest their arguments upon the assumption that we do not really need to *do* anything in order to see: that if something is illuminated and before our opened eyes, if it projects an optical image onto the

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[9]   For further discussion of eye-movement studies relevant to the understanding of imagery, see [42,44,82].

retina (and the relevant nerve pathways are intact, *etc.*), then *we see it*, quite regardless of whether we attend to it, perhaps even regardless of whether we are aware of it, or whether we respond to it in any way. From this perspective, turning the eyes is not really part of the process of seeing at all; it is something that intervenes between actual instances of seeing. Real seeing occurs when the eye is still enough to receive a nice, steady image on the retina.

I believe this implicitly *passive* view of vision (or even of perception in general), is deeply ingrained in the way that many people (perhaps particularly the scientifically and philosophically well educated) think about vision, and lies behind many of the misconceptions about the imagination held by McGinn and other modern and contemporary philosophers, not just the frequently endorsed argument from **will**. Accordingly, in this section I will digress from the direct philosophical consideration of imagination to critique this passive view of perception, investigate its historical and analogical roots, and, hopefully, thereby, weaken its likely hold upon the reader's intuitions. This will prepare us for the further consideration of imagination, and further defense of the continuum theory, in the sections to follow.

An alternative, radically *active* conception of vision (and perception in general) has recently been strongly advocated by philosopher Alva Noë, as well as by a number of roboticists and visual scientists [58–69]. I am very sympathetic to these views [40,43], but I do not believe my current argument about imagination depends upon a full acceptance of them. For present purposes, I only need to establish that eye movements play an essential, rather than merely incidental, role in the normal process of seeing, and that the radically *passive* conception of vision, even though implicit acceptance of it is so widespread, is not a conceptual or empirical inevitability. It is neither the inescapable verdict of science, nor a deliverance of some timeless philosophical intuition. Rather, it has become entrenched in modern educated common sense for quite contingent historical reasons.

Recent visual science shows, quite clearly, that our eyes move continually and purposefully, and that these movements play a central and ineliminable role in human vision. Indeed, it has been claimed that "*most* human behaviors are eye movements" ([117], p. 76).[10] The fact that we deliberately turn our eyes every so often, in order to look in a different direction, is only the tip of the iceberg; if our eyes did not move, we would, quite literally, be unable to see. If the optical image is kept artificially stable on the retina for more than a small fraction of a second (as the eyes are so naturally mobile, this is something that can only be achieved using quite sophisticated technology) then, due to the fatiguing of the retinal receptor cells, the visual experience fades away and the subject ceases to see anything at all [118,119].[11] In order to extract the useful information from the structured light, the optic array [120], that surrounds us, our eyes (directed, for the most part, by sub-personal, unconscious brain processes) constantly flit about in large and small motions.

There are several distinct types of eye movement, but the best studied (and perhaps the most important) are the rapid, irregular "flicks" known as *saccades*. In humans, these occur, on average,

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10 Emphasis added. Of course, this raises questions about the countability of behaviors, but the mere *prima facie* plausibility of the claim brings home the fact that we do make an awful lot of eye movements, and suggests that there must be some very good reasons for them.

11 It does not follow, however, that the avoidance of receptor fatigue is the only, or even main, function of eye movements, as we shall shortly see.

about three to five times every second [121,122], and are absolutely integral to our vision. Despite this, and despite the fact that a large saccade will very radically alter the optical image falling one's retina, we are normally unaware of their occurrence. Not just their frequency but their very existence came as some surprise to the late 19th century visual scientists who first formally described them [123], and their true significance for our understanding of vision did not really begin to be widely recognized by visual scientists until the work of the Russian biophysicist Yarbus was published in English in the 1960s [124–126]. Although the existence of saccades may by now be quite well known, their significance for our understanding of how seeing works is probably still not much appreciated by many people outside a small circle of vision researchers.

Recent technological advances have made the accurate measurement and recording of eye movements in the laboratory a much easier task than it was in Yarbus' time, such that now we are in the midst of a great flowering of research on eye movements, and starting to gain an unprecedented appreciation of their role in vision [122,123,127,128]. Yarbus' contention that, despite the fact that we are largely unaware of making them, saccades are nevertheless under purposeful cognitive control, has been amply confirmed. The pattern of saccadic movement is complex and irregular, but it is far from random. It depends both on the detailed structure of the visual scene that a person is looking at, and on the larger purpose behind the looking: on what is there, on what we hope to discover, and on what we need to know in order successfully to pursue our ongoing behavioral goals [124,127,129–131].

In fact, human eyes are not stationary, even during the periods of so-called fixation that occur between major saccades. Not only are there the large, relatively easily observable saccades, through which we turn our eyes to look at different parts of the scene before us, and over which we can exert at least a limited degree of voluntary control, there are also *microsaccades* which continue to occur, well below the threshold of consciousness, even when we seem, subjectively, to be holding our eyes still. Even in the intervals between microsaccades, the eyes continue to move, making slower movements of comparable amplitude known as *drifts*. Superimposed on all these other movements, a low amplitude, high frequency *tremor* carries on continually [118,130,132,133].[12] As already noted, although most of them are not made by conscious volition, saccades, including microsaccades are clearly under cognitive control, and serve important visual functions. The evidence is, as yet, less clear concerning drift and tremor, but there are good reasons to think that the same is also true of them [118,132,133,135–141]. Indeed, counterintuitive as it may seem, "fixation eye movements" in general (microsaccades and/or drifts, and perhaps tremor too) seem to be necessary in order for us to make out fine levels of visual detail. This is because neurons in the visual cortex are, for the most part, wired so as to respond not to visual stimulation of the retina *per se*, but to changing, moving retinal stimulation ([142], chapter 4). Just as you need to move your finger over a surface in order to feel its texture, and locate all the fine ridges, bumps, grooves, and other irregularities, you need to move the retinal optical image over the retinal receptor cells in order to sense all the fine details, edge positions and so forth, inherent in its optical structure [118,130,137–141,143–147].

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[12] Apart from saccades and the three types of "fixational" eye movements just discussed, there are also a number of other types of largely involuntary eye movement. These include the *smooth pursuit* or *tracking* movements by which our eyes follow the path of a moving object, and the *vergence* movements whereby the two eyes converge to fixate objects at different distances ([134], §2.1.1).

In addition to direct evidence of this sort there are more general considerations, arising from the anatomical structure of the human visual system, that point towards the crucial importance of eye movements to ordinary visual experience. Because of the structure of the human retina, at any one instant our eyes can only take in fine detail and rich color in a very small, central region of our visual field, corresponding to the *fovea*, the central region of the retina, where most of the color sensitive cone cells are located, and where they are packed together most closely. The fovea comprises only about 1% of the total area of the retina, and it takes in information from a visual solid angle of only about 2°, "about the size of a thumbnail at arm's length", as compared to about 200° for the eye (and retina) as a whole [122]. Moving away from the fovea towards the peripheral retina, the light sensitive cells are progressively spaced further and further apart, and a decreasing proportion of them are color-sensitive cone cells. Most of the cones are in, or fairly close to, the fovea, and the light sensitive cells in the peripheral retina are not only widely spaced, but are mostly rods, which do not register color at all, and which are only functional in low light [148–151]. The few scattered cones that do occur in the far periphery of the visual field seem to be of only one type ("blue sensitive" S-cones), and thus do not provide color vision there [151]. Thus our capacity for color vision and for discriminating fine detail falls off sharply away from the central 2° of our visual field, and in the far periphery we can do little more than sense the mere presence or motion of some indefinite, indefinitely colored thing, which we must bring into foveal vision if we want to identify it ([152], p. 54). Our normal impression that we constantly see a richly detailed and colored visual world all around us is sustained only because of the way our eyes effortlessly, involuntarily, and constantly turn in their sockets, rapidly moving the searchlight beam of detailed, foveal color vision from one spot to another. Just as it seems as if the refrigerator light is always on (because as soon as we open the door to check, it is!), so it seems that we see the whole scene around us in rich color and detail; because as soon as we turn our attention, and so our eyes, to any particular part of it to check, we do indeed see that part in rich color and detail [40]. We do not normally notice—indeed, it is hard to tell—that our peripheral vision is uncolored, but that is just one more token of the fact that eye movements are a constant, integral, and automatic (and so largely unnoticed) part of normal seeing.

I do not, however, mean to imply that the dependence of vision upon eye movement is entirely a consequence of the specific type of retinal anatomy possessed by humans. Most species of animal do not have a foveally structured retina, but most species that have a more than rudimentary visual capacity (including many invertebrates) *do* make frequent eye movements of various sorts (some saccade-like) that play a vital role in their visual functioning [125,153,154]. The photoreceptor systems of eyes, across the animal kingdom, respond not so much to light as to *changes* in the light illuminating them, and, more often than not, the best way to induce the sorts of changes that will provide useful visual information is to move the eyes.[13] Animals that cannot move their eyes

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[13] There are circumstances in which it is useful for some animals (not humans) to keep their eyes truly static, but that is when they have no interest in the scene in front of them unless something moves in it, and when they want to be able to very quickly and reliably detect such movement (usually of other animals: prey or predator) within an otherwise static visual field. A frog waiting to catch a fly is in this situation, and keeps very still until a fly crosses its visual field, seeing *nothing but* the fly ([155], see also [125], p. 346). However, if humans or other animals want to be able to see the world around them, which is usually mostly static, they must move their eyes.

independently, and that, in some cases, have eyes very different from ours, ranging from various birds and mammals to insects, cephalopods, and even simple plankton animals (whose eyes do not focus any sort of image, and have only a single light sensitive cell[14]) will move their whole head, or sometimes their whole body, in order to put their eyes in motion, and thereby obtain the visual information they need [156–161]. Humans, too, will do this when necessary. Gilchrist and his colleagues studied a woman whose eye muscles have been paralyzed by disease since birth, but who nevertheless seems to be able to see quite well. They found that she had learned to compensate for her inability to move her eyes in their sockets by making frequent, small, jerky movements of her head that functionally mimicked the normal movement patterns of healthy eyes [162,163]. Movement of the eyes is clearly *necessary* for anything like normal human vision.

Let me re-emphasize that the function of eye movements is not just to turn the eyes in a new direction in order to bring new things into view (though they do that too). Animals, including humans, need their visual receptor cells to be in motion relative to the optic array in order to be able to extract particular types of useful information (such as edge locations [137–141,143–146], the direction of the sun [156], object distances [157,159–161], speed and direction of self-motion [164,165], and even color information [166–168]) from the structural features of that array.

Some of the facts that we have just discussed, about eye movements and their important, integral role in vision, are very recent discoveries, and others have only quite recently had their significance fully recognized, but many of them have been known for several decades, which makes it all the more shocking that Findlay and Gilchrist could write, as recently as 2003, that "Many [college level] texts on vision do not even mention that the eyes can move" ([63], p. 1). Even when the fact *is* mentioned in such works, it is usually given relatively little attention. I fear the situation has not improved very much even since 2003. I looked, admittedly not very systematically (via Google Books and Amazon.com), for textbooks on visual science published since 2010. I found five. Three of them did not seem to contain the word "saccade" (or any of its relatives) at all [169–171]; the other two managed only a handful of brief allusions in their several hundred pages each, and certainly did very little to make the enormous functional importance of human eye movements clear [172,173].

Indeed, even many professional visual scientists seem to think of eye movements as though they are a "problem" that our visual system must somehow overcome, rather than an important functional aspect of that system (e.g., [174]): our brains, it is assumed, must have developed elaborate ways to "compensate" for the movements of our eyes, so that the things we are experiencing do not seem to jump about wildly as the optical image on the retina (and the corresponding neural representation in the visual cortex), changes radically with every major saccade (about 3 to 5 times per second, remember) and wobbles and jitters about with each little fixation movement.[15] Seeing, many seem to

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[14] Actually, the "eye-spots" of the animals in question (*Platynereis* larvae—but the article's authors appear to believe that their results are likely to generalize to other animals of similar type) consist of *two* cells, a single light-sensitive receptor and a pigmented cell, which shades the receptor from light coming from one side. This shading plays an important role, together with the animal's movement, in its ability to sense the direction from which light is coming [156].

[15] It is true that there is a neural mechanism known as *saccadic suppression* that appears to suppress aspects of visual processing during the saccade itself [175]. The issue of current concern, however, is not what happens *during* saccades, but the fact that from one saccade to the next the images of each feature of the visual scene will have changed position

think, would be so much easier if only we were able to hold our eyes still, so as to produce a nice steady retinal image for the brain to analyze at its leisure.

As others have noted [62,63,176–178], something is very wrong with that picture. Not only have we somehow failed to evolve the capacity to hold our eyes still, we have evolved an elaborate systems of muscles (and brain regions controlling those muscles) that actively keep them in constant and irregular motion. If those muscles fail someone, they keep their eyes moving nevertheless, by making jerky movements of their whole head [162,163]. In fact, we do not need a stable retinal image in order to be able to see a stable world, nor do we need a stable representation in visual cortex, because we experience neither image nor representation, but the world itself (which, thankfully, is normally fairly stable). What we need in order to see it properly, it turns out, is an image that gets moved, in a suitable way, across the retina, thereby inducing an informative pattern of *change* in the firing rates of the receptor cells, and a corresponding pattern of change in the cortical responses. Eye movements are not a bug, they are a feature.

Why, then, are the theoretical implications of eye movement research so widely ignored or dismissed? Why are undergraduates generally taught little, if anything, about them? I suggest that it is because most visual science today is dominated by a paradigm (the Kuhnian [179] language is, I think, quite appropriate) known as Visual Information Processing Theory (henceforth VIPT), which is the modern scientific form of the passive view of perception that goes back to Descartes in the 17th century (or even further, to Alhacen,[16] in the 11th). In all its multifarious variants, VIPT holds (roughly speaking) that the process of perception consists of a (mostly) one-way flow of information from the external environment, in through the sense organs, and through various stages of computational processing in the brain, in which it is combined and compared with, and modified by, information already stored in memory, until it achieves a form, and/or reaches a functional location in the cognitive system, in which it can give rise to perceptual experience and is suitable for guiding behavior.[17]

Although VIPT was already very influential amongst cognitive scientists by the early 1970s [183,184], and textbooks devoted to it were appearing before the end of the decade [185], David Marr's very influential 1982 monograph, *Vision* [186] (yet another work that barely acknowledges that the eyes move) is now often considered to constitute its canonical statement. Not only the very recent textbooks cited above [169–173], but also most other in-print textbooks of visual cognitive science (e.g., [187–191]), make their primary allegiance to VIPT (and their debt to Marr) quite clear.[18]

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on the retina. Also, of course, during the brief periods of (relative) fixation between saccades, when this suppression is lifted, other forms of eye movement such as drift and tremor are continuing.

[16] Abū ʿAlī al-Ḥasan ibn al-Ḥasan ibn al-Haytham (d. c. 1039 A.D.), known in the West as Alhacen or Alhazen, was a Muslim scientist who appears to have been the first to establish that human vision involves the focusing of light into an image within the eye. His work had considerable influence on European optical theorists through the later Middle Ages and the era of the Scientific Revolution [180–182].

[17] Please note that, in criticizing VIPT as a theory of the overarching architecture of perceptual cognition, I do not thereby mean to imply that the concepts of information, of processing, and the closely associated notion of computation, do not have legitimate uses in cognitive science, and even in the theory of vision.

[18] Amongst current editions of texts still in print, I have been able to find just three clear exceptions to this rule. One is the 1997 fifth edition (still by the original author) of *Eye and Brain*, a text first published in 1966, before VIPT became the dominant theory [192]. It discusses Marr, and VIPT in general, only briefly and quite skeptically. It also devotes a few

This bias, furthermore, is not confined to undergraduate texts. Popularizations, such as Pinker's *How the Mind Works* [194] or Hoffman's *Visual Intelligence* [195], tell the same story: vision is mostly a matter of the processing of information in the brain, and the movements of the eyes, are relegated to unimportance by the simple expedient of scarcely being mentioned. Consider, also, popularizations aimed at children: the estimable series *Explore Your Senses*, for instance, is intended to introduce elementary-school-aged children to the modern science of perception. It consists of five short books, each dealing with one of the traditional five senses [196–200]. Each one of them is at pains to drive home the points that the organ that *really* does the main work of perceiving is the brain, that perceptual experience occurs in the brain (not, as one might think, in the sense organs) and, by implication, that the eyes and other sense organs are nothing more than transducers, passive receivers of sensation or information. Indeed, most of us have been told, repeatedly and authoritatively, since childhood, that this is the only truly scientific way to think about how vision works. For this story, the fact that our eyes are constantly, purposefully on the move, that, indeed, we cannot see *without* moving our eyes, is not just an irrelevance, it is an embarrassment.

Of course the broader conceptual framework within which VIPT has flourished goes back to long before concepts like computation and information processing were introduced into psychology in the mid-twentieth century [201,202]. Perhaps the original source of the passive conception of vision is the tempting analogy that has long been drawn between the process of seeing and the process of making an impression of an object in soft wax, which may have been first used by Democritus, in the 5th century B.C. ([203], p. 111). Plato, the first cognitive theorist whose works survive *in extenso*, uses the wax impression analogy only tentatively, in his discussion of memory formation (*Theatetus* 191c,d in [204]). However, when Plato's former student Aristotle comes to discuss the workings of vision, he unambiguously embraces the analogy (*De Anima* 424a 17ff in [205]), and thus, of course, the idea was passed on to the scholastics of the Middle Ages, and to more modern times. The wax, of course, represents the mind as it waits, passively, to be imprinted by an incoming sensory form.[19] As a metaphor for perception, the word "impression" is still very much with us, having been revived in the 17th century by Descartes and Hobbes, amongst others, and then becoming central to Hume's philosophy [34]. The fact that not only Hume himself, but most of his readers, even today, seem to regard it as an entirely innocuous, untendentious metaphor, is an index of how deeply the passive view of perception in general, and vision in particular, has become embedded in modern, educated common sense.

But the prevalence of the passive conception of vision in modern thought is by no means entirely due to the influence of Aristotle and the *impression* metaphor. It is also bound up with one of the

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pages (distinctly more than most of the other current textbooks) to eye movements and their physiology, and acknowledges, but does not greatly elaborate upon, their functional role in vision. The other two exceptions were both first published relatively recently, and both give eye movements a prominent and central role in their accounts of human vision, explicitly or implicitly rejecting VIPT [63,193]. These represent the newer, alternative, paradigm for visual science.

[19] This last remark does not apply to Democritus, who appears to have held that an impression was made, quite literally, upon the air between the perceiver and the perceived object, after which the impression, made of, as-it-were, compressed solidified air, presumably entered the eye [206]. Aristotle and Plato, however, clearly think of the impression (or something analogous to one) as being formed within the subject, impressed (perhaps metaphorically) into the substance of the soul.

emblematic discoveries of the Scientific Revolution, which lies at the very roots of modern science and modern philosophy. The theory of the retinal image, and the optics of its formation, was first worked out (under the influence of the much earlier work of Alhacen) in the early 17th century, by Johannes Kepler [180]. Kepler is even better known, of course, for his major contribution toward our modern understanding of the solar system, and is thus one of the leading hero-figures in our mythos of the Scientific Revolution [207]. Before long, Kepler's retinal image theory was being confirmed experimentally, most notably, perhaps, by Descartes (not only "the father of modern philosophy", but himself a key figure in the Scientific Revolution). In his *Optics* (*Discourse V*: [208], p. 166) Descartes describes how to prepare and set up an eyeball taken from a recently deceased person or animal, in order to see for yourself the retinal image formed within it.[20]

The fact that this is done with a dead eye, dissected out of the body of which it was once a part, highlights the implication that retinal image formation is a purely passive matter, driven not by the agency of a living animal, but entirely by the incoming light. Descartes built the rest of his theory of visual perception (and, to a considerable degree, his epistemology too) upon the foundation of this important scientific discovery. The optics of the retinal image became the basis for speculations about visual cognition that went far beyond the available empirical evidence. Nerve pathways from the retina, he suggested, terminate near the pineal gland, in the center of the brain, and are so arranged as to cause another image, isomorphic to the image on the retina, to be projected onto the surface of the gland. Notoriously, of course, the pineal gland was the place where he believed that the physical processes of the body managed, in some unexplained fashion, to interact with the immaterial, conscious soul. Thus, it is not our retinal images, and still less the external world, that are the direct cause of our visual experience, but the images formed in this mysterious, hidden, inner place. Descartes explicitly identified this place, the pineal surface, as the locus of the imagination, and suggested that images of imagination or memory, created or recreated from information stored in the brain in the form of modifications to the nerve fibers that comprise it, were also projected there when they were experienced (*Treatise on Man* in [208], pp. 105ff.; and see [44], §2.3.1). It is these images on the pineal surface, rather than the world outside, that we (our true selves, our souls) directly experience. Note, also, that it is only at this last stage, as the soul is affected by the imaginal representation inside the brain, that anything possessing agency even enters the Cartesian story about vision. Everything leading up to it, in the eye and in the brain, are things our bodies passively suffer as a result of the impact of light or the movements of fluids within the nerve fibers.[21]

The mere fact that seeing involves the formation of a retinal image does not, of course, *entail* that seeing is fundamentally passive. Nobody has ever seriously believed, after all, that retinal image formation is the whole of the story. Nevertheless, if it is the *one big fact* that you know about vision,

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[20] Descartes was not the first to describe such an experiment. He was anticipated by some seven years by the Jesuit, Christoph Scheiner [123].

[21] This physiological theory remains in the background of the more "philosophical" works of Descartes, such as the *Meditations*, for which he is best known today, but is spelled out in detail in his now lesser known "scientific" works, such as the *Optics* and, especially, the *Treatise on Man* (both, abridged, in [208]). In their time, these works were widely read and very influential. Although the *Treatise on Man* was written relatively early in Descartes' career, and was not published until after his death, there is ample evidence in late material such as the *Passions of the Soul* [208] and the *Conversation with Burman* [209], that the ideas therein continued to shape his thinking to the end.

the crucial, new, exciting discovery that has made your understanding of vision modern and scientific (as heliocentrism made astronomy and cosmology modern and scientific), then it is understandable that you might be led to model the rest of your visual theory upon and around it. This was what Descartes did, and what his successors, up the present day, have continued to do.

The above, very brief account of Descartes' theory of vision simplifies and glosses over both physiological and philosophical aspects of it, but not, I think, in such a way as to be misleading in the present context. One wrinkle is worth noting, however. Descartes insists that it is not important that the visual representation in the brain (*i.e.*, the image on the pineal surface) resembles what it represents (*Optics* IV and VII, in [208]); what is important is merely that the representation affects the soul in the right way, causing the appropriate experiences [210]. Thus, although the image on the pineal gland does happen to resemble its object, *that* is not what makes it a representation of that object. It is a representation because of its causal relations and functional role within the process of vision: its causal relations with, on the one hand, the object that is seen and, on the other, the experiencing consciousness to which it is presented. In this respect, then, Descartes' view is much closer to modern philosophical functionalism—which also types mental entities according to their functional causal relations—than it might superficially appear to be. By the same token, of course, contemporary functionalist versions of the passive theory of vision (in practice that means VIPT, in its various forms, as well as theories of mental imagery that were developed within the framework of VIPT: specifically, those of Kosslyn [45–48] and Pylyshyn [49–54]) are much more Cartesian than is commonly recognized.

Very few philosophers or cognitive scientists today believe in the Cartesian immaterial soul, and almost every detail of Descartes' speculative neurophysiology has long since been superseded. Nevertheless, although almost every brick in the original edifice has been replaced, the basic architecture of the Cartesian model of vision continues, as we have seen, to strongly shape popular and introductory, and even not-so-introductory, accounts of visual science. The idea that the essence of seeing is the passive reception of an image by the eyes, followed by the projection (and, in modern versions, processing) of the visual information contained in that image back, deep into the brain, where it somehow gives rise to both a knowledge and an experience of the world before our eyes, remains firmly entrenched in the minds of both educated laymen (in which group I include philosophers) and many visual scientists. More often than not (and insofar as it is possible), the findings of modern neuroscience are still interpreted in the light of this theoretical framework, and most of us are well socialized into believing that any other way of thinking about how vision is not only repugnant to common sense, but also thoroughly unscientific. This is the case, however, only for historically contingent reasons. If what has been recently discovered about the ubiquity and functional importance of eye movements (or even just a portion of it) had been discovered by the great scientific pioneers of the 17th century, and if the retinal image and the way it is formed were relatively recent discoveries, then current, educated-common-sense intuitions about how vision works might look very different indeed.

I emphasize *educated* common sense, however, because it turns out that people whose minds are untainted by Cartesian or computational theories, and who do not know about retinal images (or perhaps do know, but do not care enough to draw conclusions), do not necessarily find the passivity of vision particularly intuitively compelling. One type of evidence for this comes, again, from history, and another from recent psychological research. In the ancient world, and (up to the time of Alhacen) in the early medieval Islamic civilization that flourished while Europe was in its "dark ages", the

understanding of vision was, for many centuries, dominated (though not entirely monopolized) by so called "extramission" theories: theories that understood vision to be a fundamentally active process in which the seeing organism reaches out exploritatively into the visual world in order to see it, rather than passively waiting to be affected by it. Such theories were developed with considerable philosophical and mathematical detail and sophistication that, in fact, did much to pave the way for modern scientific optics [180,211].

It is true that we now know that extramission theories were founded upon some fundamental misconceptions about the natures of both light and the eye. Certainly no "rays" emerge from the eyes to reach towards the objects of vision, as these ancient theorists believed. Like the discovery of the retinal image (though less famously), the thorough debunking of the belief (once widely accepted by the learned and the laity alike) that light emerges from our eyes when we see, also dates back to the era of the scientific revolution [212]. Despite this, however, recent research has found that, even in the modern U.S.A., many children, and even many educated adults who have apparently not yet had the fundamentals of retinal optics (and the accompanying ideology of Cartesian passivism) sufficiently dinned into them, think of vision as working much as the ancient extramissionists thought it did [213,214]. One might be tempted to deplore these people's scientific ignorance, as the discoverers of this situation clearly do. No doubt, inasmuch as these modern naïve extramissionists think that seeing involves light being emitted from the eyes, they are badly mistaken. However, they are almost certainly *not* under the influence either of largely forgotten ancient optical theories or recent empirical discoveries about eye movements. Rather, they almost certainly have reached their views largely or entirely on the basis of their own experience of seeing ([213], p.140. [214], pp. 422–23). They doubtless have at least a limited introspective awareness of the fact that they must move their eyes in order to look at different things (although they will not be directly aware of anything like the full panoply of their eye movements), and certainly they will know that seeing things involves looking at or for them: the active orientation of attention. Thus, intuition, introspection, and self-observation alone, untainted by theory, tends to lead people to think of vision as a fundamentally active, outward-directed, exploratory process, rather than a passively receptive one. Twenty-first century visual science, as opposed to that of the seventeenth century, suggests that they may not be so very far off the mark.

Thanks to the sophisticated techniques and instruments now available to visual scientists, the optics of retinal image formation by no means remains (as it was in the 17th century) the only well-established, hard-scientific knowledge that we have about the workings of our eyes. We know quite a lot of other things now, and although these newer facts cannot match the fame or heroic luster that still attaches to retinal image optics, they are just as factual, and, I want to suggest, when given their due weight they point towards an understanding of the visual process as a whole that is really quite at odds with passivism, and has something (though not everything) in common with the activist "extramission" theories of the ancients. The very least we should acknowledge is that the movements of the eyes, and the mechanisms by which they are controlled and directed, are central and integral to the process and experience of seeing, and must not to be dismissed as though they were theoretically and conceptually irrelevant nuisances.

6. Reestablishing Continuity: (ii) Recognition

Now that we are armed with an understanding of vision that is rooted in 21st rather than 17th century science, let us return to the consideration of the relationship between imagination and perception. Ichikawa [90] apparently thinks that the criterion of **will** is quite sufficient to establish that there is a sharp distinction in kind between them. Sartre and Wittgenstein [85,86] may have thought so too. McGinn, however, seems not to be so sanguine, and, as we have seen, offers us *eight* further criteria to do the same job ([30], chapter 1). We are now ready to consider the rest of them.

In fact, however, McGinn justifies his claim about **recognition** as a corollary of his views about the **will**: if everything we imagine is something we have chosen to imagine, he suggests, we do not need to recognize it to know what it is. On the other hand, we *do* need to recognize the things we perceive, because they are not chosen but, as it were, imposed on us by the external world. As we saw earlier, however, our voluntary control over our imagery is far from absolute. If an image comes to mind unbidden, it may indeed take an effort of recognition to realize what it represents. Sometimes, an image of a face of someone from our past might drift into consciousness, and it might not be at all easy to put a name to it, or even remember the circumstances from which we recall it. Likewise, perhaps the most infuriating of the tunes that gets stuck in your head are the ones that you cannot readily identify. Even deliberately formed mental images are not always the images we want. Surely I am not alone in having had the experience of trying to recall the appearance of some particular place or person from my past, and thinking I had succeeded, only to realize later on that the image I had called to mind could not possibly be of what I had intended, and to recognize it as a memory of somewhere or someone else (or perhaps, even, from a dream).

Conversely, I am less than convinced that seeing something *always* calls for an act of recognition. Just as I can choose to imagine something, cannot I also sometimes choose to see something, by simply, once again, turning my eyes towards it? If I already knew what and where the thing was before I looked toward it, do I really actually need to recognize it when it comes into view? When I look at myself in the bathroom mirror in the morning, do I really need to recognize myself in order to know I am seeing me?

It is probably true that perceiving calls for recognizing much more often than imagining does, but perception may not always call for recognition, and imagining certainly does sometimes have a place for it. As with the criterion of **will**, from which it derives, the difference with respect to **recognition** is one of degree, not kind.

7. Reestablishing Continuity: (iii) Attention

I have no quarrel with the contention that imagery necessarily involves **attention**, or what McGinn calls "attentive intentionality". Indeed, I myself have elsewhere proposed a theory that could reasonably be nutshelled by saying that mental images are, in a sense, *made of attention* [40,43,44,82],[22]

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[22] To put it just a little less gnomically, I hold that mental imagery is (or supervenes upon) the (generally covert and partial) enactment of those specific acts of directed attention that would be necessary for the perceiving of the imagined object, if it were actually present to the senses.

and although other imagery theorists may not go quite so far as that, they may nevertheless give attentional processes an important role in their account [48].

It is important to remember, in this context, that eye movements are far from being the *only* means by which we direct our visual attention. There are also numerous acts of directed attention that are carried out entirely within the brain, and at multiple levels of the visual processing hierarchy. Furthermore, visual attention is not just a matter of focusing on a particular spatial direction or location. There are brain mechanisms that enable us to pay attention selectively to particular objects rather than just spatial locations, and even to particular aspects or features of objects, such as edge orientation, color, or mode of motion [215–219].[23] Many of the attentional processes involved in imagery are, undoubtedly, internal attentional processes of this sort.

McGinn is mistaken, however, in denying that attention is also necessary for seeing. The Cartesian, passivist conception of vision may tempt us into thinking that if something is, right now, *potentially* visible to us (*i.e.*, we are awake, it is before our opened eyes, it is illuminated, nerve pathways are intact, *etc.*) then we *ipso facto* see it. In fact, however, passive reception of energies by the sense receptors, even if followed by transmission to the brain, is insufficient for perception in general, and for seeing in particular. Well known experimental studies have shown that, if our attention is sufficiently tied up with some other task, we may well have no conscious awareness whatsoever of even downright conspicuous things that appear right in front of us, the counterintuitive but well established phenomenon of "inattentional blindness" [92,220–222]. Full, conscious visual experience depends upon the active, purposeful, attentive seeking out of environmental information, and this attentional activity plays a constitutive, and not merely incidental, role in vision.

It is true that things to which we are inattentionally blind can nevertheless have some subtle effects on our behavior or behavioral dispositions [92,223]. Clearly our brains are affected by them, via our eyes, and perhaps this deserves to be called seeing in some sense. Perhaps they even deserve to be called conscious seeing in *some* sense. Lamme [224], for instance, holds that attention does not so much account for the distinction between the conscious and the non-conscious, as between experiences that are remembered, and can be described, and those that are almost instantly forgotten: conscious but unattended experiences may simply be too fleeting and fugitive, or too inchoate, to be reportable (but see [225]). However, be that as it may, it does not help the case of those who wish to draw a sharp distinction between imagery and perception. Clearly the contrast they are trying to draw is not one between imagery (which is only known to exist inasmuch as it is remembered or reported) and some sort of automatic, fleeting, and instantly forgotten registration of visual stimuli. They want to distinguish two modes of full, reportable consciousness: imagery, and fully conscious, rememberable perceptual experience. There appears to be no real room for dispute that the latter, like the former, depends upon attention.

Attention may be all there is to imagery. It is certainly not all there is to seeing: At the very least, seeing also depends upon the appropriate stimulation of the visual receptors in the eyes. Nevertheless, attention is necessary both to imagery *and* to full-fledged seeing, so McGinn is mistaken to think that we can draw a sharp distinction between them on the basis of its involvement.

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[23] For further relevant citations, see [82].

8. Reestablishing Continuity: (iv) Visual Field

On the face of things, McGinn's claim that the **visual field** of imagery is unrestricted has been directly refuted by experimental studies. Kosslyn [226] reports experiments by which he claims to have actually measured "the visual angle of the mind's eye", and to have found it to be not very different from that of the bodily eyes. This is not, however, a straightforward case of the armchair philosopher being proved wrong by the experimental scientist, but, rather, a matter of dueling preconceptions. The experiments in question in fact depend upon people being asked to imagine themselves staring fixedly ahead at some scene, not turning their eyes, heads, or bodies as they normally would, and then being asked about what they can "see" in their mental image of the scene under those circumstances. The outcome is unsurprising. They "see" only as much as they would see if they were staring fixedly ahead.[24] McGinn is clearly right to think that when the imagination is not deliberately and unnaturally constrained in this way, what it can "see" is not noticeably restricted by visual angle, or even by position: the mind's eye can quickly and easily skip around to new vantage points.

The trouble is that if the eyes are not subjected to similar unnatural restrictions, they too can easily skip around to new vantage points. Of course, if a physiologist wants to measure the visual field (*i.e.*, the visual angle) of your eyes, then they must be held still while the measurement is made, and McGinn is certainly right to think that *while* the eyes themselves are thus held nearly still (or if we consider only what they could see during one very brief "snapshot" instant) their anatomically determined visual angle restricts what can be seen. However, he is not entitled to treat the imagination and the eyes asymmetrically, comparing what the imagination can encompass in its normal, free condition, over time,[25] with what the eyes can see only while they are held carefully immobile (or only

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[24] Other, related experiments have found similar results [227,228], but are vulnerable to essentially same objection. The theoretical preconceptions of the experimenters—in particular, the notion that the mind's eye *should* have some reasonably well defined visual angle—are built into the very structure of the experiment and the instructions given to the subjects. More generally, experiments of this sort, that rely crucially upon introspective reports that cannot be independently checked, are particularly likely to be vulnerable to having their results distorted by what psychologists call *experimental demand characteristics* ([229–231]; and see [44], §4.3 supplement 2), a serious pitfall for many forms of psychological experimentation on humans. Demand characteristics are formal and informal features of the experimental design, situation, and context that may enable the subjects to infer or guess something about the experimenters' preconceptions, intentions, and/or expectations, and to adjust their performance accordingly (usually by doing their best to provide the results they think the experimenters want).

[25] I doubt whether it is even possible to get a clear sense of the contents of one's imaginative experience at an instantaneous "snapshot" moment (the story that Mozart could imaginatively grasp a whole symphony in an atemporal moment is a myth [232]). However, I doubt even more whether, if I actually *could* isolate such an imaginative snapshot, it would prove to have an unrestricted visual field. If visual experience actually consisted of a series of visual snapshots, like photographic stills, (it does not: see [64], chapter 2), and if mental images were like reproductions of such snapshots, then we would surely find that the visual field of an image would be quite as restricted as that of the fixated eyes. This, indeed, is what Kosslyn, and Finke, *did* find when they built such assumptions about the nature of vision and imagery into the demand structures of their experiments [226–228]. McGinn's claim about the spatially unrestricted field of the imagination is plausible only if we take it (as it is natural to do) as a claim about what we are capable of imagining over some (possibly quite brief) interval of time. It is true that there have very occasionally been reports in the literature on imagery that, at first blush, seem to suggest that some people may be capable of visualizing a scene "from no particular point of view" or of visualizing things as being concealed behind or inside other (opaque) things, or

during an instant). If our standard for vision is the constrained, (relatively) immobile eye—the Cartesian, passive eye—then it deserves to be compared with an equivalently constrained imagination, as in the experiments of Kosslyn and his colleagues [226–228]; if our point of comparison is to be the unconstrained imagination, then we should be comparing it with the unconstrained eye, whose physiological "visual angle", once it is set free from external constraints, places few if any limitations upon what can be seen. The eyes can flit freely about from viewpoint to viewpoint very nearly as easily as the imagination can. It is *very* easy to move the eyes in their sockets (indeed, much easier than it is to hold them even somewhat still), fairly easy to turn the head, and far from impossible to move the whole body. We constantly do all these things in order to bring new vistas into view. Even though it takes a lot less effort for me to imagine Timbuktu than it does for me to go and see the city, going there is by no means beyond my powers. The difference (given that no-one, I think, holds that imagination is completely effortless) is, once again, one of degree.

If it did happen to be quite impossible, in practice, for me to get to Timbuktu, that would be for merely contingent and nomological reasons, quite unsuitable for underwriting any sort of principled or conceptual distinction between imagination and perception. Although I can imagine being on Mars, I cannot get there to see it for myself, but that is only because no suitable spacecraft has yet been built. Whatever the basis for our distinction between perception and imagination may be, it isn't rocket science.

The difference in degree between imagination and perception with respect to **visual field** may be regarded as a consequence of the fact that the body, being subject to the laws of physics and the facts of geography, is generally more recalcitrant to the **will** than is the imagination. (Perhaps the mind is subject to the laws of physics too, but it certainly takes much less effort just to fire off a few action potentials than it does to turn the head, or even the eyes, let alone travel to Timbuktu.) We have already seen that the difference between imagination and perception with respect to **will** is a difference of degree rather than kind, so, of course, we should not be surprised to have found that this corollary, the difference with respect to **visual field**, is likewise.

9. Reestablishing Continuity: (v) Absence and its Consequences

I will return to McGinn's claim about **absence**, but let us grant it, provisionally. The things we perceive are really there, whereas the things we imagine are not. I think this apparently conceptual truth is actually what underpins several of his other suggested criteria of differentiation between perception and imagery: **saturation**, **occlusion**, **thought**, and **observation**. These four, at least

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of visualizing all sides of an opaque object, such as a dice, at once [233–235]. However, I think such reports are best understood as misleadingly phrased expressions of the great fluidity and rapidity with which "the mind's eye" can move to new points of view (perhaps coupled with the common enough abilities to mentally rotate visualized objects [236], and to imagine opaque things as if they were transparent). I very much doubt that McGinn truly intends to affirm that it is possible to visualize a scene in a 360° panorama, all at once, or to visualize an object as it would appear from two or more directions at once. Not only has there never been anything like this in my imaginative experience (to the extent that I cannot really even conceive what it might be like) but, beyond the three citations just given, there is also virtually no suggestion of it in all the rest of the voluminous scientific literature on mental imagery. It would also be an experience so radically phenomenologically unlike normal visual perception that it would violate standard definitions of what mental imagery is [40,43,44,237–240]. For a defense of such definitions, see ([44], §1).

inasmuch as they appear to be differences in kind rather than of degree, are consequences of the more fundamental fact of the **absence** of the imagined object.

Let us begin with **saturation**. McGinn's view, to recap, is that visual perceptual experience is "saturated" in the sense that "every point of the visual field is such that some quality manifest there, whereas this is not true of the [mental] image" ([30], p. 25). It does indeed seem to be the case that imagery is not saturated in this sense. My mental image of a Jackson Pollock painting (for example), no matter how vivid it is, and how well I know the work, almost certainly does not specify what color appears at every single point on the canvas, and it does not need to do so in order to be a recognizable and serviceable image of the painting.

However, my visual experience in front of an actual Pollock canvas differs, in the relevant regard, not because of any fact about my instantaneous visual experience, but because of the fact that as soon as I want to know the color at any arbitrary point, I can quickly turn my attention there and find it. It is the physical world that is saturated with qualities (colors in particular), not my instantaneous perceptual experience of it.

If I were to stand far enough back, I could get an optical image of the whole canvas on my retina, but I would still not thereby be experiencing the color at every point simultaneously. As we have seen, the peripheral parts of the retina have very few color sensitive cone cells, and do not seem to be capable of differentiating colors at all [150,151]. I would have to stand *very* far away from a typically large Pollock if I wanted to get an image of the whole canvas on my *fovea*. Remember, foveal vision, whereby we see rich color and fine detail, comprises only about 2° of visual angle. Clearly nobody could make out much of the intricate detail of Pollock's paint splatters if the painting were far enough away to look "about the size of a thumbnail [held] at arm's length" [122]. If I were close enough to the canvas to discriminate all the artistically relevant detail, its retinal image would greatly overflow my fovea, and it would be physiologically impossible for me to take in information about the color at every point on the canvas without moving my eyes to foveate (*i.e.*, point my fovea directly at) different areas in turn. We do not normally notice that we are getting no color information from the peripheral visual field, but that is because we normally move our eyes so frequently and automatically.

Of course, the visible world, the external, physical world around us, *does* seem to be saturated, colored all over, but that is because it *is* colored all over. Some color quality is indeed manifested at every visible point[26] (or else it would not be visible), and, as soon as I turn my eyes to foveate any of those points, I *cannot avoid* seeing the color there (even if I have no particular interest in it at that moment, and am currently much more concerned with, say, shape). Our visual perceptual experience seems saturated with qualities because the world we are experiencing is itself saturated (in the relevant sense). When we are merely imagining, by contrast, there is no (relevant) external world there to force us to experience color in this way, and it becomes possible to shift our attentional viewpoint around an

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[26] I incline toward a realist or physicalist view of color, whereby colors are (for the most part) to be identified with spectral reflectance properties of object surfaces [241,242]. However, the present argument does not depend upon that controversial theory. If you have some objection to my saying that some "color quality" is manifested at every visible point in the external world, please feel free to substitute "some property disposed to cause a certain sort of color experience in normally sighted humans", or whatever your preferred theory of color would dictate. Of course, I am using "color" in the broad sense that includes black, white, and grays.

imagined object or scene, paying attention, perhaps, to shapes or spatial relationships, without taking the trouble to imagine what color would manifest itself at every point. The apparently complete saturation of perceptual experience, then, arises from the physical *presence* of whatever is being perceived, and imagery can be, and often is, experienced as unsaturated because the physical **absence** of whatever is being imagined allows it to be.

Imagery's lack of the power of **occlusion** also seems to be a fairly straightforward consequence of the **absence** of imagined objects. Things we perceive are really there, where we see them to be, so of course they block the light that would otherwise come to us from whatever is behind them. Imaginary things are not there at all, so they do not block any light.

There is a little more that should be said, however, because imagery does have *some* power to cause us to fail to see things that we would otherwise see. There may even be rare individuals who sometimes experience imagery as partially or even fully occlusive.[27] Be that as it may, even the rest of us, if we are devoting some of our attentional effort to maintaining an image in consciousness, are likely to miss seeing things that we might otherwise have seen. Keeping a visual image in mind generally reduces people's ability to detect and discriminate visual stimuli [245–247]. Of course this is not actual occlusion—no light is being blocked; rather, the effect is probably closely related to the *inattentional blindness* we discussed earlier—but the difference between a mental image and an opaque object, in respect of their powers to prevent us from seeing things, is not quite as absolute as we might at first be tempted to think.

The **absence** of imagined objects also explains McGinn's observations about **thought**. Yes, if we have an image in mind but then start to think about some other, unrelated topic, the image is likely to go away. As McGinn rightly sees, mental images are only sustained in consciousness by an effortful, ongoing act of attention, and our attention has, *ex hypothesis*, turned elsewhere. However, images are not unique in this regard. If we become sufficiently engrossed in some train of thought we may equally well cease to pay attention to what is before our open eyes, and thus cease to be conscious of it (inattentionally blind). It may well be true that it takes a greater degree of absorption in our thoughts to make the world go away than it does to make a mental image go away, but this is, again, a difference of degree, quite consistent with the continuum view. The sense of a more absolute, qualitative difference between the perceptual and imaginal effects of being absorbed in thought arises, I think, because when we eventually turn our attention back to the visible world, we immediately see that the same world is still there (still present, not **absent**), constraining us to have much the same sorts of visual experiences as we were having before. This (reinforced, perhaps, by the knowledge that the light has been pouring into our eyes all along, and that this, from the Cartesian, passivist perspective, ought to be sufficient for seeing) invites the questionable inference that we have been seeing the scene in front of us all along, even when we were not actually aware of it. By contrast, any mental image we may have had before becoming otherwise engrossed will be utterly gone, and can be recalled only with

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27   Schatzman [243] claims to have discovered a woman with fully occlusive imagery. He describes experiments in which her vivid mental images appeared to completely block her visual cortex's response to real stimuli that were "behind" them. However, after studying the same individual (although not repeating the most directly relevant experiment), Harris & Gregory [244] were skeptical about her alleged powers.

effort, if at all. There is thus not the same temptation to think that we might somehow have been unconsciously experiencing it the whole time.

McGinn's claim about **observation** is also, I think, a consequence of the fact that the objects of perception are materially present to us, whilst the objects of imagination are **absent** or non-existent. Sartre ([85], chapter 1) and Wittgenstein ([86], §627 and §632) both argued that we can never learn anything new from our imagery, because an image contains nothing but what the imager put there, which must already have been in their mind. This may be misleading, however. It is as if one were to say that if someone knows all the axioms and definitions of Euclidean geometry, they thereby necessarily know all of its theorems. In fact, of course, the theorems must be inferred, and this is not a trivial matter. Kosslyn [46,47] and Taylor [248], have independently pointed out that imagery can sustain a form of inference: the information about the appearances of things that is stored in one's memory may entail facts of which one is unaware, and, in many cases, these facts can best be discovered by forming and examining a mental image. One of Kosslyn's favorite examples is the question "What shape are a German Shepherd dog's ears?" [46,249]. He has provided persuasive experimental evidence that people confronted with a question like this will often answer it by recalling a mental image of whatever they are being asked about (such as a German Shepherd), and "seeing" the relevant feature (such as the shape of the ears) in their image [45,46,250,251].

McGinn concedes this point to Kosslyn, but nonetheless insists (rightly, I think, in this case) that Sartre's and Wittgenstein's argument still points to an important truth. Drawing out fresh implications from what we already know is, after all, only one of the ways, and not the most important or fundamental way, in which we increase our knowledge. Through the use of my senses, through **observing** the world around me, I constantly get to know things that could not possibly have been inferred from what was already in my head. I find out, for instance, the color of a berry on a bush—whether it is unripe and green, or ripe and reddish—by looking at it. Somehow, through perception, new information comes *from the berry itself* into my mind. This sort of knowledge gain can never come through mere imagination, because, of course, when I merely imagine a berry there *is* no berry to draw any information from. Although we can imagine something in its **absence**, we can only perceive something, and thereby draw new information from it, if it is actually there.

So is **absence** (and the differences with respect to **saturation**, **occlusion, thought**, and **observation** that flow from it) the true criterion of demarcation between imagery and perception? To say that we *perceive* something is normally to imply that it is present to be perceived. Imagery, by contrast, has often been *defined* (by me, amongst others) as quasi-perceptual experience of something in the absence of that something [40,43,44,237–240]. This is a genuine difference between imagination and perception, but, despite appearances, it is, once again, really a difference of degree. It only appears otherwise when we fix our attention firmly on the far opposite ends of the continuum of perceptual/imaginative experience: "plain as day" veridical perception at one end, and "pure", totally stimulus-independent imagery at the other. As McGinn recognizes (he devotes a whole chapter to the matter), there is a whole range of forms of what he calls "imaginative perception" in between: mistaking a bush for a bear in the darkness; seeing the shapes of animals or angels in the clouds; mistakenly recognizing a stranger as an acquaintance; seeing an ambiguous drawing as depicting a duck (or a rabbit); recognizing the politician in the caricature; seeing paint on canvas as a portrait of Napoleon; and so on and on. These are all cases of seeing something *as* something else: *something* is

present to the senses, but it is not quite what we take (or deliberately fancy) it to be. (Although even veridical seeing is *seeing as*: seeing something as what it in fact is.) The imagination, here, is not entirely free, but is constrained, to a greater or lesser degree, by what is present to the senses. We are not going to mistake that bush for a giraffe, or take the duck-rabbit figure to depict a motorcycle, and although that cloud might equally well be seen as very like a whale, a weasel or a camel, it is certainly nothing like a hollyhock.

Although he knows it is real and important, McGinn cannot quite understand imaginative perception. Because he thinks that percepts and images are radically disparate things, he is forced to say that, in imaginative perception, a percept and a distinct mental image somehow become blended together, or overlain on one another. He recognizes that this is unsatisfactory, but tries to brazen it out:

> This joining of imagistic and perceptual space is particularly perplexing…The intentional object of the image fuses with the object located by the percept, as if the objects of imagination have come down to earth temporarily—jumped spaces, as it were. (I know this is very obscure, but someone has to say it.) ([30], p. 172, note7)

Someone does *not* have to say it! This "obscurity", this incoherence that McGinn tries to hide away in an endnote, is entirely the result of his insistence on denying the continuum theory, the fact that imagination differs from perception only in degree rather than in kind. The various types and examples of "imaginative perception" clearly differ in the extent to which the intentional content of the experience is constrained by what is present to the senses (I do not say this is the only dimension along which they differ). That being so, normal, veridical perception and imagery readily find their respective places at the opposite ends of this continuum of constraint, as limit cases of imaginative perception. At one end, reliable, veridical perception (seeing things as just what they are) occurs when good seeing conditions and an intent not to be deceived converge to ensure that our experience is maximally constrained by what is present (although, even here, philosophers as diverse as Aristotle, Hume, and Kant have held that imagination still plays a vital role, interpretatively transforming raw sensory stimulation into meaningful perceptual experience [14,24,33,252]). At the other end of the spectrum, when we choose to set aside the constraints of the current deliverances of our senses almost entirely, our imagination is free to construct what imagery it will. Imagining something, entertaining a mental image of it, is, like perceiving something, a form of *seeing as*, but it is unconstrained *seeing as*: it is seeing *nothing* (which, being nothing, imposes no constraints) *as* whatever we may want it to appear to be ([40]; [44], §4.5.1).

10. Dreams and the Spectrum of Imagination

Having now gone through McGinn's [30] entire list of differences between imagery and perception, I believe I have shown that his nine items can actually be reduced to just two, or perhaps three. The differences with respect to **saturation**, **occlusion**, **thought**, and **observation** are all consequences of the **absence** of the imagined object (together with some facts about the role of **attention** in perception and imagery). The differences with respect to **recognition** and **visual field**, inasmuch as they are real, are consequences of the difference with respect to **will** (again, when taken together with some of the facts about **attention**). However, the genuine differences that McGinn labels as **absence** and **will**, I

have argued, are both best understood as differences of degree rather than of kind. The way that **attention** interacts with the voluntary control (**will**) dimension, and especially with the **absence**-presence dimension, to give rise to the other effects, may be what gives the impression that perception and imagery differ in their degree of dependence on **attention**. In fact, however, there is *no* real difference in this regard. Despite what the Cartesian, passive theory of perception might seem to imply, perceptual experience (at least, any that can be remembered or reported) depends upon active **attention** quite as much as imaginal experience does.

Not only does McGinn fail to make his case for a distinction in kind between imagination and perception, but his insistence on it leads him into many needless difficulties (quite besides those that, as we have seen, he has with imaginative perception). For example, he devotes over twenty closely argued pages to the defense of the thoroughly unsurprising claim that dreams are products of the imagination. Ichikawa [90] spills yet more ink in this direction. Why do they feel the need to tilt so hard at this windmill? Because (lucid dreams aside) we seem to have very little voluntary control over our dreams, and, for them both, voluntary controllability (**will**) is an essential characteristic of imagery, demarcating it from perception. Dreams thus look like a significant counterexample to the dichotomy that has been set up between imagery and perception, and McGinn must work hard to persuade us that, all appearances to the contrary, they really are under the control of the will.

He is also much concerned to reject the quite plausible notion (defended by, for example, Windt [253] and Hobson [254]) that dream experiences are akin to that other form of quasi-perceptual experience that escapes voluntary control, hallucination. This is because he has committed himself to the view that hallucinations are a type of percept, and thus, by his lights, not imaginative products at all. In order to keep dreams within the fold of imagination he must go to elaborate lengths to distinguish them from hallucinations, and to explain why we can't usually control them even though he thinks that they consist of inherently voluntaristic imagery.

From the continuum perspective, the problem situation looks very different (and, dare I say, more interesting): percepts, dreams, hallucinations, and waking mental images, as well as all the various types of imaginative perception, are all products of the imagination, and our task is not to sort them all into two Procrustean boxes, nor to assimilate any one to any other, or banish any from the fold, but rather to map the space of imagination and the various dimensions along which imaginative experiences may differ from one another. Our analysis of McGinn's ideas has, I think, left us with three such dimensions: **absence-presence** (which might more perspicuously be called *stimulus constrainedness*), **will** (or *amenability to voluntary control*), and the old Humean dimension of "vivacity" or *vividness*. (There may also, perhaps, be others that neither Hume, McGinn, nor I have thought of.) Non-lucid dreams, presumably, score low, far from imagery and close to percepts, on the *amenability to voluntary control* scale, and also very low on the dimension of *stimulus constrainedness*, in this case being far from percepts but close to waking imagery.[28]

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[28] *Vividness*, inasmuch as something so subjective can be quantified in a meaningful way [43], may well vary markedly from dream to dream and from person to person, as seems to be the case with waking imagery [255]. As Windt [253] notes, however, dreams do seem to differ from typical examples of waking imaginative experience in their degree of "immersiveness". Possibly this represents another dimension along which imaginative experiences may be mapped, or perhaps it merely reflects the combination of very low *stimulus constrainedness* with the low *amenability to voluntary*

11. Hallucinations

The philosophy of perception has long been much concerned with hallucinations, but this interest is usually motivated primarily by epistemological concerns. Can hallucinations be distinguished from veridical percepts, and, if so, how? My focus here, however, like McGinn's in *Mindsight* [30], is quite different. Both he and I are concerned with questions of (philosophical) psychology: with the architecture of the mind, with how, or whether, hallucinations fit in with imaginative phenomena such as mental images and dreams. McGinn [30] classifies hallucinations squarely with percepts, and insists that they are quite distinct from mental images or other products of the imagination. He does not tell us how he arrived at this view, indeed, he barely attempts to justify it at all, but states it as if it were obvious or commonly agreed (which, as we shall soon see, it certainly is not). I suspect that his view is actually rooted in his acquaintance, as a philosopher, with the epistemological tradition, but I shall argue that, as *psychology* (even *philosophical psychology*), it is unfounded and unrealistic. I am not sure whether it matters if epistemologists work (as I fear they generally do) with a psychologically unrealistic concept of hallucination, but when one's concern is to understand not the nature of knowledge but the nature and structure of the mind, it matters a great deal.

Even if, for the sake of argument, we were to grant McGinn his sharp imagination/perception distinction, we might still wonder why he so confidently classes hallucination with perception (and why Ichikawa [90] uncritically follows him in this). Is it not at least *prima facie* plausible that hallucinations are imaginative products: mental images that, like dreams, have somehow escaped voluntary control and normal waking "reality monitoring"? It is certainly my impression that this sort of view is common, perhaps even standard, amongst those psychologists and clinicians who actually study people who suffer from hallucinations.[29] Some hold that hallucinations are mental images that tend to get mistaken for percepts (perhaps because they are especially vivid, or particularly recalcitrant to voluntary control, and perhaps because the person's critical judgment is acutely or chronically impaired) [262–268]. Others prefer to focus on the similarities between hallucinations and dreams [254,269–271]. However, if, as is widely believed (and as McGinn, Ichikawa, and I all agree), dreams are products of the imagination, and largely consist of mental imagery, then this latter view is merely a special case of the former.

It is puzzling, then, that McGinn [30] makes almost no attempt to justify his perceptual view of hallucination. Rather, he treats it more like a self-evident premise in several of his arguments, including some of those intended to bolster the imagination/perception distinction itself. Things become even more puzzling in chapter 8 of the book, where we find that, in McGinn's view, psychopathological symptoms such as the voices and visions sometimes experienced by schizophrenics come from the imagination, and thus, by his lights (but contrary to normal usage), do not count as hallucinations at all. What on Earth *are* hallucinations then? He gives two sorts of examples: Once or twice he passingly mentions hallucinations produced by psychedelic drugs, and, rather more often, the experiences of brains in vats.

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control that is typical of (non-lucid) dreams. I will not pursue this issue further here, except to point out that Windt ([250], p. 296 note 1) seems to be sympathetic to some form of continuum theory.

[29] In addition to the works otherwise cited, I also consulted several overviews of the science of hallucination in order to get a sense of the scientific consensus [256–261].

I am confident that if he had given even minimal attention to the actual phenomenology of psychedelia McGinn would have classed it as a form of imaginative experience, as he does dreams and psychopathological visions, rather than as a form of true (*i.e.*, for him, unimaginative and purely perceptual) hallucination. After all, psychedelic experience has often been understood, by researchers, to be a sort of temporary psychosis, whose hallucinations are akin to those of schizophrenia [271–273]. Certainly, psychedelic experience is *not* like sober, veridical perception except that some of the things that seem plainly to be there really are not. What fun would that be?

In fact, psychedelic drug induced hallucinations seem to take three major (sometimes overlapping) forms:[30]

(1) What seems best described as exceptionally intense, colorful and vivid mental imagery. This often has bizarre content (often including abstract patterns), may have synaesthetic elements (music or other sounds may trigger experiences of color and light, for example), and partially escapes voluntary control, but it can be experienced with the eyes closed at least as well as with the eyes open, and subjects are rarely, if ever, tempted to think of it as experience of things actually physically existing out in the environment. It *seems* like mental imagery, or at least it seems *quasi*-perceptual, rather than being like actual perception.

(2) Probably the more salient aspect of most psychedelic experience is a marked change in the *way* that the things that really are out there in the environment are experienced. It is not seeing things that are not there; rather it is a phantasmagoria of imaginative perceiving run amok, with imagination intruding even more on perception than it normally does. Meaningless shapes and patterns may become meaningful. Inanimate objects may seem to pulsate with life, or their shapes may appear distorted. Objects (and people) may take on strong emotional valences that they do not normally have. They may directly appear to be threatening, or benign, or emblematic in one way or another. A house might suddenly seem like a bejeweled palace or a filthy hovel, for instance; an ordinary pencil might somehow seem terribly important or significant; or a perfectly ordinary woman might appear to be (not be thought of as, or believed to be, but visually appear to be) a fairy princess, or a wicked witch.

(3) Occasionally, reports of psychedelic experience include accounts of what seem to be dreamlike episodes, wherein the subject is transported to another world or another place, or where they believe they are doing things, in their current environment (or something resembling it), that they actually are not. It seems likely (though I am not aware of it having been confirmed scientifically) that, like a sleeping dreamer, people in such states are temporarily largely unaware of what is really going on around them.

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[30] The following sketch of a phenomenology of psychedelic experience is synthesized from several sources: my own memories of a number of LSD "trips"; anecdotal accounts from hallucinogenic drug users, gathered from various informal sources (including conversation and the internet); and formally published, first or second hand accounts of the effects of various hallucinogens, mostly from the scientific literature [38,271–279]. The systematization, such as it is, is my own, and I make no great claims for the account's comprehensiveness or scientific standing. My aim is merely to show that actual psychedelic experience comes nowhere near fitting McGinn's idiosyncratic conception of hallucination.

The first two of these are entirely at odds with McGinn's view of hallucination as a non-imaginal, non-imaginative subtype of perception; as for the third, we have already seen that he determinedly insists that dreams are not hallucinations.

It seems, though, that, for McGinn, the truly paradigmatic examples of hallucination are the experiences of *brains in vats*—disembodied brains kept alive in vats of nutrient, and electrically stimulated into experiencing themselves as still in bodies, having normal perceptual experiences. However, of course, such things do not exist outside of science fiction stories and the thought experiments of epistemologists and, there are reasons for doubting whether they even *could* exist [152,280,281][31] The intuition that they should be possible, though it often goes unquestioned, may well depend upon the prior assumption, already challenged in this essay, that passive reception of stimuli is sufficient for normal perception. In fact, as we have seen, visual experience depends just as much on the movements of the body (notably the eyes), as controlled by the brain's efferent outputs, as it does upon the inputs into sensory receptors.[32]

If brain-in-vat experiences could and did occur, McGinn is surely right to think that they ought to be classed as percepts rather than as mental images. Not only do the stories *stipulate* that the envatted experiences are subjectively completely indistinguishable from percepts, but their causes (usually something like electrical impulses fed directly into the sensory neurons from a supercomputer) are, like those of percepts, external to the organism, whereas the causes of imagery are, presumably, internal, in the brain somewhere. The actually occurring phenomena that medical professionals and others refer to as "hallucinations," however, are not caused by supercomputers, but arise from inner sources, just as mental images do. If there were a sharp distinction to be drawn here (which, of course, I deny) it would not be between hallucinations and images, but between putative brain-in-vat experiences and actual hallucinations. In terms of our multidimensional continuum, although brain-in-vat experiences and true hallucinations resemble one another in their high recalcitrance to voluntary control, and perhaps in vividness,[33] they fall toward opposite ends of the scale of stimulus constrainedness. Brain-in-vat experiences (if they occurred) would be highly constrained by the stimulation provided by the hypothetical supercomputer, just as normal perceptual experience is constrained by the environment, but "true" hallucinations, like mental images, are free figments of the brain.

Perhaps the actually occurring hallucinations that come closest to what McGinn has in mind (although there is no sign he has ever heard of them) are those of *Charles Bonnet syndrome*. This

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[31] Putnam's argument [277] is well known amongst philosophers, but both its soundness and its significance are controversial [282]. It is sometimes taken to establish the conceptual impossibility of brains in vats (as philosophers have traditionally thought of them). As I read it, however, even if sound, it does not so much establish that brains in vats cannot exist, but, rather, that the brain-in-a-vat thought experiment fails to provide the sort of support for radical skepticism that it is designed to provide. On that interpretation, Putnam's argument is not relevant to our current concerns. However, Dennett [152] and (in much more detail) Cosmelli and Thompson [278] make a quite different, biologically based case for the nomological impossibility of the brain-in-a-vat scenario. If they are right, hallucinations as conceived by McGinn do not and cannot occur.

[32] Although what was said above focused on vision, there are good reasons to believe that *all* modes of perceptual experience—not only vision, but also hearing [283,284], touch [285,286], smell [287–290], and taste [290,291]—similarly depend upon bodily action.

[33] Not all hallucinations are particularly vivid ([256], p. 121), but then, (as McGinn is aware) neither are all percepts.

condition can afflict people whose reason and critical judgment is quite intact, but whose vision is partially impaired. In most cases, damage to either their retina or their visual cortex has left them blind in part of their visual field. Such people may occasionally experience visual hallucinations, often of people, objects or animals in the affected part of their visual field (they may also experience "elementary" hallucinations: flashes of colored light and the like). Voluntary control over these hallucinations is limited: they are clearly not deliberately summoned up, and they may be difficult to get rid of. However, the people who suffer from them are not deluded, and usually seem to recognize quite quickly and spontaneously that these are not true percepts. Furthermore, as with other types of hallucination, scientific attempts at explanation of Charles Bonnet Syndrome frequently rely upon notions such as mental imagery, dreamlike processes, or imaginative (i.e., interpretive) seeing that has escaped normal voluntary control [292–294]. That is to say, those who have clinical or personal experience with Charles Bonnet hallucinations generally regard them as imaginative phenomena.

They could be wrong, of course, but it seems very much more likely that McGinn (who evinces no familiarity whatsoever with the scientific literature on hallucinations) is wrong in thinking that hallucinations are *not* products of the imagination. When philosophers who were engaged in epistemological thought-experiments about brains in vats borrowed the word "hallucination" from the psychiatrists,[34] they actually gave it a quite new meaning. In purely epistemological contexts this may, perhaps, be harmless, but when McGinn tries to impose the new, epistemological meaning back upon the realm of psychology, where "hallucination" already has an established use, only confusion can ensue. By conflating hallucinations with brain-in-vat experiences, McGinn leads his readers (and probably himself) badly astray. His claims apply, at best, only to a non-existent phenomenon, and very likely to one that could not possibly exist. When we turn to the various types of hallucinations that people really do experience, we find that they are almost certainly quite closely related to mental imagery in both their phenomenology and their etiology, and readily find their place along the multidimensional spectrum of imagination.[35]

12. Imagining That

Let us turn, now, to the notion of *imagining that*. It raises difficulties for any attempt to produce a unified account of imagination, because, unlike the imaginative phenomena we have been considering up to now—dreams, hallucinations, and all the various forms of imaginative seeing—it is not, in any very obvious way, related to either imagery or perception. It is not absurd, for example, to suggest that someone might be able to imagine that pigs can fly without ever forming a mental image of a flying pig. Indeed, I can *imagine that* certain things might be the case without even being capable of *imagining* them (in the sense of forming imagery that represents them in a non-arbitrary way): for

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[34] The word appears to have been given its modern meaning in the early 19th century, by the French psychiatrist Esquirol [262]; the Latin root from which it came had nothing particularly to do with seeing, or otherwise perceiving, things that are not there, but, rather, meant wandering of the mind, or idle, foolish talk and behavior [295].

[35] Some phenomena that may occasionally get called hallucinations, such as afterimages, phosphenes and migraine auras [296], probably owe little or nothing to the imagination, and much more to the anatomy of the visual system. Probably these *should* be classed as percepts. However, they are clearly not what McGinn has in mind.

example, I can imagine that *Goldbach's Conjecture*, or, say, *the correspondence theory of truth*, is true, but I find myself at a loss to form images of those situations.

Perhaps a case could be made for locating *imagining that* in the region of our three-dimensional spectrum where *vividness* is at a minimum (indeed, where it has gone to zero), where *stimulus constrainedness* is also very low, but where *amenability to voluntary control* is high. However, it seems more likely that when we talk of *imagining that*, we are actually using the word "imagining" in an extended or metaphorical sense [24]. Philosophers have been aware for a very long time that "imagination" often is used metaphorically: Aristotle, at the very outset of the philosophical discussion of the concept, explicitly noted the point when he defined *imagination* as "(apart from any metaphorical sense of the word) the process by which we say an image is presented to us" (*De Anima* III.iii 428a [205]).[36] It is easy enough to see how a word with that literal meaning could quickly have come to be used also to mean the capacity that we have for entertaining propositions without regard for their truth value.[37]

After all, the entertaining of imagery and the entertaining of propositions are both ways in which we are able to think about non-actual situations, and in practice we very often use both of them together. If you ask me to imagine that pigs can fly, it is very probable (in my case, at least) that I will not only entertain the proposition, but will also experience, at least dimly and fleetingly, an image of a wingèd pig flapping through the air. Although the image may not be strictly necessary in order for me to have complied with your request, it is psychologically likely. Of course, imagery is very idiosyncratic: perhaps some people have little or no tendency to form such an image when entertaining that proposition, and, very likely, others tend to form much more vivid and sustained images of flying pigs than I do. Furthermore, even for the same person on different occasions, imagery can vary greatly in vividness and copiousness, and different propositions are likely to vary in their tendency to evoke imagery in different people. I have never been to Samarkand, and have only the haziest idea of what the city might be like. If you ask me to imagine that I am in Samarkand, I can certainly entertain the proposition, but any imagery I produce is likely to be very weak, meager and vague, at best. On the other hand, someone who once spent many a happy hour exploring the streets of Samarkand may well produce vivid and copious imagery of it, even if they have very little tendency ever to produce imagery of flying pigs.

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[36]   Schofield [297] says that Aristotle may fairly be said to have invented the concept of imagination (see also [298]), but, of course, it is more accurate to say that he initiated philosophical (and psychological) discussion of it. The very fact that he felt the need to distinguish between literal and metaphorical senses of the term implies that it was already in vernacular use, in both senses, in his time. Of course, Aristotle was not actually discussing the English word "imagination" but the Greek "*phantasia*", and the word translated here as "image" is "*phantasma*". For a defense of these standard, but occasionally questioned, translations, see ([44], §2.2); for accounts of how the Aristotelian *phantasia* developed into the richer Latin concept of *imaginatio*, and eventually into our *imagination*, see [299,300].

[37]   White [19] takes some delight in catching out the great philosophers of past centuries writing of "imagining that" X (where X is an abstract notion of which we cannot form an image), even though their "official" view is that imagination has to do with imagery and perception. For White, this is evidence that their relevant views were incoherent. I would suggest, instead, that it is no more than evidence that they sometimes employed dead metaphors in their writing (as do we all).

Now suppose you, with rich imagery of Samarkand swirling in your head, inform me that you are imagining being in Samarkand. The term "imagining" may seem appropriate to you (more appropriate than, say "thinking about") precisely because of the imagery you are having: to you, at this point, it *means* "having imagery of." But for me, although I can understand perfectly well what it is to entertain the proposition that one is in Samarkand, when I do so it evokes little or no imagery. Might I not carelessly conclude that, as you use the word, "imagine" sometimes means merely to entertain a proposition, and carries no particular implications about imagery? After a few such experiences, might I not come to use the word in this way myself, even perhaps when I am talking about the entertainment of propositions that may have little potential for evoking imagery in anyone? And, of course, more people would soon start to pick up this usage from me. Given the fact that we can never tell, independently of what they say, whether or not people are having imagery, it seems almost inevitable that things like this would happen, and that "imagining", even if originally coined to refer only to episodes of experiencing imagery (or other things along the spectrum), would very quickly extend its meaning to include the mere entertaining of propositions.[38] (There is no reason to expect that this would *displace* the imagery meaning, however, because it is also likely that on many of the occasions when X tells Y that she is imagining that *p*, this *will* evoke p-appropriate imagery for Y, and that might even sometimes happen when X is, in fact, *not* experiencing any relevant imagery, but merely entertaining a proposition.).

I thus find myself in at least partial agreement with those deflationists who hold that the verb "to imagine" is polysemous. It has two distinct, although easily confusable, meanings. I differ from most of them, however, in that I believe that the sense that refers to the multidimensional spectrum of imaginative phenomena—imagery, hallucination, dreaming, interpretive perception, *etc.*—is conceptually primary, and of considerably more importance and interest. Throughout most of the twentieth century, most analytical philosophers seem to have been much more comfortable with the notion of *imagining that* than they were with mental imagery and its kin. This shift in emphasis has sometimes been presented as though it were a modern discovery, as if we now know that imagination is "really" a propositional matter, and Aristotle, Descartes, Hume, Kant, Coleridge, and the rest were not really talking about what they thought they were talking about when they discussed imagination (e.g., [19]; [301], p. 208). Far from being a discovery, however, it is scarcely even a claim: it is an attempt to change the subject. *Imagining that* is a linguistic, or at any rate a propositional matter, and, as such, lends itself to explication in terms of the characteristic tools of the analytical philosopher, logical and linguistic analysis. Those tools, however, provide relatively little purchase on something non-propositional like imagery (unless it can somehow be shown to be reducible to a propositional format) or imaginative perception. The upshot has been that most analytical philosophers (with occasional exceptions, which have perhaps become more frequent in recent years: e.g., [11,25,30,302–308[39]) have

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[38] It is also not difficult to see how, in a similar way, the meaning of "imaginary" might come to be extended from "apprehended via imagery" to "apprehended only via imagery" to "not apprehensible via the senses" to "non-existent".

[39] In the end, in Mindsight [30], McGinn officially follows the analytical herd in ascribing a greater importance to propositional imagination, imagining that. However, this is somewhat belied by the fact that he devotes much more space (and, it seems to me, despite my disagreements with him, much more care) to imagery and the other phenomena of the spectrum.

preferred either to ignore imagery, or to deprecate its importance to the mental economy ([44], §3.3; [306]).[40] When one is highly skilled with a hammer, things tend to look like nails.

Thus, despite the manifest etymology of the word, and despite the way it was universally understood by earlier philosophers ([1]; [19], part 1), in the 20th century *imagination* came to be treated, by most analytically trained philosophers, as primarily a matter of *imagining that*, and only secondarily, if that, as having anything to do with imagery or perception (see, e.g., [18–22,312]). Implicitly, imagery came to be considered as a sort of mental luxury, serving no real purpose save the inconveniencing of philosophers of mind with the need to explain it away. From that perspective, deflationism became almost inevitable. The capacity to entertain propositions without assenting to them is scarcely a likely candidate for being that from which "not only all the good, universally, but also all the bad, can be derived" [6], let alone "the living power and prime agent of all human perception...a repetition in the finite mind of the eternal act of creation in the infinite I AM" [29]. From the deflationary perspective, such claims are not just overblown, they are incomprehensible. From the perspective of the multidimensional spectrum, although they remain bombastic, we can make sense of them.

13. Concluding Remarks: Creativity and Imaginativeness

In this article, I have tried to establish that there can be a cohesive, coherent and scientifically viable concept of a faculty of imagination, a faculty that plays a large and essential role in human cognition, and that can accommodate most of the mental phenomena, from memory images to dreams, and from hallucination to veridical perception, that have traditionally been ascribed to it.

What, then, of the creative imagination? That, after all, is what calls forth most of the hyperbole, but, like *imagining that,* it seems to fit in no particular place on our multidimensional spectrum. In this case, however, this is not because it is a different, metaphorical meaning of the word, discontinuous with the others, but because to call a particular piece of mental work (or its products, the ideas, actions or artifacts that result) creative is not to classify it psychologically, but to evaluate it in a certain way. It is to say that an idea, or the concrete products or practices to which it gave rise, was both *original* and *effective* in the context of the problem situation (artistic, practical, or whatever) in which it arose and was applied [313].

By no means all acts of the imagination are creative in this sense. There is nothing particularly original (or, indeed, effective) about seeing the duck-rabbit figure as a duck (or a rabbit), or recalling a mental image of your mother's face, or hallucinating an accusatory voice, or, indeed, having some

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[40] And see section 2, above. For much of the 20th century, this attitude was also validated by (and, no doubt, reciprocally helped to validate) the pervasive "iconophobia" of the Behaviorist movement that dominated scientific psychology until the 1960s ([44], §3.2 supplement 2; [309,310]), and I certainly do not mean to imply that the widespread iconophobia amongst intellectuals in the first half of the 20th century was solely, or even mainly, a consequence of the analytical philosophy movement. Indeed, something closely related also seems to have taken hold of the "continental philosophy" tradition during roughly the same era [311]. Some of the (doubtless unconscious) roots of this attitude may have lain in racist theories (from the colonial era, but later embraced by Nazis) about a contrast between the supposedly image-based thinking of "primitive" peoples (and children) and the supposedly verbal thinking of "civilized" adults ([44], §3.2 supplement 1).

hackneyed dream of flying, or falling, or being caught naked in public. Some confusion over this point may arise from the fact that the adjective "imaginative" (or phrases such as "shows a lot of imagination") has come to be used to describe people, or thought processes or products, that are deemed to be particularly creative. However, if imagination is essential to all thought and memory (as Aristotle, and many since, have held) and to all interpretive perception, including veridical perception, as I have suggested, then it is a fundamental cognitive function, and if it makes any sense at all to speak of one person having more of it than another (or applying more of it to some particular problem), it is certainly not clear how such vaguely specified quantitative differences might be responsible for the difference between creative successes and failures.

However, the association between imagination and creativity is certainly not fortuitous. Although imagination is not always, or even usually, creative (in anything beyond a trivial sense), it may well be the case that creativity, when it does arise, necessarily springs from the imagination. In the central regions of our multi-dimensional spectrum, and thus at the heart of our concept of imagination, where experience is tied to stimulation, but not too strongly, and where our voluntary control over that experience is neither absolute nor entirely lacking, we find the various phenomena of imaginative perception, our capacity for *seeing as* (and, more generally, *perceiving as*). I have argued elsewhere that *this* is what makes creative insight, thinking that is both original and effective, possible [24,40] (see also, [79]). If our thought is not anchored in reality, not stimulus bound at all, or if it is quite out of our voluntary control, it is unlikely to be effective; if it is too closely bound to present actuality, or so much under conscious control that it cannot escape the confines of what we already explicitly believe, then it cannot be original. Imaginative perception, however, *seeing as* in both the literal and metaphorical senses of that expression, opens up the possibility of seeing things in new ways. If we are lucky and alert we may be able to see previously unnoticed aspects and possibilities in our world that open the path to a new understanding of some facet of our natural, social, or intellectual environment. If we also have the requisite skills, we may be able to convey this insight to others, to shape or bias *their* imagination, so that they are led to notice what we have noticed, through whatever communicative medium is most appropriate to the insight: painting or poem, scientific or philosophical article, or what have you.

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Conflict of Interest

The author declares no conflict of interest.

References

1.   Eva T.H. Brann. *The World of the Imagination: Sum and Substance.* Savage, MD: Rowman & Littlefield, 1991.

2. Thomas McFarland. *Originality and Imagination.* Baltimore, MD: Johns Hopkins University Press, 1985.

3. Jennifer Ouellette. "The death and life of American imagination." *The Rake*, 16 October 2007. http://www.rakemag.com/2007/10/death-and-life-american-imagination/.

4. Blaise Pascal. *Pensées*. Edited by Louis Lafuma. Translated by John Warrington. London: Dent, 1960. Original French, c. 1670.

5. Richard Kearney. *The Wake of Imagination: Ideas of Creativity in Western Culture.* London: Hutchinson, 1988.

6. Harry Caplan. *Gianfrancesco Pico della Mirandola: On the Imagination: The Latin Text with an Introduction, an English Translation, and Notes.* New Haven, CT: Yale University Press, 1930.

7. Lorraine Daston. "Fear and loathing of the imagination in science." *Dædalus* 127, no. 1 (1998): 73–95.

8. Nigel J.T. Thomas. "Imagining minds." *Journal of Consciousness Studies* 10, no. 11 (2003): 79–84.

9. Kendal L. Walton. *Mimesis as Make-Believe.* Cambridge, MA: Harvard University Press, 1990.

10. Derek Matravers. "Why we should give up on the imagination." *Midwest Studies in Philosophy* 34, no. 1 (2010): 190–99.

11. Paul Crowther. "How images complete us: Imagination and the unity of self-consciousness." *Journal of Consciousness Studies* 20, no. 11–12 (2013): 101–23.

12. Gilbert Ryle. *The Concept of Mind.* London: Hutchinson, 1949.

13. Annis Flew. "Images, supposing and imagining." *Philosophy* 28, no. 106 (1953): 246–54.

14. Peter F. Strawson. "Imagination and perception." In *Experience and Theory*. Edited by Lawrence Foster and Joe W. Swanson. London: Duckworth, 1971, pp. 31–54.

15. Anthony Flew. *A Dictionary of Philosophy.* London: Macmillan and Pan, 1979, p. 152.

16. Francis Sparshott. "Imagination—the very idea." *The Journal of Aesthetics and Art Criticism* 48, no. 1 (1990): 1–8.

17. Leslie Stevenson. "Twelve conceptions of imagination." *British Journal of Aesthetics* 43, no. 3 (2003): 238–59.

18. Amélie O. Rorty. "Imagination and power." In *Mind in Action: Essays in the Philosophy of Mind*. Boston, MA: Beacon Press, 1988, pp. 330–45.

19. Alan R. White. *The Language of Imagination*. Oxford: Blackwell, 1990.

20. Robert Nozick. *The Nature of Rationality.* Princeton, NJ: Princeton University Press, 1993.

21. Shaun Nichols, and Stephen Stich. "A cognitive theory of pretense." *Cognition* 74, no. 2 (2000): 115–47.

22. Ruth M.J. Byrne. The Rational Imagination: How People Create Alternatives to Reality. Cambridge, MA: The MIT Press, 2005.

23. Susanna Schellenberg. "Belief and desire in imagination and immersion." *Journal of Philosophy* 110, no. 9 (2013): 497–517.

24. Nigel J.T. Thomas. "Imagery and the coherence of imagination: A critique of White." *Journal of Philosophical Research* 22 (1997): 95–127.

25. Amy Kind. "Putting the image back in imagination." *Philosophy and Phenomenological Research* 62, no. 1 (2001): 85–109.

26. Percy B. Shelley. "A defense of poetry." In *A Study of Shelley's A Defense of Poetry.* Edited by Fanny N. Deslisle. Salzburg: Institut für Englische Sprache und Literatur, Universität Salzburg, 1974.

27. William Wordsworth. "The prelude." In *The Prelude: A Parallel Text.* Edited by J.C. Maxwell. Harmondsworth, UK: Penguin, 1971, pp. 520–21

28. William Blake. "Milton." In *The Complete Writings of William Blake.* Edited by Geoffrey Keynes. Oxford: Oxford University Press, 1966, pp. 480–535.

29. Samuel T. Coleridge. *Biographia Literaria.* Edited by George Watson. London: Dent, 1975, p. 167.

30. Colin McGinn. *Mindsight: Image, Dream, Meaning.* Cambridge, MA: Harvard University Press, 2004.

31. Colin McGinn. "Can we solve the mind-body problem?" *Mind* 98, no. 391 (1989): 349–66.

32. Colin McGinn. The Mysterious Flame: Conscious Minds in a Material World. New York, NY: Basic Books, 1999.

33. Nigel J.T. Thomas. "Fantasi, eliminativisme og bevidsthedens forhistorie." *Slagmark: Tidsskrift for Idéhistorie* 46 (2006): 15–31. In Danish, but an English draft is available online: http://www.imagery-imagination.com/ieph/ieph.htm (accessed on 17 November 2013).

34. David Hume. *A Treatise of Human Nature*, 2nd Oxford ed. Edited by L.A. Selby Bigge and P.H. Nidditch. Oxford: Oxford University Press, 1978.

35. Immanuel Kant. *Critique of Pure Reason,* 2nd ed. Edited and translated by N.K. Smith. London: Macmillan, 1933.

36. Mary Warnock. *Imagination.* London: Faber & Faber, 1976.

37. Joseph Jastrow. "The mind's eye." *Appleton's Popular Science Monthly* 54 (1899): 299–312.

38. C. Wade Savage. "The continuity of perceptual and cognitive experiences." In *Hallucinations: Behavior, Experience, and Theory*. Edited by Ronald K. Siegel and Louis J. West. New York, NY: Wiley, 1975, pp. 257–86.

39. Peter E. Morris, and Peter J. Hampson. *Imagery and Consciousness.* London: Academic Press, 1983.

40. Nigel J.T. Thomas. "Are theories of imagery theories of imagination? An *active perception* approach to conscious mental content." *Cognitive Science* 23, no. 2 (1999): 207–45.

41. Luigi F. Agnati, Diego Guidolin, L. Battistin, G., Pagnoni, and K. Fuxe. "The neurobiology of imagination: Possible role of interaction-dominant dynamics and default mode network." *Frontiers in Psychology* 4, no. 296 (2013): doi:10.3389/fpsyg.2013.00296.

42. Emily T. Troscianko. "Reading imaginatively: The imagination in cognitive science and cognitive literary studies." *Journal of Literary Semantics* 42, no. 2 (2013): 181–98.

43. Nigel J.T. Thomas. "Visual imagery and consciousness." In *Encyclopedia of Consciousness.* Edited by William P. Banks. Oxford: Academic Press, 2009, vol. 2, pp. 445–57. An expanded version is available online: http://www.imagery-imagination.com/viac.htm (accessed on 28 March 2014).

44. Nigel J.T. Thomas. "Mental imagery." In *The Stanford Encyclopedia of Philosophy.* Edited by Edward N. Zalta. Stanford, CA: Center for the Study of Language and Information, 2013. Available online: http://plato.stanford.edu/entries/mental-imagery/ (accessed on 12 October 2013).

45. Stephen M. Kosslyn. "Information representation in visual images." *Cognitive Psychology* 7, no. 3 (1975): 341–70.

46. Stephen M. Kosslyn. *Image and Mind.* Cambridge, MA: Harvard University Press, 1980.

47. Stephen M. Kosslyn. *Image and Brain.* Cambridge, MA: The MIT Press, 1994.

48. Stephen M. Kosslyn, William L. Thompson, and Giorgio Ganis. *The Case for Mental Imagery.* Oxford: Oxford University Press, 2006.

49. Zenon W. Pylyshyn. "What the mind's eye tells the mind's brain: A critique of mental imagery." *Psychological Bulletin* 80, no. 1 (1973): 1–25.

50. Zenon W. Pylyshyn. "Imagery and artificial intelligence." *Minnesota Studies in the Philosophy of Science* 9 (1978): 19–55.

51. Zenon W. Pylyshyn. "The imagery debate: Analogue media *versus* tacit knowledge." *Psychological Review* 88, no.1 (1981): 16–45.

52. Zenon W. Pylyshyn. "Mental imagery: In search of a theory." *Behavioral and Brain Sciences* 25, no. 2 (2002): 157–237.

53. Zenon W. Pylyshyn. *Seeing and Visualizing: It's Not What You Think.* Cambridge, MA: The MIT Press, 2003.

54. Zenon W. Pylyshyn. "Return of the mental image: Are there really pictures in the brain?" *Trends in Cognitive Sciences* 7, no. 3 (2003): 113–18.

55. Geoffrey Hinton. "Some demonstrations of the effects of structural descriptions in mental imagery." *Cognitive Science* 3, no. 3 (1979): 231–50.

56. Jerry A. Fodor. *The Language of Thought.* New York, NY: Thomas Crowell, 1975.

57. James J. Gibson. *The Senses Considered as Perceptual Systems.* Boston, MA: Houghton Mifflin, 1966.

58. Ruzena Bajcsy. "Active perception." *Proceedings of the IEEE* 76, no. 8 (1988): 996–1005.

59. Dana H. Ballard. "Animate vision." *Artificial Intelligence* 48, no. 1 (1991): 57–86.

60. Yiannis Aloimonos. *Active Perception.* Hillsdale, NJ: Erlbaum, 1993.

61. Arun Katkere, and Ramesh Jain. "A framework for information assimilation." In *Exploratory Vision: The Active Eye.* Edited by Michael S. Landy, Laurence T. Maloney and Misha Pavel. New York, NY: Springer-Verlag, 1996, pp. 241–56.

62. J. Kevin O'Regan, and Alva Noë. "A sensorimotor account of vision and visual consciousness." *Behavioral and Brain Sciences* 24, no. 5 (2001): 939–1031.

63. John M. Findlay, and Iain D. Gilchrist. *Active Vision: The Psychology of Looking and Seeing.* Oxford: Oxford University Press, 2003.

64. Alva Noë. *Action in Perception.* Cambridge, MA: The MIT Press, 2004.

65. Mototaka Suzuki, and Dario Floreano. "Enactive robot vision." *Adaptive Behavior* 16, no. 2–3 (2008): 122–28.

66. Monica S. Castelhano, Michael L.Mack, and John M. Henderson. "Viewing task influences eye movement control during active scene perception." *Journal of Vision* 9, no. 3, (2009): 1–15.

67. Dimitri Ognibene, Giovanni Pezzulo, and Gianluca Baldassare. "Learning to look in different environments: An active-vision model which learns and readapts visual routines." In From Animals to Animats 11, Proceedings 11th International Conference on Simulation of Adaptive Behavior, Paris-Clos Lucé, France, August 2010; Edited by Stéphane Doncieux, Benoît Girard, Agnès Guillot, John Hallam, Jean-Arcady Meyer and Jean-Baptiste Mouret. Berlin and Heidelberg: Springer, 2010, pp. 199–210.

68. Shengyong Chen, Youfu Li, and Ngai Ming Kwok. "Active vision in robotic systems: A survey of recent developments." *International Journal of Robotics Research* 30, no. 11 (2011): 1343–77.

69. J. Kevin O'Regan. *Why Red Doesn't Sound like a Bell: Understanding the Feel of Consciousness.* New York, NY: Oxford University Press, 2011.

70. Shimon Ullman. "Visual routines." *Cognition* 18 no. 1–3 (1984): 97–159.

71. Pieter R. Roelfsema, Victor A.F. Lamme, and Henk Spekreijse. "The implementation of visual routines." *Vision Research* 40, no. 10–12 (2000): 1385–1411.

72. Mary Hayhoe. "Vision using routines: A functional account of vision." *Visual Cognition* 7, no. 1–3 (2000): 43–64.

73. Pieter R. Roelfsema. "Elemental operations in vision." *Trends in Cognitive Sciences* 9, no. 5 (2005): 226–33.

74. Sancho I. Moro, Michiel Tolboom, Paul S. Khayat, and Pieter R. Roelfsema. "Neuronal activity in the visual cortex reveals the temporal order of cognitive operations." *Journal of Neuroscience* 30, no. 48 (2010): 16293–303.

75. Ulric Neisser. *Cognition and Reality.* San Francisco, CA: Freeman, 1976.

76. Ulric Neisser. "Perceiving, anticipating and imagining." *Minnesota Studies in the Philosophy of Science* 9 (1978): 89–106.

77. Paolo Bartolomeo. "The relationship between visual perception and visual mental imagery: A reappraisal of the neuropsychological evidence." *Cortex* 38, no. 3 (2002): 357–78.

78. Paolo Bartolomeo, and Sylvie Chokron. "Can we change our vantage point to explore imaginal neglect?" *Behavioral and Brain Sciences* 25, no. 5 (2002): 184–85.

79. Peter J. Blain. "A Computer Model of Creativity Based on Perceptual Activity Theory." Unpublished doctoral dissertation, Griffith University, Queensland, Australia, 2006.

80. Helena De Preester. "The sensory component of imagination: The motor theory of imagination as a present-day solution to Sartre's critique." *Philosophical Psychology* 25, no. 4 (2012): 503–20.

81. Jan F. Sima, and Christian Freksa. "Towards computational cognitive modeling of mental imagery: The attention-based quantification theory." *KI-Künstliche Intelligenz* 26, no, 3 (2012): 261–67.

82. Nigel J.T. Thomas. "New support for the perceptual activity theory of mental imagery: An ongoing bibliographic essay." Available online: http://www.imagery-imagination.com/newsupa.htm (accessed on 16 March 2014).

83. Peter Slezak. "The 'philosophical' case against visual imagery." In *Perspectives on Cognitive Science: Theories, Experiments and Foundations.* Edited by Peter Slezak, Terry Caelli, and Richard Clark. Norwood, NJ: Ablex Publishing, 1995, pp. 237–71.

84. Thomas Reid. *An Inquiry into the Human Mind on the Principles of Common Sense.* Edited by Derek R. Brookes. University Park, PA: Pennsylvania State University Press, 1997. Original work published in 1764.

85. Jean-Paul Sartre. *The Psychology of Imagination.* Translated by B. Frechtman. New York, NY: Philosophical Library, 1948.

86. Ludwig Wittgenstein. *Zettel.* Edited by G.E.M. Anscombe and G.H. von Wright, Translated by G.E.M. Anscombe. Oxford: Blackwell, 1967.

87. John W. Yolton. *Perception and Reality: A History from Descartes to Kant.* Ithaca, NY: Cornell University Press, 1996.

88. Dorthe Berntsen. *Involuntary Autobiographical Memories: An Introduction to the Unbidden Past.* Cambridge: Cambridge University Press, 2009.

89. C. Philip Beaman, and Tim I. Williams. "Earworms ('stuck song syndrome'): Towards a natural history of intrusive thoughts." *British Journal of Psychology* 101, no. 4 (2010): 637–53.

90. Jonathan Ichikawa. "Dreaming and imagination." *Mind and Language* 24, no. 1 (2009): 103–21.

91. Michael I. Posner. "Orienting of attention." *Quarterly Journal of Experimental Psychology* 32, no. 1 (1980): 3–25.

92. Arien Mack, and Irvin Rock. *Inattentional Blindness.* Cambridge, MA: The MIT Press, 1998.

93. Yehoshua Tsal, and Lori Kolbet. "Disambiguating ambiguous figures by selective attention." *Quarterly Journal of Experimental Psychology* A37, no. 1 (1985): 25–37.

94. Stephan A. Brandt, and Lawrence W. Stark. "Spontaneous eye movements during visual imagery reflect the content of the visual scene." *Journal of Cognitive Neuroscience* 9, no. 1 (1997): 27–38.

95. Michael J. Spivey, and Joy J. Geng. "Oculomotor mechanisms activated by imagery and memory: Eye movements to absent objects." *Psychological Research* 65, no. 4 (2001): 235–41.

96. Joystone Gbadamosi, and Wolfgang H. Zangemeister. "Visual imagery in hemianopic patients." *Journal of Cognitive Neuroscience* 13, no. 7 (2001): 45–56.

97. Bruno Laeng, and Dinu-Stefan Teodorescu. "Eye scanpaths during visual imagery reenact those of perception of the same visual scene." *Cognitive Science* 26, no. 2 (2002): 207–31.

98. Roger Johansson, Jana Holšánová, and Kenneth Holmqvist. "Pictures and spoken descriptions elicit similar eye movements during mental imagery, both in light and in complete darkness." *Cognitive Science* 30, no. 6 (2006): 1053–79.

99. Katherine Humphrey and Geoffrey Underwood. "Fixation sequences in imagery and in recognition during the processing of pictures of real-world scenes." *Journal of Eye Movement Research* 2, no. 2 (2008): article 3, 1–15. http://www.jemr.org/online/2/2/3.

100. Jana Holšánová, Richard Andersson, Roger Johansson, Kenneth Holmqvist, and Sven Strömqvist. "Lund eye tracking studies in research on language and cognition." *Slovo a Slovesnost* 71, no. 4 (2010): 317–28.

101. Jan F. Sima, Maren Lindner, Holger Schultheis, and Thomas Barkowsky. "Eye movements reflect reasoning with mental images but not with mental models in orientation knowledge tasks." In *Spatial Cognition VII*. Edited by Christoph Hölscher, Thomas F. Shipley, Marta O. Belardinelli, John A. Bateman, and Nora S. Newcombe. Berlin and Heidelberg: Springer, 2010, pp. 248–61.

102. Clémence Bourlon, Bastien Oliviero, Nicolas Wattiez, Pierre Pouget, and Paolo Bartolomeo. "Visual mental imagery: What the head's eye tells the mind's eye." *Brain Research* 1367, no. 7 (2011): 287–97.

103. Roger Johansson, Jana Holšánová, Richard Dewhurst, and Kenneth Holmqvist. "Eye movements during pictorial recall have a functional role, but they are not reinstatements of those from encoding." *Journal of Experimental Psychology: Human Perception and Performance* 38, no. 5 (2012): 1289–314.

104. Maryam Fourtassi, Abderrazak Hajjioui, Christian Urquizar, Yves Rossetti, Gilles Rode, and Laure Pisella. "Iterative fragmentation of cognitive maps in a visual imagery task." *PLoS One* 8, no. 7 (2013): e68560, 1–8.

105. Daniel M. Wegner, David J. Schneider, Samuel R. Carter III, and Teri L. White. "Paradoxical effects of thought suppression." *Journal of Personality and Social Psychology* 53, no. 1 (1987): 5–13.

106. Richard M. Wenzlaff and Daniel M. Wegner. "Thought suppression." *Annual Review of Psychology* 51 (2000): 59–91.

107. Chris R. Brewin, James D. Gregory, Michelle Lipton, and Neil Burgess. "Intrusive images in psychological disorders: Characteristics, neural mechanisms, and treatment implications." *Psychological Review* 117, no. 1 (2010): 210–32.

108. John S. Antrobus, Judith S. Antrobus, and Jerome L. Singer. "Eye movements accompanying daydreaming, visual imagery, and thought suppression." *Journal of Abnormal and Social Psychology* 69, no. 3 (1964): 244–52.

109. Jerome L. Singer, and John S. Antrobus. "Eye movements during fantasies: Imagining and suppressing fantasies." *Archives of General Psychiatry* 12, no. 1 (1965): 71–76.

110. Christopher F. Sharpley, Jain M. Montgomery, and Lina A. Scalzo. "Comparative efficacy of EMDR and alternative procedures in reducing the vividness of mental images." *Scandinavian Journal of Behaviour Therapy* 25, no. 1 (1996): 37–42.

111. Jackie Andrade, David Kavanagh, and Alan Baddeley. "Eye-movements and visual imagery: A working memory approach to the treatment of post-traumatic stress disorder." *British Journal of Clinical Psychology* 36, no. 2 (1997): 209–23.

112. Alastair L. Barrowcliff, Nicola S. Gray, Tom C.A. Freeman, and Malcolm J. MacCulloch. "Eye-movements reduce the vividness, emotional valence and electrodermal arousal associated with negative autobiographical memories." *Journal of Forensic Psychiatry & Psychology* 15, no. 2 (2004): 325–45.

113. Bradley R. Postle, Christopher Idzikowski, Sergio Della Sala, Robert H. Logie, and Alan D. Baddeley. "The selective disruption of spatial working memory by eye movements." *Quarterly Journal of Experimental Psychology* 59, no. 1 (2006): 100–20.

114. Donatas Jonikaitis, Heiner Deubel, and Claudio de'Sperati. "Time gaps in mental imagery introduced by competing saccadic tasks." *Vision Research* 49, no. 17 (2009): 2164–75.

115. Ad de Jongh, Robert Ernst, Lisa Marques, and Hellen Hornsveld. "The impact of eye movements and tones on disturbing memories involving PTSD and other mental disorders." *Journal of Behavior Therapy and Experimental Psychiatry* 44, no. 4 (2013): 477–83.

116. Marcel A. van den Hout, Nicola Bartelski, and Iris M. Engelhard. "On EMDR: Eye movements during retrieval reduce subjective vividness and objective memory accessibility during future recall." *Cognition and Emotion* 27, no. 1 (2013): 177–83.

117. Bruce Bridgeman. "Conscious vs unconscious processes: The case of vision." *Theory and Psychology* 2, no. 1 (1992): 73–88.

118. Susana Martinez-Conde, Stephen L. Macknik, and David H. Hubel. "The role of fixational eye movements in visual perception." *Nature Reviews: Neuroscience* 5, no. 3 (2004): 229–40.

119. David Coppola and Dale Purves. "The extraordinarily rapid disappearance of entoptic images." *Proceedings of the National Academy of Sciences of the USA* 93, no. 15 (1996): 8001–04.

120. James J. Gibson. *The Ecological Approach to Visual Perception.* Boston, MA: Houghton Mifflin, 1979.

121. Kenneth Holmqvist, Marcus Nyström, Richard Andersson, Richard Dewhurst, Halszka Jarodzka, and Joost van de Weijer. *Eye Tracking: A Comprehensive Guide to Methods and Measures.* Oxford: Oxford University Press, 2011.

122. Daniel C. Richardson and Michael J. Spivey. "Eye tracking." In *Encyclopedia of Biomaterials and Biomedical Engineering.* Edited by Gary E. Wnek and Gary L. Bowlin. New York: Marcel Dekker, 2004, vol. 1, pp. 568–82.

123. Nicholas J. Wade and Benjamin W. Tatler. *The Moving Tablet of the Eye: The Origins of Modern Eye Movement Research.* Oxford: Oxford University Press, 2005.

124. Al'fred L. Yarbus. *Eye Movements and Vision* (translated from the Russian by Basil Haigh). New York: Plenum Press, 1967.

125. Michael F. Land. "Motion and vision: Why animals move their eyes." *Journal of Comparative Physiology A* 185, no. 4 (1999): 341–52.

126. Benjamin W. Tatler, Nicholas J. Wade, Hoi Kwan, John M. Findlay, and Boris M. Velichkovsky. "Yarbus, eye movements, and vision." *i-Perception* 1, no. 1 (2010): 7–27. http://i-perception.perceptionweb.com/journal/I/article/i0382.

127. Mary Hayhoe and Dana Ballard. "Eye movements in natural behavior." *Trends in Cognitive Sciences* 9, no. 4 (2005): 188–94.

128. Michael F. Land. "Eye movements and the control of actions in everyday life." *Progress in Retinal & Eye Research* 25, no. 3 (2006): 296–24.

129. Lawrence Stark and S.R. Ellis. "Scanpaths revisited: Cognitive models direct active looking." In *Eye Movements: Cognition and Visual Perception.* Edited by Dennis F. Fisher, Richard A. Monty, and John W. Senders. Hillsdale, NJ: Erlbaum, 1981, pp. 193–226.

130. Susana Martinez-Conde and Stephen L. Macknik. "Windows on the mind." *Scientific American* 297 (August 2007): 56–63.

131. Constantin A. Rothkopf, Dana H. Ballard and Mary M. Hayhoe. "Task and context determine where you look." *Journal of Vision* 7, no. 14 (2007): article 16, 1–20. doi:10.1167/7.14.16.

132. Susana Martinez-Conde. Eye movements during fixation. In *Encyclopedia of Perception*. Edited by E. Bruce Goldstein. Thousand Oaks, CA: Sage Press, 2009, vol. 1, pp. 438–39.

133. Martin Rolfs. "Microsaccades: Small steps on a long way." *Vision Research* 49, no. 20 (2009): 2415–41.

134. P.E. Hallett. "Eye movements." *In Handbook of Perception and Human Performance.* Edited by Kenneth R. Boff, Lloyd Kaufman, and James P. Thomas. New York: Wiley-Interscience, 1986, vol. 1, pp. 10.1–10.112.

135. Alexander Spauschus, Jon Marsden, David M. Halliday, Jay R. Rosenberg, and Peter Brown. "The origin of ocular microtremor in man." *Experimental Brain Research* 126, no. 4 (1999): 556–62.

136. Matthias H. Hennig, Nicolas J. Kerscher, Klaus Funke, and Florentin Wörgötter. "Stochastic resonance in visual cortical neurons: Does the eye-tremor actually improve visual acuity?" *Neurocomputing* 44 (2002): 115–20.

137. Igor Kagan, Moshe Gur, and D. Max Snodderly. "Saccades and drifts differentially modulate neuronal activity in V1: Effects of retinal image motion, position, and extraretinal influences." *Journal of Vision* 8, no. 14, Article 19 (2008): 1–25. doi:10.1167/8.14.19.

138. András Róka, Ádám Csapó, Barna Reskó and Péter Baranyi. "Edge detection model based on involuntary tremors and drifts of the eye." *Journal of Advanced Computational Intelligence and Intelligent Informatics* 11, no. 6 (2007): 648–54.

139. András Róka, Ádám Csapó, Barna Reskó and Péter Baranyi. "Edge detection model based on involuntary eye movements of the eye-retina system." *Acta Polytechnica Hungarica* 4, no. 1 (2007): 31–46.

140. Igor Kagan. "Active vision: Fixational eye movements help seeing space in time." *Current Biology* 22, no. 6 (2012): R186–R188.

141. Xutao Kuang, Martina Poletti, Jonathan D. Victor, and Michele Rucci. "Temporal encoding of spatial information during active visual fixation." *Current Biology* 22, no. 6 (2012): 510–14.

142. David H. Hubel. Eye, *Brain, and Vision*, 2nd ed. San Francisco: W.H. Freeman, 1995.

143. Kenneth Gaarder. "Transmission of edge information in the human visual system." *Nature* 212, no. 1 (1966): 321–23.

144. Michele Rucci and Gaëlle Desbordes. "Contributions of fixational eye movements to the discrimination of briefly presented stimuli." *Journal of Vision* 3, no. 11 (2003): Article 18, 852–64. http://www.journalofvision.org/content/3/11/18. doi:10.1167/3.11.18.

145. Michele Rucci, Ramon Iovin, Martina Poletti, and Fabrizio Santini. "Miniature eye movements enhance fine spatial detail." *Nature* 447, no. 7146 (2007): 851–54.

146. Kristian Donner and Simo Hemilä. "Modelling the effect of microsaccades on retinal responses to stationary contrast patterns." *Vision Research* 47, no. 9 (2007): 1166–77.

147. Xoana G. Troncoso, Stephen L. Macknik, and Susana Martinez-Conde. "Microsaccades counteract perceptual filling-in." *Journal of Vision* 8, no. 14, Article 15 (2008): 1–9. doi:10.1167/8.14.15. http://journalofvision.org/8/14/15/.

148. Bevil R. Conway. "Color vision, cones, and color-coding in the cortex." *The Neuroscientist* 15, no. 3 (2009): 247–90.

149. Austin Roorda and David R. Williams. "The arrangement of the three cone classes in the living human eye." *Nature* 397, no. 6719 (1999): 520–22.

150. Christine A. Curcio, Kimberly A. Allen, Kenneth R. Sloan, Connie L. Lerea, James B. Hurley, Ingrid B. Klock, and Ann H. Milam. "Distribution and morphology of human cone photoreceptors stained with anti-blue opsin." *Journal of Comparative Neurology* 312, no. 4 (1991): 610–24.

151. B.R. Wooten and George Wald. "Color-vision mechanisms in the peripheral retinas of normal and dichromatic observers." *Journal of General Physiology* 61, no. 2 (1973): 125–42.

152. Daniel C. Dennett. *Consciousness Explained.* Boston, MA: Little, Brown, 1991.

153. M.F. Land, J.N. Marshall, D. Brownless, and T.W. Cronin. "The eye-movements of the mantis shrimp *Odontodactylus scyllarus* (Crustacea: Stomatopoda)." *Journal of Comparative Physiology A* 167, no. 2 (1990): 155–66.

154. N.J. Marshall, M.F. Land, and T.W. Cronin. "Shrimps that pay attention: Saccadic eye movements in stomatopod crustaceans." *Philosophical Transactions of the Royal Society B: Biological Sciences* 369, no. 1636 (2014): 1–8. doi:10.1098/rstb.2013.0042.

155. Jerome Y. Lettvin, Humberto R. Maturana, Warren S. McCulloch, and Walter H. Pitts. "What the frog's eye tells the frog's brain." *Proceedings of the Institute of Radio Engineers* 47, no. 11 (1959): 1940–51.

156. Gáspár Jékely, Julien Colombelli, Harald Hausen, Keren Guy, Ernst Stelzer, François Nédélec, and Detlev Arendt. "Mechanism of phototaxis in marine zooplankton." *Nature* 456, no. 7220 (2008): 395–99.

157. Adrian Horridge. "Pattern and 3D vision of insects." In *Visual Navigation: From Biological Systems to Unmanned Ground Vehicles.* Edited by Yiannis Aloimonos. Mahwah, NJ: Erlbaum, 1996, pp. 26–59.

158. Björn Brembs. "The importance of being active." *Journal of Neurogenetics* 23, nos. 1–2 (2009): 120–26.

159. G.A. Horridge. "The evolution of visual processing and the construction of seeing systems." *Proceedings of the Royal Society of London B: Biological Sciences* 230, no. 1260 (1987): 279–92.

160. Karl Kral."Behavioural–analytical studies of the role of head movements in depth perception in insects, birds and mammals." *Behavioural Processes* 64, no. 1 (2003): 1–12.

161. Wen-Sung Chung and Justin Marshall. "Range-finding in squid using retinal deformation and image blur." *Current Biology* 24, no. 2 (2014): R64–R65.

162. Iain D. Gilchrist, Valerie Brown, and John M. Findlay. "Saccades without eye movements." *Nature* 390, no. 6656 (1997): 130–31.

163. Iain D.Gilchrist, Valerie Brown, John M. Findlay, and Michael P. Clarke. "Using the eye–movement system to control the head." *Proceedings of the Royal Society of London. Series B: Biological Sciences* 265, no. 1408 (1998): 1831–36.

164. Denis N. Lee. "The optic flow field: The foundation of vision." *Philosophical Transactions of the Royal Society of London B: Biological Sciences* 290, no. 1038 (1980): 169–78.

165. Florian Raudies, Stefan Ringbauer, and Heiko Neumann. "A bio-inspired, computational model suggests velocity gradients of optic flow locally encode ordinal depth at surface borders and globally they encode self-motion." *Neural Computation* 25, no. 9 (2013): 2421–49.

166. Hanne H. Thoen, Martin J. How, Tsyr-Huei Chiou, and Justin Marshall. "A different form of color vision in mantis shrimp." *Science* 343, no. 6169 (2014): 411–13.

167. Aline Bompas and J. Kevin O'Regan. "Evidence for a role of action in colour perception." *Perception* 35, no. 1 (2006): 65–78.

168. Aline Bompas and J. Kevin O'Regan. "More evidence for sensorimotor adaptation in color perception." *Journal of Vision* 6, no. 2 (2006): 145–53. doi:10.1167/6.2.5.

169. John P. Frisby, and James V. Stone. *Seeing: The Computational Approach to Biological Vision.* Cambridge, MA: The MIT Press, 2010.

170. James V. Stone. *Vision and Brain: How We Perceive the World.* Cambridge, MA: The MIT Press, 2012.

171. George Mather. *Essentials of Sensation and Perception.* Hove, UK: Routledge, 2011.

172. Robert Snowden, Peter Thompson, and Tom Troscianko. *Basic Vision: An Introduction to Visual Perception*, 2nd ed. Oxford: Oxford University Press, 2012.

173. Nicholas Wade and Mike Swanston. *Visual Perception: An Introduction,* 3rd ed. Hove, UK: Psychology Press, 2013.

174. John, M. Ross, Concetta Morrone, Michael E. Goldberg, and David C. Burr. "Changes in visual perception at the time of saccades." *Trends in Neurosciences* 24, no. 2 (2001): 113–21.

175. Ignacio Vallines and Mark W. Greenlee. "Saccadic suppression of retinotopically localized blood oxygen level-dependent responses in human primary visual area V1." *Journal of Neuroscience* 26, no. 22 (2006): 5965–69.

176. J. Kevin O'Regan. "Solving the 'real' mysteries of visual perception: the world as an outside memory." *Canadian Journal of Psychology/Revue Canadienne de Psychologie* 46, no. 3 (1992): 461–88.

177. Bruce Bridgeman, A.H.C. Van der Heijden, and Boris M. Velichkovsky. "A theory of visual stability across saccadic eye movements." *Behavioral and Brain Sciences* 17, no. 2 (1994): 247–92.

178. Bruce Bridgeman. "How the brain makes the world appear stable." *i-Perception* 1, no. 2 (2010): 69–72. http://i-perception.perceptionweb.com/journal/I/article/i0387.

179. Thomas S. Kuhn. *The Structure of Scientific Revolutions*, 2nd ed. Chicago: University of Chicago Press, 1970.

180. David C. Lindberg. *Theories of Vision from Al-Kindi to Kepler.* Chicago: University of Chicago Press, 1976.

181. Izet Masic. "Ibn al-Haitham—father of optics and describer of vision theory." *Medicinski Arhiv* 62, no. 3 (2008): 183–88.

182. David C. Lindberg. *Roger Bacon and the Origins of Perspectiva in the Middle Ages.* Oxford: Oxford University Press, 1996.

183. Peter H. Lindsay and Donald A. Norman. Human Information Processing: An Introduction to Psychology. New York: Academic Press, 1972.

184. Ralph N. Haber. "Information Processing." In *Handbook of Perception.* Edited by Edward C. Carterette and Morton P. Friedman. New York and London: Academic Press, 1974, vol. 1, pp. 313–33.

185. John P. Frisby. *Seeing: Illusion, Brain and Mind.* Oxford University Press, 1979.

186. David Marr. *Vision.* San Francisco: Freeman, 1982.

187. Ronald G. Boothe. *Perception of the Visual Environment.* New York: Springer, 2002.

188. Hanspeter A. Mallot. *Computational Vision: Information Processing in Perception and Visual Behavior.* Translated by John S. Allen. Cambridge, MA: The MIT Press, 2000.

189. Vicki Bruce, Patrick R. Green, and Mark A. Georgeson. *Visual Perception: Physiology, Psychology and Ecology*, 4th ed. Hove, UK: Psychology Press, 2003.

190. Stephen E. Palmer. *Vision Science: Photons to Phenomenology.* Cambridge, MA: The MIT Press, 1999.

191. Ian E. Gordon. *Theories of Visual Perception*, 3rd ed. Hove, UK: Psychology Press, 2004.

192. Richard L. Gregory. *Eye and Brain*, 5th ed. Princeton, NJ: Princeton University Press, 1997.

193. Michael F. Land, and Benjamin W. Tatler. *Looking and Acting: Vision and Eye Movements in Natural Behaviour.* Oxford: Oxford University Press, 2009.

194. Steven Pinker. *How the Mind Works.* New York: Norton, 1997.

195. Donald D. Hoffman. *Visual Intelligence: How We Create What We See.* New York: Norton, 1998.

196. Laurence P. Pringle. *Explore Your Senses: Sight.* Tarrytown, NY: Marshall Cavendish, 2000.

197. Laurence P. Pringle. *Explore Your Senses: Hearing.* Tarrytown, NY: Marshall Cavendish, 2000.

198. Laurence P. Pringle. *Explore Your Senses: Smell.* Tarrytown, NY: Marshall Cavendish, 2000.

199. Laurence P. Pringle. *Explore Your Senses: Taste.* Tarrytown, NY: Marshall Cavendish, 2000.

200. Laurence P. Pringle. *Explore Your Senses: Touch.* Tarrytown, NY: Marshall Cavendish, 2000.

201. Howard Gardner. *The Mind's New Science: A History of the Cognitive Revolution*, 2nd ed. New York: Basic Books, 1987.

202. George Sperling. "The magical number seven: Information processing then and now." In *The Making of Cognitive Science.* Edited by William Hirst. Cambridge: Cambridge University Press, 1988, pp. 71–80.

203. George M. Stratton. *Theophrastus and Greek Physiological Psychology before Aristotle.* London: Allen & Unwin, 1917.

204. Edith Hamilton, and Huntington Cairns. *Plato: The Collected Dialogues, Including the Letters.* Princeton, NJ: Princeton University Press, 1961.

205. Jonathan Barnes. *The Complete Works of Aristotle: The Revised Oxford Translation.* Princeton, NJ: Princeton University Press, 1984, vol. 2.

206. Richard W. Baldes. "Democritus on visual perception: Two theories or one?" *Phronesis* 20, no. 2 (1975): 93–105.

207. Arthur Koestler. *The Watershed: A Biography of Johannes Kepler.* Garden City, NY: Anchor Books, 1960.

208. René Descartes. *The Philosophical Writings of Descartes, Vol. 1.* Edited and translated by John Cottingham, Robert Stoothoff, and Dugald Murdoch. Cambridge: Cambridge University Press, 1985.

209. René Descartes. *Descartes' Conversation with Burman.* Edited and translated by John Cottingham. Oxford: Oxford University Press, 1976.

210. John Hyman. "The Cartesian theory of vision." *Ratio* 28, no. 2 (1986): 149–67.

211. A. Mark Smith. "Saving the appearances of the appearances: The foundations of classical geometrical optics." *Archive for History of Exact Sciences* 24, no. 2 (1981): 73–99.

212. Otto-Joachim Grüsser, and Michael Hagner. "On the history of deformation phosphenes and the idea of internal light generated in the eye for the purpose of vision." *Documenta Ophthalmologica* 74, no. 1–2 (1990): 57–85.

213. Gerald A. Winer and Jane E. Cottrell. "Does anything leave the eye when we see? Extramission beliefs of children and adults." *Current Directions in Psychological Science* 5, no. 5 (1996): 137–42.

214. Gerald A. Winer, Jane E. Cottrell, Virginia Gregg, Jody S. Fournier and Lori A. Bica. "Fundamentally misunderstanding visual perception: Adults' belief in visual emissions." *American Psychologist* 57, no. 6–7 (2002): 417–24.

215. John H. Reynolds and Leonardo Chelazzi. "Attentional modulation of visual processing." *Annual Review of Neuroscience* 27 (2004): 611–47.

216. Wu Li, Valentin Piëch, and Charles D. Gilbert. "Perceptual learning and top-down influences in primary visual cortex." *Nature Neuroscience* 7, no. 6 (2004): 651–57.

217. Taosheng Liu, Jonas Larsson, and Marisa Carrasco. "Feature-based attention modulates orientation-selective responses in human visual cortex." *Neuron* 55, no. 2 (2007): 313–23.

218. Steven L.Bressler, Wei Tang, Chad M. Sylvester, Gordon L. Shulman, and Maurizio Corbetta. "Top-down control of human visual cortex by frontal and parietal cortex in anticipatory visual spatial attention." *Journal of Neuroscience* 28, no. 40 (2008): 10056–61.

219. Kerry McAlonan, James Cavanaugh, and Robert H. Wurtz. "Guarding the gateway to cortex with attention in visual thalamus." *Nature* 456, no. 7220 (2008): 391–94.

220. Ulric Neisser and Robert Becklen. "Selective looking: Attending to visually specified events." *Cognitive Psychology* 7, no. 4 (1975): 480–94.

221. Daniel J. Simons and Christopher F. Chabris. "Gorillas in our midst: Sustained inattentional blindness for dynamic events." *Perception* 28, no. 9 (1999): 1059–74.

222. Daniel J. Simons. "Monkeying around with the gorillas in our midst: Familiarity with an inattentional-blindness task does not improve the detection of unexpected events." *i-Perception* 1, no. 1 (2010): 3–6. http://i-perception.perceptionweb.com/journal/I/article/i0386.

223. Paola Bressan and Silvia Pizzighello. "The attentional cost of inattentional blindness." *Cognition* 106, no. 1 (2008): 370–83.

224. Victor AF. Lamme. "Why visual attention and awareness are different." *Trends in Cognitive Sciences* 7, no. 1 (2003): 12–18.

225. Felipe De Brigard and Jesse Prinz. "Attention and consciousness." *Wiley Interdisciplinary Reviews: Cognitive Science* 1, no. 1 (2010): 51–59.

226. Stephen M. Kosslyn. "Measuring the visual angle of the mind's eye." *Cognitive Psychology* 10, no. 3 (1978): 356–89.

227. Ronald A. Finke and Stephen M. Kosslyn. "Mental imagery acuity in the peripheral visual field." *Journal of Experimental Psychology: Human Perception and Performance* 6, no. 1 (1980): 126–39.

228. Ronald A. Finke and Howard S. Kurtzman. "Mapping the visual field in mental imagery." *Journal of Experimental Psychology: General* 110, no. 4 (1981): 501–17.

229. Martin T. Orne. "On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications." *American Psychologist* 17, no. 11 (1962): 776–83.

230. Margaret J. Intons-Peterson. "Imagery paradigms: How vulnerable are they to experimenters' expectations?" *Journal of Experimental Psychology: Human Perception and Performance* 9, no. 3 (1983): 394–412.

231. Ralph L. Rosnow. "The nature and role of demand characteristics in scientific inquiry." *Prevention & Treatment* 5, no. 1, (2002): article pre0050037c, 1–7.

232. Peter Kivy. "Mozart and monotheism: An essay in spurious aesthetics." *Journal of Musicology* 2, no. 3 (1983): 322–28.

233. Francis Galton. "Statistics of mental imagery." *Mind* 19 (1880): 301–18.

234. James J. Gibson. "Visualizing conceived as visual apprehending without any particular point of observation." *Leonardo* 7, no. 1 (1974): 41–42.

235. Ulric Neisser and Nancy Kerr. "Spatial and mnemonic properties of visual images." *Cognitive Psychology* 5, no. 2 (1973): 138–50.

236. Roger N., Shepard and Lynn A. Cooper. *Mental Images and Their Transformations.* Cambridge, MA: The MIT Press, 1982.

237. Peter McKellar. *Imagination and Thinking.* London: Cohen & West, 1957.

238. Alan Richardson. *Mental Imagery.* London: Routledge & Kegan Paul, 1969.

239. Ronald A. Finke. *Principles of Mental Imagery.* Cambridge, MA: The MIT Press, 1989.

240. Nigel J.T. Thomas. "Mental Imagery, Philosophical Issues About." In *Encyclopedia of Cognitive Science.* Edited by Lynn Nadel. London/Hoboken, NJ: Nature Publishing/John Wiley, 2003/2005, vol. 2, pp. 1147–53. Online preprint: http://www.imagery-imagination.com/mipia.htm (accessed on 17 November 2013).

241. Alex Byrne, and David R. Hilbert. "Color realism and color science." *Behavioral and Brain Sciences* 26, no. 1 (2003): 3–59.

242. Nigel J.T. Thomas "Color realism: Toward a solution to the 'hard problem'." *Consciousness and Cognition* 10, no. 1 (2001): 140–45.

243. Morton Schatzman. *The Story of Ruth: One Woman's Haunting Psychiatric Odyssey.* London: Duckworth, 1980.

244. John Harris, and Richard L. Gregory. "Tests of the hallucinations of 'Ruth'." *Perception* 10, no. 3 (1981): 351–54.

245. Sydney J .Segal and Vincent Fusella. "Influence of imaged pictures and sounds on detection of visual and auditory signals." *Journal of Experimental Psychology* 83, no. 3 (1970): 458–64.

246. Catherine Craver-Lemley and Adam Reeves. "How visual imagery interferes with vision." *Psychological Review* 99, no. 4 (1992): 633–49.

247. Catherine Craver-Lemley, and Martha E. Arterberry. "Imagery-induced interference on a visual detection task." *Spatial Vision* 14, no. 2 (2001): 101–20.

248. Paul Taylor. "Imagination and information." *Philosophy and Phenomenological Research* 42, no. 2 (1981): 205–23.

249. Stephen M. Kosslyn (with John Brockman and Zenon W. Pylyshyn). "What shape are a German Shepherd's ears?" *Edge.org*, 13 July 2002. http://www.edge.org/conversation/what-shape-are-a-german-shepherd-39s-ears.

250. Stephen M. Kosslyn. "Using imagery to retrieve semantic information: A developmental study." *Child Development* 47, no. 2 (1976): 434–44.

251. Stephen M. Kosslyn. "Can imagery be distinguished from other forms of internal representation? Evidence from studies of information retrieval times." *Memory & Cognition* 4, no. 3 (1976): 291–97.

252. Nigel J.T. Thomas. "Imagination." In *Dictionary of Philosophy of Mind.* Edited by Chris Eliasmith and Eric Hochstein, 1999. Available online: https://sites.google.com/site/minddict/imagination (accessed on 3 April 2013).

253. Jennifer M. Windt, "The immersive spatiotemporal hallucination model of dreaming." *Phenomenology and the Cognitive Sciences* 9, no. 2 (2010): 295–316.

254. J. Allan Hobson. *Dreaming as Delirium: How the Brain Goes Out of its Mind.* Cambridge, MA: The MIT Press, 1999.

255. David F. Marks. "Consciousness, mental imagery and action." *British Journal of Psychology* 90, no. 4 (1999): 567–85.

256. Peter D. Slade and Richard P. Bentall. *Sensory Deception: A Scientific Analysis of Hallucination.* Baltimore, MD: Johns Hopkins University Press, 1988.

257. Ghazi Asaad and Bruce Shapiro. "Hallucinations: Theoretical and clinical overview." *American Journal of Psychiatry* 143, no. 9 (1986): 1088–97.

258. Ghazi Assad. *Hallucinations in Clinical Psychiatry: A Guide for the Mental Health Professional.* New York: Brunner/Mazel, 1990.

259. Mark Manford and F. Andermann. "Complex visual hallucinations: Clinical and neurobiological insights." *Brain* 121, no. 10 (1998): 1819–40.

260. James R. Brasić. "Hallucinations." *Perceptual and Motor Skills* 86, no. 3 (1998): 851–77.

261. André Aleman and Frank Larøi. *Hallucinations: The Science of Idiosyncratic Perception.* Washington DC: American Psychological Association, 2008.

262. Jean-Étienne D. Esquirol. "Sur les illusions des sens chez les aliénés." *Archives Générales de Médecine* 2 (1832): 5–23 (in French).

263. Sanford Mintz and Murray Alpert. "Imagery vividness, reality testing, and schizophrenic hallucinations." *Journal of Abnormal Psychology* 79, no. 3 (1972): 310–16.

264. Mardi J. Horowitz. "Hallucinations: An information processing approach." In *Hallucinations: Behavior, Experience, and Theory.* Edited by Ronald K. Siegel and Louis J. West. New York: Wiley, 1975, pp. 163–95.

265. Richard P. Bentall. "The illusion of reality: A review and integration of psychological research on hallucinations." *Psychological Bulletin* 107, no. 1 (1990): 82–95.

266. Koen B.E. Böker, Ron Hijman, René S. Kahn, and Edward H.F. Haan. "Perception, mental imagery and reality discrimination in hallucinating and non−hallucinating schizophrenic patients." *British Journal of Clinical Psychology* 39, no. 4 (2000): 397–406.

267. André Aleman, Edward H.F. de Haan, Koen B.E. Böcker, Ron Hijman, and René S. Kahn. "Hallucinations in schizophrenia: Imbalance between imagery and perception?" *Schizophrenia Research* 57, no. 2 (2002): 315–16.

268. Gildas Brébion, Ruth I. Ohlsen, Lyn S. Pilowsky, and Anthony S. David. "Visual hallucinations in schizophrenia: Confusion between imagination and perception." *Neuropsychology* 22, no. 3 (2008): 383–89.

269. Ernest Hartmann. "Dreams and other hallucinations: An approach to the underlying mechanisms." In *Hallucinations: Behavior, Experience, and Theory.* Edited by Ronald K. Siegel and Louis J. West. New York: Wiley, 1975, pp. 71–80.

270. Maria G. Vita, Anna P. Batocchi, Serena Dittoni, Anna Losurdo, Alessandro Cianfoni, Maria C. Stefanini, Catello Vollono, Giacomo Della Marca, and Paolo Mariotti. "Visual hallucinations and pontine demyelination in a child: Possible REM dissociation?" *Journal of Clinical Sleep Medicine* 4, no. 6 (2008): 588–90.

271. Lawrence G. Fischman. "Dreams, hallucinogenic drug states, and schizophrenia: A psychological and biological comparison." *Schizophrenia Bulletin* 9, no. 1 (1983): 73–94.

272. Steven J. Novak "LSD before Leary: Sidney Cohen's critique of 1950s psychedelic drug research." *Isis* 88, no. 1 (1997): 87–110.

273. Anna Marsh. "Visual hallucinations during hallucinogenic experience and schizophrenia." *Schizophrenia Bulletin* 5, no. 4 (1979): 627–30.

274. Heinrich Klüver. "Mescal visions and eidetic vision." *American Journal of Psychology* 37, no. 4 (1926): 502–15.

275. Aldous Huxley. *The Doors of Perception—Heaven and Hell.* New York: Harper & Row, 1956.

276. Ronald K. Siegel, & Murray E. Jarvik. "Drug induced hallucinations in animals and man." In *Hallucinations: Behavior, Experience, and Theory.* Edited by Ronald K. Siegel and Louis J. West. New York: Wiley, 1975, pp. 81–161.

277. Albert Hofmann. *LSD, My Problem Child.* New York: McGraw-Hill, 1980.

278. Ronald K. Siegel. *Fire in the Brain: Clinical Tales of Hallucinations.* New York: Dutton, 1992.

279. Benny Shanon. "Hallucinations." *Journal of Consciousness Studies* 10, no. 2 (2003): 3–31.

280. Hilary Putnam. *Reason, Truth and History.* Cambridge: Cambridge University Press, 1981.

281. Diego Cosmelli, and Evan Thompson. "Embodiment or envatment? Reflections on the bodily basis of consciousness." In *Enaction: Towards a New Paradigm for Cognitive Science.* Edited by John Stewart, Olivier Gapenne and Ezequiel di Paolo. Cambridge MA: The MIT Press, 2010, pp. 361–86.

282. Tony Brueckner. "Brains in a vat." In *The Stanford Encyclopedia of Philosophy*, Winter 2011 Ed. Edited by Edward N. Zalta. Stanford, CA: Center for the Study of Language and Information, 2011. Available online: http://plato.stanford.edu/archives/win2011/entries/brain-vat/ (accessed on 1 April 2014).

283. Peter Dallos. "The active cochlea." *Journal of Neuroscience* 2, no. 12 (1992): 4575–85.

284. Stéphane Maison, Christophe Micheyl, and Lionel Collet. "Influence of focused auditory attention on cochlear activity in humans." *Psychophysiology* 38, no. 1 (2001): 35–40.

285. Susan J. Lederman and Roberta L. Klatzky. "Haptic exploration and object representation." In *Vision and Action: The Control of Grasping.* Edited by Melvyn A. Goodale. Norwood, NJ: Ablex, 1990, pp. 98–109.

286. Allan M. Smith, Geneviéve Gosselin, and Bryan Houde. "Deployment of fingertip forces in tactile exploration." *Experimental Brain Research* 147, no. 2 (2002): 209–18.

287. Robert Teghtsoonian, Martha Teghtsoonian, Birgitta Berglund, and Ulf Berglund. "Invariance of odor strength with sniff vigor: An olfactory analogue to size constancy." *Journal of Experimental Psychology: Human Perception and Performance* 4, no. 1 (1978): 144–52.

288. Moustafa Bensafi, Jessica Porter, Sandra Pouliot, Joel Mainland, Bradley Johnson, Christina Zelano, Natasha Young, Elizabeth Bremner, Danny Aframian, Rehan Khan, and Noam Sobel.

"Olfactomotor activity during imagery mimics that during perception." *Nature Neuroscience* 6, no. 11 (2003): 1142–44.

289. Joel Mainland, and Noam Sobel. "The sniff is part of the olfactory percept." *Chemical Senses* 31, no. 2 (2006): 181–96.

290. Bruce P. Halpern. "Tasting and smelling as active, exploratory sensory processes." *American Journal of Otolaryngology* 4, no. 4 (1983): 246–49.

291. Ranier Gutierrez, Sidney A. Simon, and Miguel A.L. Nicolelis. "Licking-induced synchrony in the taste–reward circuit improves cue discrimination during learning." *Journal of Neuroscience* 30, no. 1 (2010): 287–303.

292. Geoffrey Schultz, and Ronald Melzack. "The Charles Bonnet syndrome: 'Phantom visual images'." *Perception* 20, no. 6 (1991): 809–25.

293. Jayakrishna G. Menon, Imran Rahman, Sharmila J. Menon, and Gordon N. Dutton. "Complex visual hallucinations in the visually impaired: The Charles Bonnet Syndrome." *Survey of Ophthalmology* 48, no. 1 (2003): 58–72.

294. Pammal T. Ashwin, and Marie D. Tsaloumas. "Complex visual hallucinations (Charles Bonnet syndrome) in the hemianopic visual field following occipital infarction." *Journal of the Neurological Sciences* 263, no. 1 (2007): 184–86.

295. Theodore R. Sarbin, and Joseph B. Juhasz. "The social context of hallucinations." In *Hallucinations: Behavior, Experience, and Theory.* Edited by Ronald K. Siegel and Louis J. West. New York: Wiley, 1975, pp. 241–56.

296. Otto-Joachim Grüsser, and Theodor Landis. *Visual Agnosias and Other Disturbances of Visual Perception and Cognition.* London: Macmillan, 1991.

297. Malcolm Schofield. "Aristotle on the imagination." In *Aristotle on the Mind and the Senses.* Edited by G.E.R. Lloyd and G.E.L. Owen. Cambridge: Cambridge University Press, 1978, pp. 99–140.

298. Joseph B. Juhasz. "Greek Theories of Imagination." *Journal of the History of the Behavioral Sciences*, 7 no. 1 (1971): 39–58.

299. Gerard Watson. *Phantasia in Classical Thought.* Galway, Ireland: Galway University Press, 1988.

300. John M. Cocking. *Imagination: A Study in the History of Ideas.* London: Routledge, 1991.

301. Dominic M. Lopes. "Out of sight, out of mind." In *Imagination, Philosophy, and the Arts.* Edited by Matthew Kieran and Dominic M. Lopes. London: Routledge, 2003, pp. 208–24.

302. Bertrand Russell. "On propositions: What they are and how they mean." *Proceedings of the Aristotelian Society, Supplementary Volumes* 2 (1919): 1–43.

303. Henry H. Price. *Thinking and Experience.* London: Hutchinson, 1953.

304. Natika Newton. "Experience and imagery." *Southern Journal of Philosophy* 20, no. 4 (1982): 475–87.

305. Ralph D. Ellis. *Questioning Consciousness: The Interplay of Imagery, Cognition, and Emotion in the Human Brain.* Amsterdam: John Benjamins, 1995.

306. J.C. Nyíri. "The picture theory of reason." In Rationality and Irrationality: Proceedings of the 23rd International Wittgenstein Symposium, Kirchberg am Wechsel, Austria, 13–19 August,

2000. Edited by Berit Brogaard and Barry Smith. Vienna: Öbv & Hpt Verlagsgesellschaft, 2001, pp. 242–66. Available online: http://www.hunfi.hu/nyiri/krb2000.htm (accessed on 26 March 2014).

307. Jesse Prinz. *Furnishing the Mind: Concepts and their Perceptual Basis.* Boston, MA: The MIT Press, 2002.

308. Robert Arp. *Scenario Visualization: An Evolutionary Account of Creative Problem Solving.* Cambridge, MA: The MIT Press 2008.

309. Robert R. Holt. "Imagery: The return of the ostracized." *American Psychologist* 19, no. 4 (1964): 254–66.

310. Nigel J.T. Thomas. "Experience and theory as determinants of attitudes toward mental representation: The case of Knight Dunlap and the vanishing images of J.B. Watson." *American Journal of Psychology* 102, no. 3 (1989): 395–412.

311. Martin Jay. *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought.* Berkeley, CA: University of California Press, 1993.

312. Shaun Nichols, ed. *The Architecture of the Imagination: New Essays on Pretence, Possibility, and Fiction.* New York: Oxford University Press, 2006.

313. Robin Barrow. "Some observations on the concept of imagination." In *Imagination and Education.* Edited by Kieran Egan and Dan Nadaner. Milton Keynes, UK: Open University Press, 1988, pp. 79–90.